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Esthetic and Recreational Potential of Small Naturalistic Streams Near Urban Areas

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ESTHETIC AND RECREATIONAL POTENTIAL OF SMALL NATURALISTIC STREAMS NEAR URBAN AREAS

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PREFACE

"Esthetic and Recreational Potential of Small Naturalistic Streams Near Urban Areas" (OWRR Project No. A-010-KY) was sponsored by the University of Kentucky Water Resources Institute and supported by funds provided by the United States Department of the Interior, Office of Water Resources Research, as authorized under the Water Resources Research Act of 1964.

Work was started in January 1967 and completed in April 1968. However, some expenditures related to the production of the completion report were made during the period May 1-June 30, 1968.

Impetus for originating the project stemmed from the obvious need for additional outdoor recreation areas near cities and the equally obvious and rapid deterioration of the natural environment on the expanding urban fringe. Significant results of the study include a procedure for evaluating, more or less objectively, the potential of a small watershed or stream area for satisfying part of the local demand for short term esthetic and recreational enjoyment (Chapter II). Also included is an approach to estimating the visitation generated by an urban population for certain types of recreational activity, the capability of a developed recreation site to satisfy demand for a specific activity and the economic benefits to be derived from the development of a small stream area for recreational purposes (Chapter IV).

The methodology is tested through its application to two small watersheds in Central Kentucky (Chapter III).

Reader comments or criticisms on the problem, the described procedures or the findings presented should be directed to the principal investigator.

ACKNOWLEDGEMENTS

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Dr. Robert Kuehne, Department of Zoology, University of Kentucky for his ideas on the relationship between stream order and the distribution of fish species;

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the Kentucky Department of State Parks and the Jefferson County Parks Department for permission to use their camping records for Boonesboro State Park and Otter Creek Park;

the property owners along Boone and Jessamine Creeks for their cooperation in completing the opinion questionnaires and permitting project personnel to enter upon their land;

the University of Kentucky Computing Center for guidance and use of their facilities in deriving the demand and visitation prediction equations;

and to Dr. R. A. Lauderdale, Director of the Water Resources Institute of the University of Kentucky and his secretaries, Mrs. Betty Bradshaw and Mrs. Carolyn Anderson for their help and patient understanding, during all stages of the project.

ABSTRACT

The purpose of this study was to find a way to evaluate the esthetic and recreational potential of small streams and their watersheds. Research was limited to naturalistic streams with drainage areas under 100 square miles and located within 25 miles of a city. A methodology, based on some previous work of the U.S. Soil Conservation Service and the principles or concepts of terrain analysis, land use planning, value judgment philosophy and the economics of outdoor recreation, was developed and applied in detail to two streams (Boone and Jessamine Creeks) near Lexington, Kentucky.

Evaluations were made of the streams' potential for camping (primitive, transient and group), fishing, picnicking, a trail system (hiking, horseback riding, bicycling and auto tour routes), esthetic enjoyment (sightseeing, nature walks and walking for pleasure) and the establishment of natural, scenic and historic areas. Limited applications were also made to two other watersheds and to selected recreation sites on Boone and Jessamine Creeks. Extensions of these case studies resulted in procedures for estimating: visitation to a developed site, future participation demand generated by an urban area and the proportion of that demand that would be satisfied at a specific site, and the economic benefits that would accrue if the sites were developed.

Conclusions reached were: (1) Esthetic and recreational values can be identified, inventoried and used to evaluate a watershed's development potential. (2) The methodology yielded fairly accurate evaluations for most of the recreational activities considered. (3) The case studies revealed that many small stream areas possess medium to high potential for camping, fishing, picnicking, trail system development and some forms of esthetic enjoyment. (4) Visitation estimates

were judged to be only approximate due to lack of relevant data on similar existing recreation areas. Estimates of participation demand, acreage requirements and annual benefits were somewhat more reliable.

Suggestions for further research include: (1) Additional applications of the evaluation methodology to streams in other Kentucky urban areas and in states having climatic, topographic and socio-economic conditions different from Kentucky's and (2) A feasibility study of the use of a psychometrics approach to determine personal preferences about outdoor recreation and the preservation of natural areas.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

Chapter I

INTRODUCTION

BACKGROUND

In late 1967, the population of the United States reached 200 million, nearly double the number of people counted in the Census of 1920. Projections over the next three decades indicate a national population of 300 to 350 million by the year 2000 (9, p. 34).[1]

Paralleling the continuing growth in population are:

A rapid increase in urbanization: In 1900 only 40 percent of the population resided in urban areas; by 1960 this had grown to about 68 percent. Present trends show that by 2000, nearly 85 percent of the population will be concentrated in urban areas (9, p. 3).

An increase in leisure time for the individual: The percentage of a person's time that can be classed as leisure (after work, sleep, and personal care) rose from about 26 1/2 percent in 1900 to 34 percent in 1950 and is expected to reach 38 percent by 2000. Coupling these percentages with the actual and projected populations for the same three years yields total annual leisure hours for the United States of 177 billions, 453 billions and 1,113 billions, respectively. Outdoor recreation, the broad concern of this study, presently accounts for the expenditure of about 7 percent of total available leisure time. This proportion has risen sharply in the past few years and is expected to continue to do so (9, pp. 5,7).

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[1] Underlined numbers in parentheses refer to references listed at end of this report.

An increase in the average per capita disposable income: Recent (1966) estimates place disposable income at $2567 per person (75). An increase to about $4000 is expected by 2000 (9, p. 34). It seems likely that a sizable portion of this additional money will be used to satisfy the recreational needs generated by the increase in leisure time.

An increase in the amount of individual travel: Clawson estimates that average annual travel per capita will increase by about 50 percent (6000 miles to 9000 miles) between 1963 and 2000 (9, p. 36). This factor, up from 500 miles per person in 1915, obviously interlocks with the increased participation in many kinds of outdoor recreation activities. Equally obvious is the causal influence of a simultaneous growth in the number of private automobiles and the network of good roads available for recreational travel. Long distance vacation travel via completed portions of the Interstate Highway System is now commonplace and will become more so as the target date for the System (1975) approaches.

The combined effect of increases in population, urbanization, leisure time, income and mobility has been an ever growing pressure on existing outdoor recreation facilities of all types, from neighborhood playgrounds and sports arenas to national parks and forests. Some areas of our state and national parks have been so heavily used (and misused) that the scenic, natural or historical values for which they were originally established have been damaged or destroyed. With the advent of the trail bike, snowmobile and private helicopter even the remote reaches of our wilderness and primitive areas have felt the pressure of too many visitors and have thereby suffered impairment of their fragile wildness.

Overuse of outdoor recreation areas is but one facet of a steady deterioration in the quality of our total environment. Air, water, auditory and visual pollution have increased to the point where they have become a major concern of most of the citizenry and various agencies of city, state and federal governments.

Nowhere are the problems of overloaded recreational facilities and environmental pollution more acute than in and near the metropolitan areas. Burgeoning populations of people and automobiles and the popularity of suburban living have required the rapid acquisition and development of large blocks of open land on the urban periphery. It has been estimated, for example, that the present rate of development in the forty eight coterminous states is nearly 1,000,000 rural acres per year (25, p. 119). In California alone 375 acres per day are being converted into highways, subdivisions, shopping centers and parking lots (13). Unfortunately, much of this growth is uncontrolled, opportunistic and poorly planned. The need for open space and the provision of opportunities for esthetic and recreational enjoyment have, with some notable exceptions, been largely ignored.

Recognition of the pressing need for open space planning is typified by this excerpt from a 1961 speech by President Kennedy (79, p. 3).

> "Land is the most precious resource of the metropolitan area. The present patterns of haphazard suburban development are contributing to a tragic waste in the use of a vital resource now being consumed at an alarming rate.
>
> Open space must be reserved to provide parks and recreation, conserve water and other natural resources, prevent building in undesirable locations, prevent erosion and floods, and avoid the wasteful extension of public services. Open land

is also needed to provide resources for future residential development, to protect against undue speculation, and to make it possible for state and regional bodies to control the rate and character of community development."

Many possibilities exist for the provision of urban and suburban open space. City and county parks, parkways, residential clusters and communally owned play areas have all been utilized by city planners and developers, both past and present. Manhattan's Central Park, an unusually large example of a "block" type open space, is a result of the early foresight of some New York residents and landscape architect Frederick Law Olmstead. Other open space designs have included the "green belt" originated by Ebenezer Howard (16) and exemplified by Cleveland's "emerald necklace" and the spoke or "green wedge" described by Tankel (61). Toronto's open space plan, based on a series of stream valleys and parkways that penetrate the urban area, is an example of the latter (64).

Advocating no particular shape or form, non-planner Henry Thoreau recommended that each town should reserve,

> "a primitive forest of five hundred or a thousand acres, where a stick should never be cut for fuel, a common possession forever, for instruction and recreation" (63, p. 298).

An open space resource that meets at least the spirit of Thoreau's idea are those small naturalistic stream areas that still prevail on the outskirts of many U. S. cities. The fate of most such streams, as they have been engulfed by the growing city, has been a gradual conversion into a combination sewer, dumping ground and general eyesore often followed by channelization into a ditch or culvert.

The memoirs of E. H. Stedman (57), pioneer Kentucky papermaker, includes a poignant description of the deterioration of one small urban stream. Stedman lived near the Town Branch of Elkhorn Creek in Lexington, Kentucky during the early nineteenth century. In 1880 he wrote of this stream:

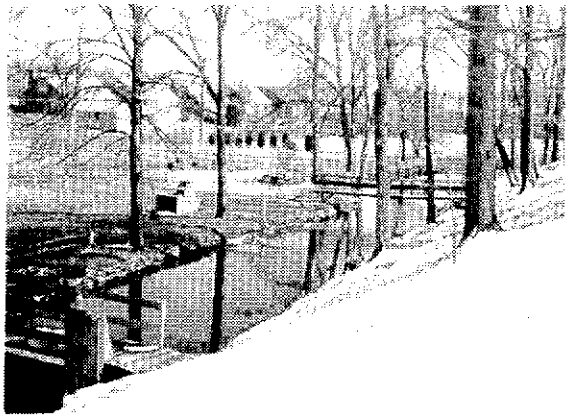
> All kinds of fish were plenty. Fine perch, in fact one man by the name of Jo Barker (for short he was called Fisherman Jo), he fished in the (mill) pond all spring, summer and fall. In the winter he used to kill ducks. So by fishing and hunting he made a good living for his family. How altered now! The mill and house is gone, the dam is gone, the pond is all filled up --- the wild duck no more visit the place. No fish, the coal tar from the gas works in Lexington has killed the last crawfish.

Figure 1 shows Town Branch and Elkhorn Creek as they appear today.

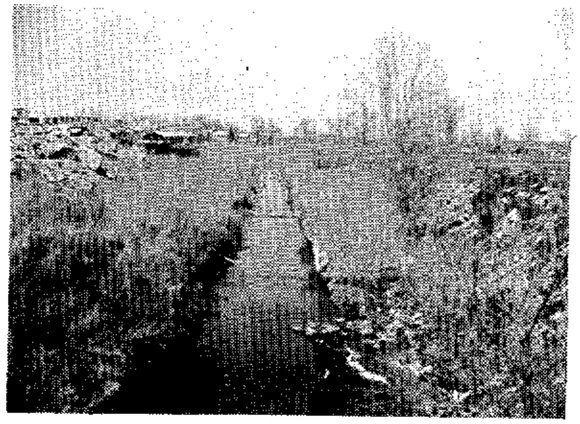
Equally poignant but more grammatical is a recent appraisal by the Department of the Interior of Washington's Rock Creek (78, pp. 7,9).

> It is a unique and well-beloved resource, and it is in bad trouble. Rains stimulate the creek to flood more easily and copiously and destructively than it used to, and for a long time after storms it runs turbidly reddish-brown. It eats its banks away in places and bares the roots of trees, which topple gracelessly athwart the stream bed. Tires and broken dolls and cans and other trash wash down from above and arrange themselves on view as non-Park Service exhibits of mass man's typical effect on things natural and fragile. Even in dry times, when the creek runs clear, it is grossly fouled with organic wastes and bacteria from a variety of unpleasant sources, so that children who wade in it do so within sight of somber "polluted" signs. Recently it was called "our beautiful sewer," which seems to be a fair enough description, shame us though it may.

Stream valleys were recognized as being "uniquely suited to serve as a basis for a system of county open space" at a 1962 forum on the Future Use of Urban Space (61). Along with forests,

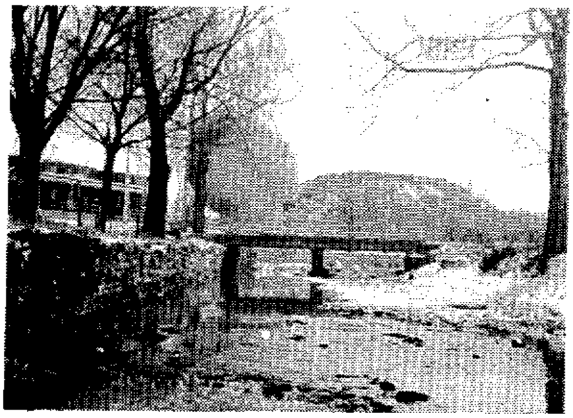


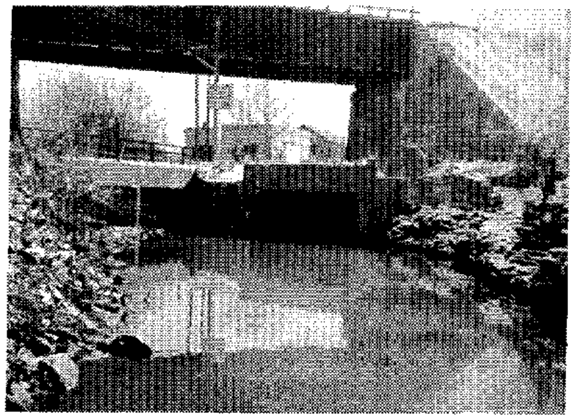
Naturalistic Section



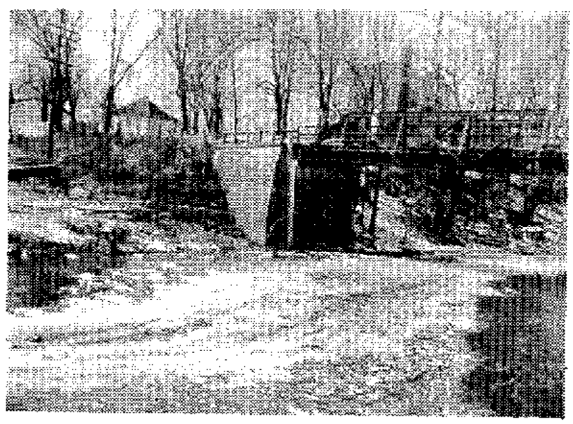
Channelized Section

a.) Wolf Run Creek - Fayette County, Kentucky





b.) Town Branch of Elkhorn Creek - Lexington, Kentucky



c.) Detergent Pollution, South Fork of Elkhorn at Wiesenberger's Mill

Figure 1. Urban Streams

wetlands, deserts and other landscape features, Tunnard and Pushharev (64) list water (in the form of lakes and streams) as one of the most important elements in open space design. Water, they maintain, "gives pleasure by its ability to reflect and enhance surrounding colors and textures" and provides a "break in texture, color and apparent density from any material which surrounds it." Also pointed out however is the overriding problem in the reservation of urban streams for non-utilitarian uses:

> ".... if enjoyment of water is our objective of our planning, it may be necessary to protect and reserve a whole drainage basin, or at any rate, the banks of a whole stream system. Protecting only a fraction leaves the door open to diversion, pollution, flood aggravation and many other hazards."

There are, in this country, only a few examples of the use of natural stream areas as urban open space. Rock Creek Park in Washington, D. C. is the oldest and best known of these. It was placed under the jurisdiction of the National Park Service in 1890 and though it has since been sorely beset (as noted above) by increasing pollution, heavy flooding, and the construction of a highway through its lower valley, it continues to serve a variety of recreational needs and remains a valuable scenic asset to the capital city. The recent rehabilitation and beautification of the San Antonio River (24) and a citizen's campaign to save California's Napa River from "channel improvements" (13) are other exceptions to the general public apathy toward urban streams and their preservation.

PURPOSE AND SCOPE

The purpose of this study is to develop a method for evaluating the esthetic and recreational potential of small naturalistic streams and their watersheds. The research is limited to streams draining watershed areas of less than one hundred square miles and located within a twenty-five mile radius of the center of an urban area. The term "urban area" includes but is not restricted to those built-up areas of the U. S. listed by the Census Bureau as Standard Metropolitan Statistical Areas (SMSA).

The proposed method emphasizes the use of all available sources of information about the stream and its watershed and is based on the principles or concepts of terrain analysis and land use planning, quantitative geomorphology, airphoto interpretation, the philosophy and psychology of value judgments and the economics of land use and outdoor recreation.

The procedure is developed and tested through case studies of two streams (Boone and Jessamine Creeks) near Lexington, Kentucky, a SMSA with a 1966 population of about 155,000. Further checks on the validity of the procedure are obtained through its limited application to two other streams in the Lexington area, Hickman and Clear Creeks (Figures 2 and 3). Brief studies of similar watersheds near other Kentucky cities serve to define the broad scope of the problem as it presently exists in the state.

Boone and Jessamine Creeks, both tributaries of the Kentucky River, drain watersheds of forty four and forty two square miles, respectively. Boone Creek is nearest the Lexington urban area and is in more or less immediate danger of being adversely affected by the city's growth. Agricultural and commercial land use, and the primary road net (including a portion of Interstate Highway 75) are highly developed in the Boone Creek watershed, especially on the plateau above the lower reaches of the stream. Although two small towns are included within its watershed,

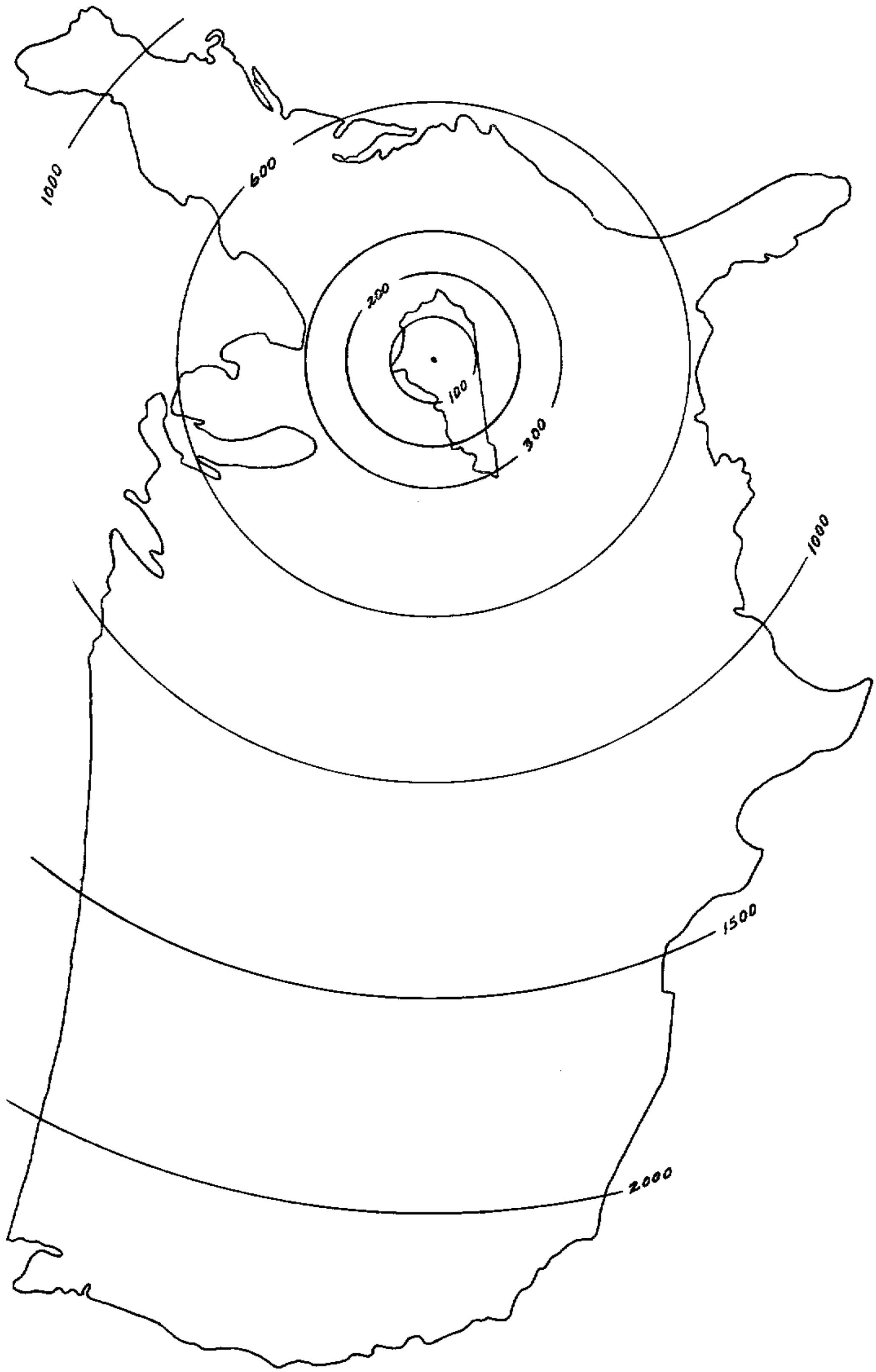


Figure 2. Location of Area Within United States and Air Distances

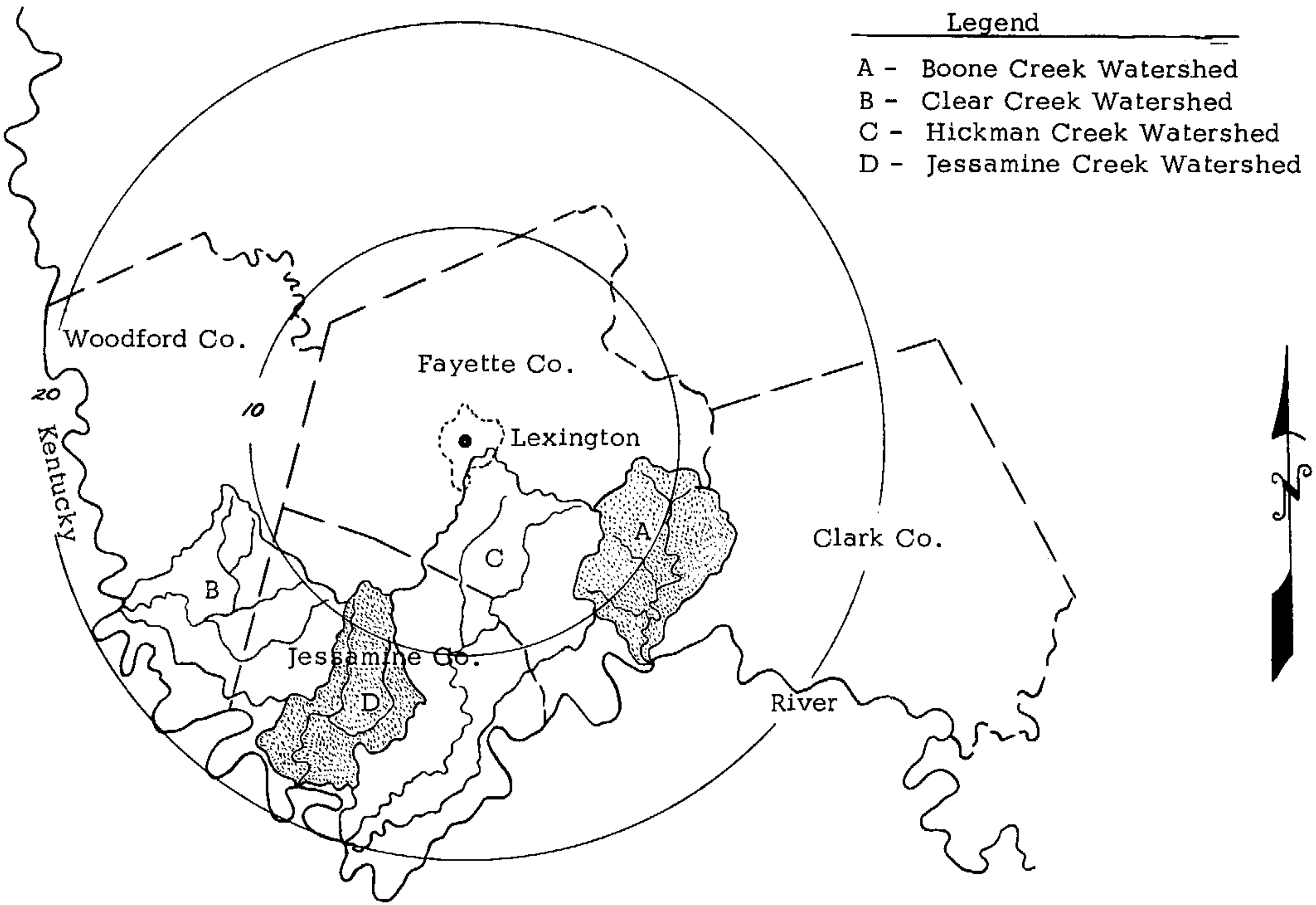


Figure 3. Location of Creeks and Lexington Urban Area
Scale: 1" = 8 miles

Jessamine Creek is comparatively undeveloped. This is particularly true of the road net, there being no through highways near those sections of the stream having the greatest recreational possibilities.

Conditions on the Hickman and Clear Creek watersheds are similar to those existing on the other two streams. The West Branch of Hickman Creek extends well into the Lexington suburbs. Several independent sewage disposal plants, necessitated by the city's fast growth, now discharge into West Branch and its tributaries. A primary highway (U.S. Route 27) crosses the Kentucky River at the mouth of Hickman Creek. Clear Creek, on the other hand, is relatively isolated from immediate urban pressures. The watershed areas of Hickman and Clear Creeks are respectively, ninety seven and sixty five square miles.

Selection of these streams for case studies was based on the following:

(1) All of the watersheds are within the influence area of a fairly large city.

(2) The city is growing so rapidly that measurable changes, social and economic, for good and for bad, are occurring and their effects can be observed over a relatively short period of time.

(3) There are few public outdoor recreation areas in or near the city; demand greatly exceeds supply.

(4) Portions of each watershed, especially the engorged lower sections of the main stream channels are still in a semi-wild state.

(5) Each watershed includes a wide range of esthetic, historical, and recreational values, both existing and potential.

(6) Each watershed also includes examples of environmental pollution arising from a variety of sources.

(7) Demographic, socio-economic, land use and present recreational supply and demand data are available or can be readily estimated for the Lexington area.

RELATED RESEARCH

EVALUATION METHODOLOGIES

The need for inventory and evaluation of scenic and recreational resources has become increasingly pronounced in the face of a growing demand for outdoor recreation and the dwindling supply of space and facilities to support it.

An early (1935) effort in this direction was the Tennessee Valley Authority's documentation of scenic areas in the Tennessee River watershed (62). Descriptions, including photographs and maps, were prepared for resources ranging from a proposed National Park (Cumberland Gap) to small secluded waterfalls in the Great Smokies. This work is, for the most part, purely descriptive. No attempt was made to compare alternate uses of the areas or objectively to rate one place against another.

In 1958 Congress created the Outdoor Recreation Resources Review Commission (ORRRC). This group's mission was to ascertain the present (1960) and future (1976 and 2000) recreation needs of the American people and the resources available to them. It was also asked to recommend those policies and procedures needed to insure an adequate balancing of recreational needs and resources both now and in the future. The Commission's report was completed in 1962 (40). This document and the twenty six Study Reports that support it constitute a detailed analysis of the overall outdoor problem in this country. Particularly pertinent to the present research are Study Reports 19, 20, and 26 which define the different outdoor recreation activities and describe procedures for estimating future participation in each of them (39,41,43). Study Report 8 sets forth the methodology used to inventory potential recreation sites in the rural areas of the Northeast United States (42). "Gorge and ravine sites" and "small stream or brook sites" are noted in this report as two of the possible landscape features with valuable recreational potential.

A comprehensive inventory and recreational evaluation of America's rivers were recommended in a 1962 paper by Frank and John Craighead (11). Their concern was with streams having watershed areas in excess of one hundred square miles. They categorized the nation's waterways into four classes: wild rivers, semi-wild rivers, semi-harnessed-developed rivers, and harnessed-developed rivers. A set of criteria and rating forms were developed to enable an evaluation of the fishing, boating and hunting resources of a given stream. An "environmental effect" criterion was also included as an expression of the scenic or esthetic quality of the stream and its surroundings.

The Soil Conservation Service (SCS) of the U. S. Department of Agriculture (USDA) recently (1966) set up an appraisal system for quantifying the potential of outdoor recreation developments (70). The system recognizes twelve types of developments and ten "key elements" that affect to a greater or lesser degree the potential of each type. Weighting factors or "multipliers" are assigned for all appropriate row and column positions of the ten by twelve development - key element matrix.

Each key element is rated (preferably by a group of knowledgable specialists) on a one to ten scale for each type of development. Total "score" for a given development is obtained by summing the products of the weight factors and the rating numbers. The system requires a rather extensive inventory for its proper use. It has been tested through its application in Jefferson County, New York (69).

J. W. Penfold, Conservation Director of the Izaak Walton League has suggested (44) the use of "isoprims" to rate the primitiveness of park and wilderness areas. The degree of remoteness from roads and civilization is indicated on a map by numbered "contour lines." The isoprim numbers range from one to ten with increasing degrees of primitiveness. The procedure was used to evaluate the primitive quality of the Rawah Wild Area in Colorado.

In developing his "environmental corridor" concept for the state of Wisconsin, Professor Philip H. Lewis, Jr. utilized a set of two hundred twenty map symbols, each representing an esthetic or recreational resource. Both natural and manmade resources were found to occur in linear patterns across the state; i.e. along streams, ridges, flood plains, etc. The delineation and evaluation of these patterns by Lewis has led to a plan for a network of "heritage trails" in Wisconsin (28,29).

A classification system for the recreational use of the Connecticut River is currently under study at the University of Massachusetts (31). Extensive use is being made of air photo interpretation techniques. Mapping symbols have been established for various types of urban and rural land use, vegetative cover, drainage conditions, riverbank and edge condition and outdoor recreation facilities.

Terrain Analysis and Land Use Planning: The growing importance of local and regional planning has emphasized the need for a more detailed and comprehensive knowledge of natural and man-modified terrain than that provided by a topographic map or a cursory ground survey. Procedures evolving from this need have included the analysis of both linear (or corridor) and areal patterns.

Mintzner and Struble (35) investigated the relative effectiveness of various analysis tools in the preliminary location of a highway. Aerial photographic interpretation supplemented by field checks was found to be satisfactory for many of the preliminary location decisions. Similar methods have been used in the location of other transportation routes.

Areal analyses are most often used to determine the suitability of land for various purposes. The county soil surveys prepared by the Soil Conservation Service are, in a sense, areal analyses for agricultural purposes. However, the newer soil surveys also include actual or inferred land capability appraisals for engineering, timber, wildlife and recreational uses. Other special purpose terrain analyses include the detailed Geologic Maps and Hydrologic Atlases prepared by the U. S. Geological Survey (USGS).

Applications of terrain analysis to expanding urban areas has been the subject of two recent (1967) studies. Kiefer (25) has suggested a system for establishing "land suitability ratings" for industrial, residential, agricultural and recreation-conservation uses on the urban fringe. The system uses various combinations of slope, soil classification, drainage capability and depth to bed rock as measures of suitability. End result of its application to a fringe location in Madison, Wisconsin, was a sketch plan delineating the areas judged to be best suited for each of the four land use categories. Anschutz and Stallard (2) have presented a similar procedure with special emphasis on the use and cost of aerial photographic interpretation techniques. A sample application in the Topeka, Kansas, area illustrates this procedure.

Quantitative Geomorphology: This relatively new branch of the earth sciences has found particular significance in the study of streams and their watersheds. In 1945 R. A. Horton (21) worked out a simple and rational way of classifying streams by "order" from the smallest upstream branches (first order) to the largest of rivers (twelfth order and higher). Mathematical relationships involving order, stream lengths, stream gradients, land slopes and other measures were derived which enable the physical characteristics of a watershed to be expressed quantitatively. Applications of Horton's work important to the present research are the modifications and extensions made by Strahler (59), the tie between basin morphometry and runoff developed by Potter (49), and the analyses of fifteen small watersheds of the Appalachian Plateau by Morisawa (36). As a way of expressing the topographic ruggedness of a watershed, K. G. Smith's "textural grading" of a drainage network is also appropriate (54).

Airphoto Interpretation: The modern aerial photograph provides detailed, up-to-date data for many planning activities. "Interpretation," as defined by Lueder (30, p. 6) implies the extraction of the maximum amount of information from the photographs when examined stereoscopically by a trained person. Correlation of the photographic findings with other information sources and the use of deductive and inductive reasoning toward a logical interpretation are also implied.

Applications of airphoto interpretation relevant to this study include the work done in hydrology and small watershed analysis by Howe (22) and Sternberg (58) and the interpretive keys for forestry, agriculture, urban areas and industry devised by Wittgenstein (80), Goodman (14), Avery (3) and Chisnell and Cole (8). Specific uses in resource inventory and recreational planning are described by Udall (66), the aforementioned MacConnell (31) and Dill (42, pp. 16-44).

Value Judgments: Clawson and Knetsch (10, pp. 297-298) recently pointed out the need for research on the evaluation of the intrinsic values or qualities peculiar to outdoor recreation areas. They suggest studies leading to the further development of rating systems like those proposed by the aforementioned Craighead brothers and P. H. Lewis, Jr.

Johnson and Huff (23) of the U.S.D.A. have proposed that the values attached to natural beauty be quantified in such a way that they can be used in benefit-cost calculations for various public and private works. An important first step toward this end has been taken by Peterson in his work on mathematical models of preference and complete value analysis (46,47). His approach is based on Santayana's idea that "there is no value apart from some appreciation of it, and no good apart from some preference of it before its absence or its opposite" (50, p. 18). The research thus far has been limited to a study of the visual quality of residential neighborhoods as perceived through the medium of color photography and subjectively rated by a number of individuals (48). An extension of these studies, now underway, includes an analysis of the intangible aspects of selected urban outdoor recreation facilities.

Economics: The monetary value of outdoor recreation as an alternative land use has received much attention during the past few years as economists, engineers, and other specialists have sought ways to justify the inclusion of recreational revenues in the overall benefits assigned to a given watershed or land development project. A new (1966) book by Clawson and Knetsch (10) provides a "state of the art" summary of outdoor recreation economics and pertinent research in that field.

Street (60), Badger (4), and Schmedemann (51) have done some recent analyses of small watershed areas. Their studies deal primarily with recreational activities related to small and medium sized stream impoundments. Benefits from such projects are considered in two general categories; those incidental to the project itself and those which accrue when recreation is the primary purpose of the project.

Master's theses by Wright (81) and Milam (34) have attempted to evaluate, respectively, the demand for outdoor recreation by urban residents and the economic importance of recreation facilities and services to the farmer. Both of those theses were developed from data collected in the state of Kentucky.

Chapter II

THE EVALUATION METHODOLOGY

This study seeks to evaluate the esthetic and the recreational potential of a naturally bounded area (the watershed) which, because of its location, is in a state of actual or impending change. To be meaningful the evaluation must consider both the tangible and intangible aspects of the existing natural and cultural features of the area. It must further recognize the demographic and socio-economic determinants of change and attempt to quantify (within the context of esthetics and outdoor recreation) their present and future effects on the watershed. Finally, the procedure must include an analytical process that, through the use of the assembled data, will enable value judgments to be made on the potential of the entire watershed or selected portions thereof.

In view of the above, the proposed methodology is divided into two major phases; Inventory and Analysis and Evaluation. Brief descriptions of these phases and their various subdivisions follow.

INVENTORY PHASE

The objective of the Inventory Phase is the collection and presentation of all pertinent, available data on the watershed and the adjacent urban area. Full use is made of the usual information sources: maps, photographs, technical and non-technical literature, census data, etc. This information is supplemented and updated by an application of airphoto interpretation techniques and a series of field investigations. The Inventory is logically divided into two categories, Natural and Cultural. Each category is made up of a group of distinct but often interrelated features, each of which has a specific significance in the evaluation.

NATURAL FEATURES

This category is made up of the remnants of the original natural environment. Some features are relatively undisturbed (topography, drainage network, etc.); others are greatly diminished or modified (forests, game animals, etc.).

Topography: Natural ground slope or gradient is a major consideration in determining land use capabilities. Excessive slope reduces the range of agricultural uses and increases the cost of residential, commercial and industrial installations. It is apparent, then, that areas of excessive natural slope are generally better suited for forestry, wildlife, recreation and other such uses. The esthetic impact of the more rugged portions of the earth's surface is well known though there are, of course, exceptions to this that vary with location and climate.

In the proposed methodology a topographic map (USGS, 1:24000, 7 1/2 minute quadrangle) is used to locate and outline those areas with average slopes in the following classes:

0-10%;	alphabetic	symbol	- fmst
10-20%;	"	"	- st
> 20%;	"	"	- vst
Cliffs;	"	"	- C

The acreages in each class are then measured on the map and the percentage of the total drainage area in each class is computed. Slope class boundaries are transferred to a planimetric map (USGS, 1:24000) and the sub-areas distinguished by graphical symbols keyed to the different classes. The end result of this work is a Watershed Slope Map.

Geology: The characteristics of the consolidated or unconsolidated parent material underlying a watershed are reflected in the surficial topography, the drainage network and the soil profile. Certain materials because of their position, thickness and degree of hardness tend to form, over long periods of geologic time, cliffs, gorges, caves, rock houses, table rocks and other items of scenic and esthetic value. The geologic conditions within an area may also limit or prohibit some types of recreational development.

Since small watersheds rarely contain many variations in parent material, the methodology includes only a delineation of the general areal extent of the major rock types. Obviously, a more detailed study may be necessary in regions of complex geology. Sources of geologic information include the highly detailed USGS, 7 1/2 minute quadrangle sheets, the geologic folios and county geologic maps of varying accuracy. The findings of this part of the Inventory are represented on a small scale (1" = 2 miles) Geological Map of the watershed. Shown on the map are the approximate boundaries of those rock types judged to be significant in terms of developmental limitations and topographic expressions that are of scenic, esthetic or scientific importance. Symbols used on the map are those normally assigned by the USGS to designate the various formations. Interesting geologic phenomena occurring within the watershed are identified by map, air photo and field studies. They are listed in a descriptive table and their locations are indicated by numbered symbols on a Resource, Transportation, Land Use and Land Use Capability Map (working scale, 1:24000).

Pedology: Of all the natural features soil is perhaps the most immediately important to the development of outdoor recreational facilities. The fertility of the soil and its usefulness for agricultural purposes is often a major factor in the decision to convert a tract of land to an alternate use such as recreation. The physical soil characteristics of texture, plasticity, permeability, etc. may impose serious limitations on the construction of roads, buildings and other improvements necessary to proper development. Finally, the top layers of the soil profile (the solum or "true soil") provide the nutrient base for the growth of trees, wildflowers and the myriad plant and animal life that make up the natural environment.

The USDA County Soil Survey is the most available and comprehensive source of pedologic information. The more recent surveys include correlations between agricultural and engineering soils classification systems that are helpful in preparing the kind of general appraisal needed in a study of this type. These same correlations may also be used to infer engineering soils data from older and less comprehensive county soils surveys and maps. To present pedologic information in a concise and meaningful form, a small scale (1" = 2 miles) watershed Soils Map is prepared on which the areal extent of various soil associations are delineated. A series of map symbols adapted from those originated by Lueder (30) and modified by Kiefer (25) are entered on the map as brief expressions of those soil characteristics important to outdoor recreation and development of facilities. A detailed explanation of the soils map units and symbols is in Appendix A.

Hydrology: The significance and evaluation of streamflow volumes and water supply sources are considered in another section of this report. Of interest here is the application of quantitative geomorphologic principles to obtain some measures of the frequency of occurrence of streams by relative size and the degree of stream dissection within the watershed. Utilizing the USGS 1:24000 topographic map (supplemented by stereoscopic examination of USDA 1:20000 aerial photographs) the entire drainage network is outlined and the streams rank ordered according to Strahler's modification (59) of the Horton system (21). The system starts with the smallest headwater streams which are designated as First Order. The juncture of two First Order streams forms a Second Order stream. The idea is extended so that whenever two streams of equal order join they form a stream of the next highest order. A tributary of lower rank does not change a higher ranking stream's order.

Horton and others have discovered many close-fitting mathematical relationships between stream order and other parameters such as stream length, slope and area of drainage basin. In this study the Horton analysis is used in two ways. First, the measures of dissection; frequency, density and texture; are computed for the entire watershed and those sub-areas that appear to differ markedly from the rest. Stream frequency is defined as the number of streams per unit area in a given drainage basin and is expressed by the equation:

$$F_s = \frac{N}{A} \qquad (1)$$

where F_s represents stream frequency, N equals the total number streams in the drainage basin, and A is the basin area. Drainage density is defined as the length of stream per unit area in a given drainage basin and is expressed by the equation:

$$D_d = \frac{\Sigma L}{A} \qquad (2)$$

where D_d is the drainage density, ΣL equals the total length of streams, and A represents the area. Once the drainage density is found it is used to compute the "texture" of the topography from an empirical equation developed by Smith (54):

$$\log T = \frac{0.219649 - \log D_d}{1.115} \tag{3}$$

where D_d equals drainage density, as above, and T equals the "texture ratio". Qualitative equivalents of the texture ratios are:

$T < 4$; Coarse textured topography

$T = 4$ to 10; medium textured topography

$T > 10$; fine textured topography

$T > 50$; ultra fine textured topography

The measures of dissection as determined above provide a means of expressing the relative ruggedness of a watershed or similar area.

Secondly, the Horton system is used as an aid in estimating the recreational (and to some extent, the esthetic) potential of sub-areas of the watershed having drainage networks of the same order or combination of successive orders. Previous research has raised the possibility of there being definite relationships between stream order and the occurrence of fish species [Kuehne (26)], invertebrates [Harrell (19)] and the natural vegetation of valley slopes [Hack (18)]. Leopold, Miller and Wolman (27) have estimated (by order) the numbers, lengths and mean drainage areas of all the streams in the United States (Table 1). Stream order categories significant to the present study range from one through five or six. The highest stream order determined in a given watershed depends upon the smallness of the stream designated as first order. The order of the master stream, therefore, may vary with the judgment of the analyst or may simply be a function of the scale of the map used. Stream orders are designated by symbols on a Stream Order, Vegetation Map (working scale, 1:24000).

TABLE 1

RELATION OF STREAM ORDER TO THE NUMBER OF STREAMS IN THE UNITED STATES, THEIR AVERAGE LENGTH AND DRAINAGE AREA

Order	Number	Average Length (mi.)	Mean Drainage Area (sq.mi.)	Total Length (mi.)
1	1,572,000	1	1	1,572,000
2	352,000	2.3	4.75	809,000
3	80,000	5.3	23	424,000
4	18,250	12	109	219,000
5	4,170	28	518	116,000
6	948	64	2,460	61,000
7	206	147	11,700	30,000
8	41	338	55,600	14,000
9	8	777	264,000	6,200
10	1	1790	1,250,000	1,800
				3,253,000

Source: 27

Small brooks and streams in the size range of orders one through six are almost invariably made up of a sequence of pools and riffles. The successive stretches of deep and shallow water harbor the various species of aquatic plant and animal life known collectively as a lotic community. Species living in the quiet pools differ from those in the fast flowing waters of the riffles (38, pp. 241,252). The pools provide a refuge for aquatic life during periods of severe drought. Recreational activities such as swimming and fishing (both activities would be on a limited scale in small streams) require reasonably large, fairly deep bodies of water along the course of the stream. The combination of pools and riffles has an esthetic quality that neither seems to have alone. For these reasons the evaluation process includes an inventory of the larger permanent or perrenial pools. Location and approximate dimensions and depths (under average flow conditions) are determined for the pools. The locations of permanent pools, springs and major rapids are indicated on a Resource, Transportation, Land Use and Land Use Capability Map by numbered symbols which are keyed to a descriptive table.

Vegetation: Trees, shrubs, wildflowers, grasses and other types of natural vegetation are so obviously related to recreational and esthetic quality that there is little need to belabor the point. It is important, however, that the inventory present the current situation regarding the areal extent of the major vegetative types found in the watershed. Interpretation of the latest USDA, 1:20000 aerial photographs enables the identification and delineation of forested areas and abandoned fields with reasonable accuracy. The techniques used are similar to those referred to in Chapter 1. The interpreted data is transferred to the Stream Order, Vegetation Map and the acreages of forests and abandoned fields are measured. The forested areas are classified by tree species, density of growth and height class. This information is shown on the map by a set of symbols adapted from MacConnell (31). See Appendix A for a list of the symbols and their meanings.

Plants and Animals: Tabulations of the more important and/or interesting species of the watershed's flora and fauna are included in the methodology. Data for these tables are gathered from published listings (when available), local scientific studies and field observation. Since the occurrences of some forms of plant and aquatic animal life seem to be correlated with stream order, the tabulation also indicates (where applicable) the approximate range of each species within the watershed.

Climate: The weather, with its daily and seasonal variations may either contribute to or detract from the quality of some outdoor recreation activities. It may also be a totally limiting factor (the impossibility of snow skiing without snow, for example). The frequency of heavy rainstorms and persistent droughts is obviously of basic significance in small stream areas that are proposed for recreational use. Seasonal changes in the appearance of the natural landscape are also the source of important esthetic values. Local weather bureau data are the best source of weather information. These data are condensed and tabulated for use in the evaluation procedure.

CULTURAL FEATURES

These include all man-made or man-modified features existing within the watershed and those demographic, political and socio-economic data needed in assessing present and future outdoor recreation demand.

Land Use and Land Use Capability: Present land use controls to a large degree the possibilities for future alternate uses such as recreation. Use is a measure of capability. Land use and land use capability categories are identified in this study from topographic maps, recent aerial photographs of the watershed, USDA Soil Surveys and the Watershed Slope Map. The boundaries of the several use and capability categories are transferred to the Resource, Transportation, Land Use and Land Use Capability Map and symbolized according to an adaptation of MacConnell's system (31), the USDA capability classifications (71), and criteria set up by Kiefer (25, p. 135). See Appendix A.

Transportation Network: The existing network of highways, roads and trails and their geographical relationship to possible recreation areas along the stream are measures of accessibility; an important and sometimes overriding consideration in evaluating the feasibility of a proposed site. The network is delineated and classified from planimetric maps and aerial photographs, supplemented by field checks where necessary. A set of map symbols based on the Kentucky Highway Department road classification system is used to express the geometrics and approximate traffic volume capacities of the roadways on the Resource, Transportation, Land Use and Land Use Capability Map. The meanings of the symbols used are in Appendix A. Other transportation systems; railroads, pipelines, power lines, etc. are indicated on the map by USGS conventional symbols.

Water Quality and Quantity: There are generally very little available data on these aspects of the small stream. Simple periodic field measurements supplemented by runoff calculations and comparable data from streams of similar size are employed in the evaluation procedure. The purpose of these measurements is to estimate the extent of pollution during periods of low flow, the condition considered to be most critical for recreational uses and the preservation of aquatic life.

Quality criteria considered are dissolved oxygen content, pH, temperature and the presence of toxic substances and visible waste material in the stream. The Yellow Springs Oxygen Meter, YS1 Model 542C with an accuracy of 1 percent of full scale is used for determining the dissolved oxygen content. Measurements of pH and temperature are done in the usual way.

Low flow discharges are obtained by conventional stream gaging methods. Flood discharges of various frequencies are estimated by a method developed by McCabe (32).

Quality and quantity data are tabulated for use in pertinent sections of the evaluation procedure.

Historical: The early histories of many sections of the United States are intimately connected with small streams. The "creek" provided the settler with a natural, low gradient path for travel on foot or horseback. It was a source of water for his household uses and a source of power for grinding his grain. Battles were fought for the possession of some now well known streams. Forts and stations and later towns and villages were built on or near small streams.

The artifacts remaining from these early activities are a part of the local and national heritage. They are recognized in the evaluation methodology as a set of "historical values" which may include (depending on the geographic location) such things as mills, mill dams, cemeteries, bridges, old houses, etc. These "values" are inventoried through a field study based on a careful review of local histories and traditions. The results are described in tabular form and the location of each historical value is indicated on the Resource, Transportation, Land Use and Land Use Capability Map by a numbered symbol keyed to the table. Historical and other values likely to be found on small watersheds in the central United States are listed in the latter section of this chapter.

Demographic and Socio-Economic: The impact of urban population growth and changes in national work patterns on the supply-demand relationship for outdoor recreation was described in the preceding chapter. Analysis of this impact for a specific city requires firm data for all the usual census items plus other determinants such as: location and usage of existing recreation areas, present production and value of rural land, distances from other urban centers to existing and potential recreation sites in the study area, current zoning practices, future land use plan, etc. In the evaluation procedure, census items are assembled on a tract basis for the local study area. SMSA census data are used for outlying cities from which recreational trips might be attracted to an existing or proposed development. Distances used are airline and are measured on a map. The collected information is tabulated or described in appropriate sections of the case studies.

Location, size and usage of existing outdoor recreation facilities in the urban influence area are obtained from field investigations, local governments and private operators. Existing outdoor recreation areas within a study watershed are tabulated separately a and their locations are indicated on the Resource, Transportation, Land Use and Land Use Capability Map by a numbered symbol keyed to the table.

Present Recreational Use of Small Streams: An effort was made during the Inventory Phase of the case studies to determine the extent of present recreational use of the selected streams. Questionnaires were prepared for individuals and informal groups, formal groups (Boy Scouts) and privately owned recreational facilities. The first questionnaire was completed through personal interviews of users encountered along the streams. It was designed to determine the socio-economic characteristics of the user or users and the distance they had traveled to reach the stream. The second was mailed to all Boy Scout, Cub Scout, and Explorer troops within the immediate area. Its purpose was to determine the number of troops using the study watersheds in their activities, the number of times each year each troop could be expected to use the areas, and the average number of participants for each use. The third questionnaire was used to determine the initial investment, upkeep, and income of the private facilities already located on the creek. A sample of each questionnaire may be found in Appendix A.

It was not anticipated that this part of the Inventory (as described above) would necessarily need to be included in a generalized methodology. Its use in the present research was to point out the intensity of demand for outdoor recreation and esthetic enjoyment in the study area. The questionnaire data are reported in later chapters covering the results of the case studies.

Disvalues and Land Husbandry: There exists within the boundaries of most small suburban watersheds evidence of man's disregard or abuse of many natural and cultural features which might otherwise enhance the area's esthetic and recreational potential. This evidence is exemplified by flagrant abuses such as dumping and littering and by land use and social modifications such as channel changes, rural slums and undesirable industrial and commercial installations. The evaluation procedure recognizes these conditions by the term "disvalue".

Conversely there are also examples of man's care of the land and cooperation with nature in making the countryside pleasant to look at. Included here are such things as well kept farms, orchards, unusual crops and fine residences.

Disvalues and examples of land husbandry are located by the interpretation of recent aerial photographs and by field investigations. They are tabulated by type and their locations are indicated by numbered symbols on the Resource, Transportation, Land Use and Land Use Capability Map.

Photographic Inventory: Most of the natural and cultural features discussed above possess values or qualities that can best be perceived, presented and evaluated from a visual standpoint. This is obviously true of the esthetic but it also applies, in a sense, to the evaluation of environments for passive recreational activities such as walking for pleasure, picnicking, nature study, etc.

To provide visual, communicable expressions of the tangible aspects of the inventoried features, panchromatic and color photographs are made of selected examples of each of the features found in the watershed. A photograph is also made of each of the permanent pools as a part of that inventory (see above). A few of these photographs (selected from the case studies) are included in this report.

An overall impression of the aggregation of natural and manmade objects, views, settings and detriments that make up a small stream and its drainage basin is difficult to convey in written and graphic form. For this reason, the methodology includes the collection of a set of 35 mm. color transparencies that present, within the limits of the skill and judgment of the photographer, a relative expression of the intangible values of the entire watershed and/or selected stream area segments. The slide collection is intended to be a part of the study report for a given stream. Its proper use helps reduce the need for additional field investigations, aids in presenting a case for acquisition or preservation and provides an additional criterion in comparative evaluations of two or more watersheds.

ANALYSIS AND EVALUATION

The second phase of the methodology attempts to define the potential of a small watershed in terms of those recreational activities for which it is best suited and the extent and quality of its natural, scenic and historical resources.

Recreational activites appropriate to small streams located near urban centers in the central United States form the framework for the evaluation process. The selected activities are, for the most part, those which lend themselves to short participation periods (day use, overnight or weekend) and are easily accessible, geographically and economically, to the city dweller. They are categorized and defined as follows:

1. Camping - defined[1] generally as living out of doors for a limited period of time. Three kinds of camping experience are recognized:

(a) Primitive - living in a small tent or temporary shelter in a remote or semi-remote area for a short (less than one week) period of time while doing without most "civilized" amenities.

(b) Transient - utilizing a developed campground as an overnight or short term stopover while enroute to a long term vacation spot or while simply wandering. The portable living quarters may range in size from small tent to house trailer.

(c) Group - organized camping, usually but not necessarily involving permanent shelter and facilities. Group camping is normally undertaken for some specific purpose, i.e.; religious, educational, therapeutic, etc.

2. Fishing - the taking of fish for non-commercial purposes. The potential of most small streams for this activity is limited by the small amount of fishable water available and the vulnerability of the lotic environment to pollution and other abuses. The unique pleasures of stream fishing are, however, considered significant

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[1] Definitions of recreational activities conform where possible to those recommended by the ORRRC (39, pp. 108, 109).

enough to warrant its inclusion in the evaluation. Two classifications of fishing activity, based on the species found in small streams are used:

(a) Pan and rough fish - usually taken on live bait with simple tackle while fishing from the bank. Pan and rough fish are somewhat more tolerant of pollution and low flow conditions than the game or sport species.

(b) Game Fish - usually taken by casting with artificial bait while wading or walking the bank. Water quality and temperature conditions are critical in maintaining a livable habitat for these fishes. A stocking program would probably be a necessity on streams subjected to medium or high fishing pressures.

3. Picnicking - the preparation or eating of a meal out of doors. This may be done as an end in itself or in conjunction with other activities such as fishing, hiking or bicycling.

4. Trail System - The streams and tributaries that make up a small watershed form a pattern of merging and diverging corridors (ridges and valleys) that are well suited to the development of various types of trail systems. Trail systems evaluated in this study are categorized by mode of travel:

(a) Hiking - This activity is distinguished from simple walking by the requirement that a pack be carried by the hiker. Hiking may be done in conjunction with picnicking and primitive camping. It may extend over a relatively long period of time and usually follows some defined set of paths or roadways.

(b) Horseback Riding - any riding done specifically for recreation. For most city dwellers, this activity would require that rental horses and established bridle trails be available.

(c) Bicycling - any man-powered cycling done for pleasure alone. The availability of rental bicycles and a defined trail system is also important to this activity though not as much as it is to horseback riding.

(d) Auto Tour Routes - This is a trail system designed to satisfy part of the demand for the most popular of all recreational activities, driving for pleasure. As an activity, it is decidedly passive and the pleasure derived from it is almost wholly dependent upon the quality of the road network and the excellence of the natural and cultural features that can be seen from a moving automobile.

5. Esthetic Enjoyment - These are passive activities that depend upon the existence, quality and accessibility of certain natural and/or cultural features of the watershed.

(a) Sightseeing - the intentional looking at or inspection of some significant natural or cultural feature. It implies the travelling of a particular route to a specific site.

(b) Nature Walks - walking for the purpose of observing wild nature (plants, birds, or other animals), collecting specimens or photographing natural subjects. Participation in the activity may be informal, as an individual or in a guided group, or take place along a documented self-guiding nature trail.

(c) Walking for Pleasure - any walking activity other than hiking or nature walks. This may be anything from a casual stroll to an all-day exploring jaunt.

This list of recreational activities could, of course, be expanded or reduced to fit the conditions prevalent in a given locality. Small game hunting, swimming, and vacationing on a farm are examples of additional activities that might be included in the evaluation process for some areas.

6. Natural, Scenic and Historical Areas - These, obviously, are not recreational activities, though the degree of excellence of

such areas as they exist in a watershed directly affects the quality of most of the recreational experiences described above. The primary reason for including area evaluations in the methodology is to establish and quantify in a comparative way criteria for the preservation, restoration and (possibly) the acquisition of significant natural, scenic and historical areas.

(a) Natural Areas - The term implies that the area has been left undisturbed by man for a period of time long enough for natural conditions to prevail or to have been restored. A natural area may or may not be scenic.

(b) Scenic Areas - Esthetic attractiveness of the landscape, either natural or man-modified, is the major descriptor of these areas. Topographic and geologic features, wild areas and well-kept farms, singly or in combination may be included in the scenic area category.

(c) Historical Areas - These are sites of past events that are of sufficient interest to attract people seeking to know more about their heritage. The sites may be of local, regional, or national significance.

Evaluation of a given watershed's potential for each of the above described activities and areas utilizes the data collected during the Inventory Phase and is based on procedures described in the Soil Conservation Service's "Guide to Making Appraisals of Potentials for Outdoor Recreation Facilities" (70). As previously outlined, this appraisal system may be used to evaluate an area's potential for several types of recreational development. Numerical ratings are assigned to a set of controlling factors or "key elements," each of which is weighted in proportion to its relative significance for a given type of development. The sum of the products of the ratings and the element weights (or "multipliers") yields a number which expresses the potential of the area for that particular kind of development.

The SCS system is oriented toward determining the potential for private (profit-making) or public recreational development in a county or region. In the present adaptation, emphasis is placed on evaluating the possibility of satisfying a localized demand (present and future) for recreational and esthetic experiences that are directly related to the tangible and intangible values peculiar to small streams. In other words, the potential to be measured exists because of the stream and its natural and man-modified surroundings; not because of the feasibility of building a lake or a golf course or other large-scale project.

The key elements and the assigned multipliers (ranging low to high, from 1 to 5) for each activity and area are similar to those used in the SCS system and are tabulated on Table 2. A key element may, under certain circumstances, become a factor which limits or precludes a given activity or completely obviates the designation of an area as natural, scenic or historic. Such elements are marked by an asterisk on Table 2. The multipliers, though seemingly quite arbitrary, are based on an objective consideration of actual conditions observed on small watersheds in Kentucky and test applications of the SCS system (69). Multipliers assigned a value of two (2) or more are of significant importance to the activities or areas to which they apply. The absence of a multiplier for any activity/area - key element combination indicates that the element either is not applicable or is of negligible significance.

In the SCS procedure numerical ratings ranging upward from zero to ten are obtained from subjective evaluations of each of the activity/area-key element combinations by a panel of knowledgeable

TABLE 2

KEY ELEMENTS FOR 16 KINDS OF RECREATIONAL ACTIVITIES OR AREAS AND THEIR MULTIPLIERS

Recreational Activities or Areas	Key Elements	Climate	Scenery	Natural Environment**	Historical Values	Soils	Water		Fish Populations	Population Characteristics			Access		Disvalues
							Quality	Quantity		Age	Occupation	Income Level	Local Roads	Tourist Routes	
Camping	Primitive	3	2	2	–	–	2	1	–	1	1	–	–	–	3
	Transient	1	1	–	–	3	1	1	–	–	–	–	–	5*	1
	Group	2	1	–	–	4	2	1	–	1	–	–	1	–	2
Fishing	Pan and Rough	1	–	–	–	–	2	3	4	–	1	–	–	–	–
	Game	1	–	–	–	–	3	3	3	–	1	1	–	1	–
Picnicking		1	1	–	–	2	–	1	–	–	–	1	1	1	2
Trail System	Hiking	3	2	2	–	–	–	–	–	1	1	–	–	–	3
	Horseback Riding	2	1	1	–	1	–	–	–	1	1	2	–	–	1
	Bicycling	2	1	1	–	2	–	–	–	1	1	1	1	–	1
	Auto Tour Routes	1	2	1	2	2	–	–	–	–	–	–	4	1	2
Esthetic Enjoyment	Sightseeing	2	2	1	3	–	–	–	–	–	–	–	3	1	3
	Nature Walks	1	1	3	–	–	–	–	–	–	1	–	1	–	2
	Walking for Pleasure	1	1	1	–	–	–	–	–	–	1	–	–	–	1
Natural, Scenic and Historic Areas	Natural Areas	–	2	5*	–	–	3	–	3	–	–	–	1	1	4
	Scenic Areas	–	5*	2	–	–	–	–	–	–	–	–	1	1	3
	Historic Areas	–	–	–	5*	–	–	–	–	–	–	–	1	3	1

* Considered as a limiting factor
** Includes wildlife populations other than fishes.

persons. The present study, following to some extent the ideas of Lewis (29), tries partially to objectify the rating process through the use of several sets of "values". The occurrence and relative importance of these values are derived directly from an analysis of the data collected during the Inventory Phase and presented in the various maps, photographs, and tables described in the first part of this chapter. It is, of course, impossible to eliminate completely from the process the personal judgment of the evaluator. This is particularly true of those key elements requiring an estimate of esthetic quality. It is here that a ground inspection and/or a thoughtful review of the aforementioned photographic inventory would be in order.

A list of values and measures of value pertinent to the determination of key element ratings for typical small stream areas in the central United States follows:

A. Natural Values
   1. Topographic
      a. percent of total area in slopes >10%
      b. ruggedness (expressed by texture, stream frequency and total relief; mouth of stream to source)
   2. Geologic
      a. cliffs; average height and total length
      b. gorge areas; length and average depth
      c. rock houses; occurrence and number
      d. caves; occurrence and number
      e. waterfalls; occurrence and number
      f. abandoned meanders; occurrence and number
      g. fossil bearing strata
      h. other unusual formations or geologic phenomena.
   3. Hydrologic
      a. percent of total stream length in each order
      b. drainage density
      c. stream frequency
      d. average channel gradient
      e. permanent pools; number, dimensions, average depth at normal flow

f. springs
g. rapids

4. Vegetation
   a. percent of total area in forest
   b. percent of total area in abandoned fields
   c. types and size of forest trees
   d. wildflowers; occurrence and number of species
   e. wild shrubs; occurrence and number of species
   f. ferns and mosses; occurrence and number of species
   g. lichens and fungi; occurrence and number of species
   h. specimen trees
5. Fish and Wildlife
   a. fishes; habitat, species and populations
   b. mammals; habitat, species and populations
   c. birds; habitat, species and populations
   d. amphibians; habitat, species and populations
   e. crustaceans; habitat, species and populations
   f. insects; habitat, species and populations
6. Climate
   a. Average summer temperature
   b. average seasonal high temperatures
   c. average seasonal low temperatures
   d. average number of clear days-seasonal
   e. average number of thunderstorms (annual)
   f. seasonal variations in the esthetic quality of the landscape.

B. <u>Cultural Values</u>
1. Land Use and Land Use Capabilities
   a. percent of total area in each land use classification
   b. percent of total area in each landcapability rating
2. Transportation
   a. length of road in each classification
   b. accessibility to stream areas
3. Water Quality and Quantity
   a. estimated low flow discharge
   b. estimated flood discharge
   c. oxygen content and pH values-seasonal
   d. water temperature variations
   e. pollution; extent and type
4. Historical
   a. old bridges, stone, covered, cast iron, etc.
   b. mill dam; intact or ruins
   c. mill house; intact or ruins

d. mill race
e. mill pond
f. historic homes or buildings; intact, ruins, or site of
g. historical marker
h. battlefield
i. fortifications; ancient or modern
j. old churches
k. old quarries or mines
l. old roads, lanes or trails
m. abandoned railroads
n. old barns, stables or other farm buildings
o. toll houses (turnpikes)
p. graveyards
q. burial mounds, ancient

5. Land Husbandry
   a. fences; plank, stone or rail
   b. horsebreeding farm
   c. well kept conventional farm
   d. unusual crops
   e. orchards
   f. fine barns or other farm buildings
   g. silos
   h. fine residences
6. Recreational
   a. riding stables
   b. church and other group camps
   c. picnic grounds
   d. boat rental
   e. trails; walking, horse or bicycle
   f. scenic overlooks
   g. public parks
   h. privately operated outdoor recreation areas

Aspects of the watershed considered detrimental to the selected recreational activities and the preservation of natural, scenic and historic resources are termed "disvalues" and are used to determine a negative rating proportional to their effect on a given key element.

7. Disvalues
   a. community dumps
   b. family or farm dumps
   c. excessive littering

d. rural slum
e. trailer camp
f. automobile dump or junk yard
g. cattle or hog feeding lots near stream
h. highway along stream
i. channel changes or channelization
j. detrimental industrial development
k. detrimental commercial development
l. uncontrolled urban expansion
m. other existing or potential sources of environmental pollution

Photographic examples of some of the natural and cultural values identified during the case studies of Boone, Jessamine, Hickman and Clear Creeks (central Kentucky) are reproduced in Figures 4 through 16.

APPLICATION OF VALUE RATING

Using the "values" concept to rate the applicable key elements for each of the activities or areas is a matter of combining those values (or measures of value) for which a number (such as a percentage) is sufficiently representative with those that require a qualitative, judgmental expression such as "poor," "good," or "excellent." [1] Individual values in each combination are, for most key elements, weighted in proportion to their importance. The final rating is actually a weighted average with the sum of the weights always being ten. Combinations of values appropriate to the key elements used in the present study are as follows:

Climate: Prevailing climatic conditions will vary little over any one urban area and its contiguous small watersheds. The ratings therefore

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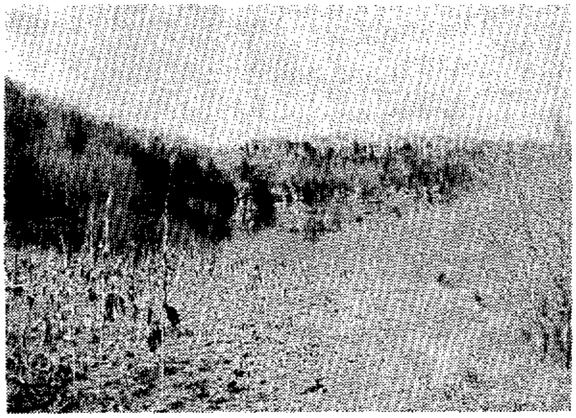
[1] Numberical equivalents assigned are: poor, 0-4; good, 5-8; excellent, 9-10.

a.) Kentucky River at Mouth of Boone Creek

b.) Kentucky River at Mouth of Jessamine Creek

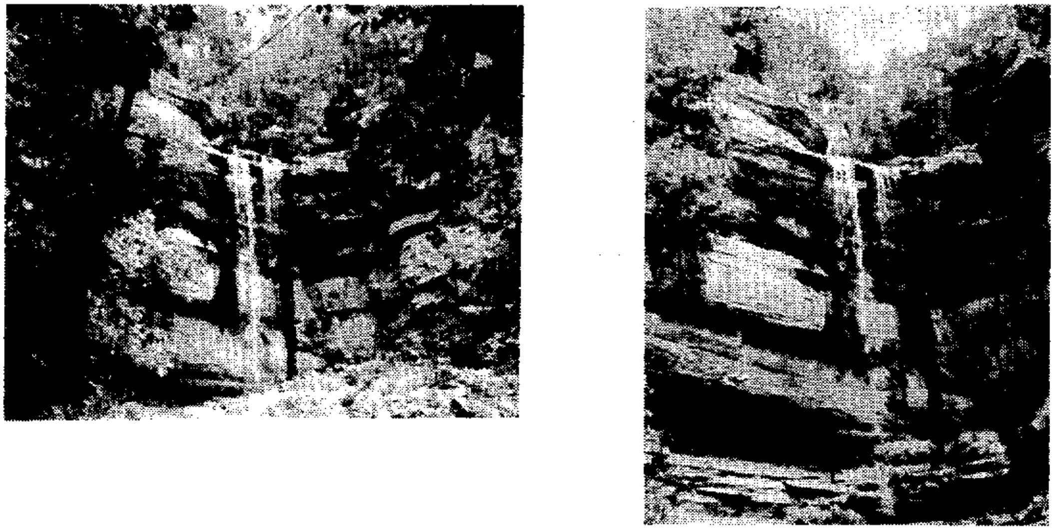
c.) Boone Creek - Spring



d.) Jessamine Creek - Cliffs

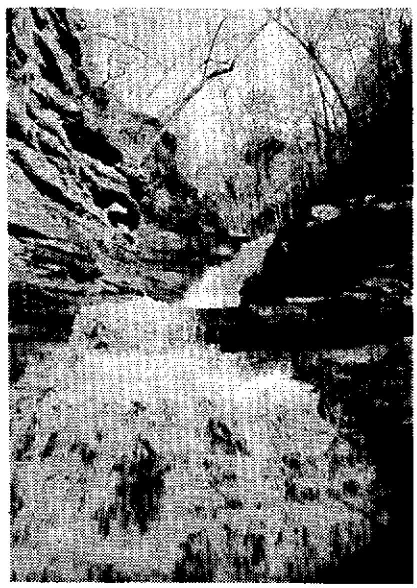
e.) Boone Creek - Abandoned Meander

Figure 4. Natural Values - Topographic, Geologic, and Hydrologic



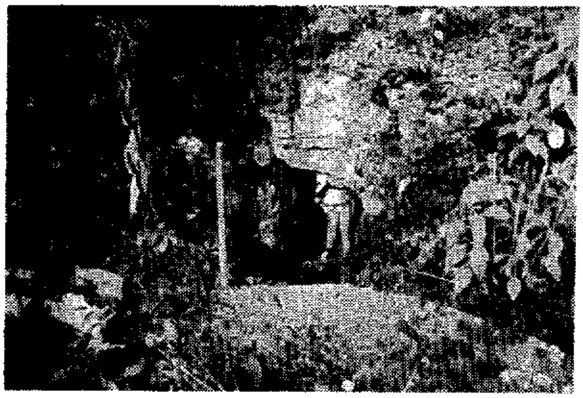
a.) Tributary of Jessamine Creek

b.) Tributary of Boone Creek



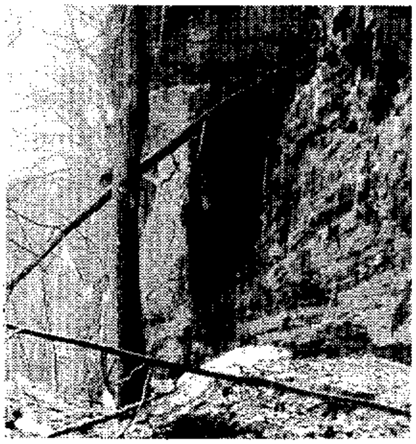
c.) Tributary of Hickman Creek - Indian Falls

Figure 5. Natural Values (Geologic) - Waterfalls

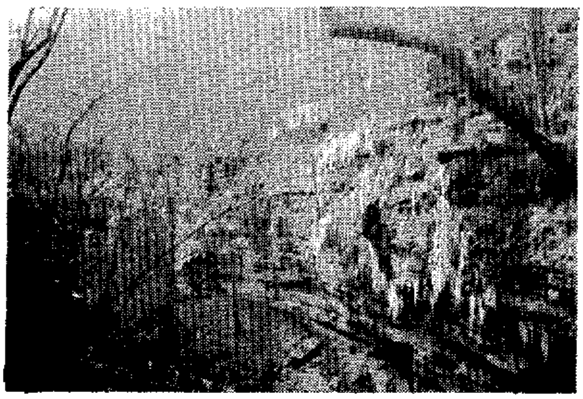


a.) Exit - Daniel Boone Cave
Hickman Creek

b.) Small Cave - Boone
Creek

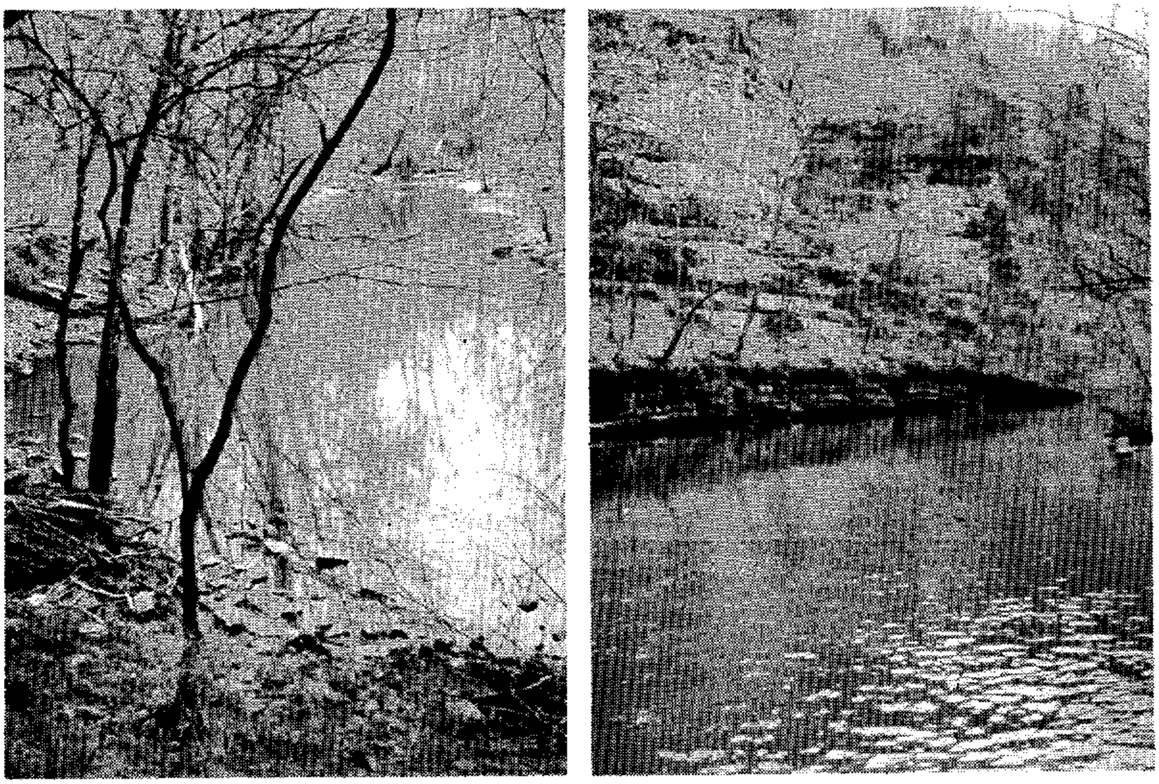


c.) Rock Pillar - Jessamine Creek



d.) Gorge Below Indian Falls - Tributary of Hickman Creek

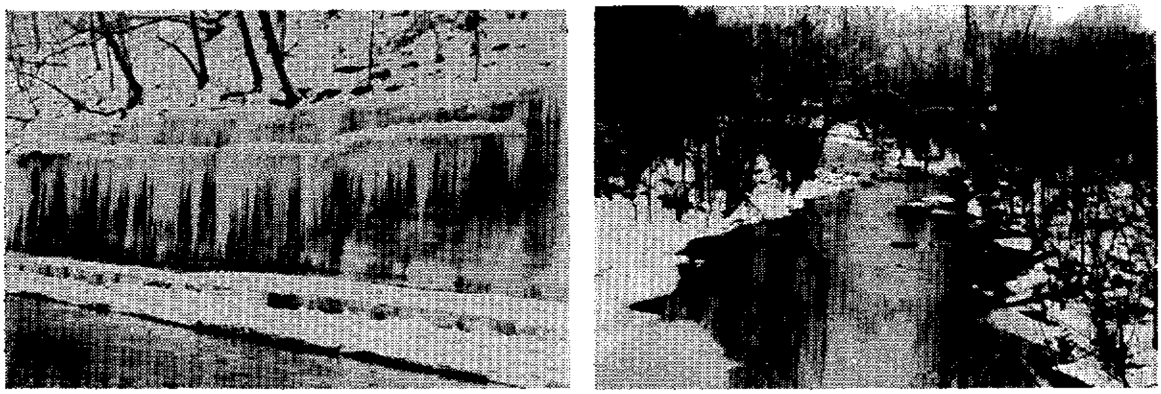
Figure 6. Natural Values (Geologic) - Caves and Gorges



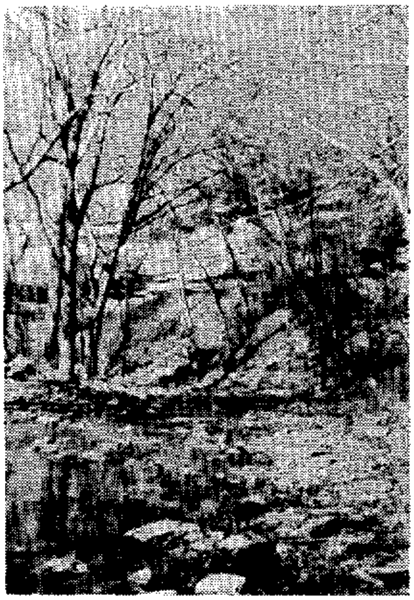
a.) Boone Creek - Pools

b.) Jessamine Creek - Riffle

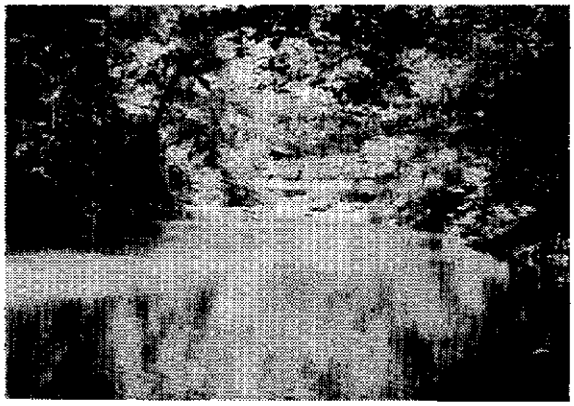
Figure 7. Natural Values (Hydrologic) - Pools and Riffles



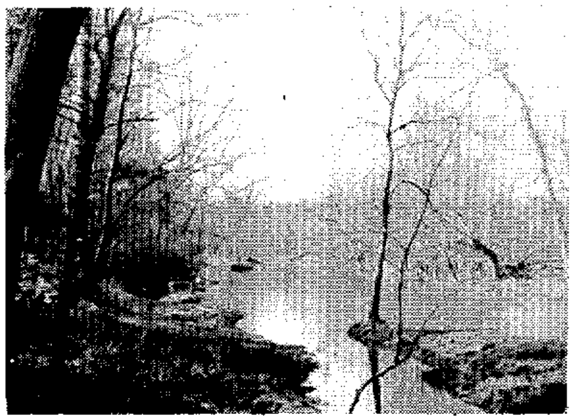
a.) Jessamine Creek - Winter



b.) Boone Creek - Fall

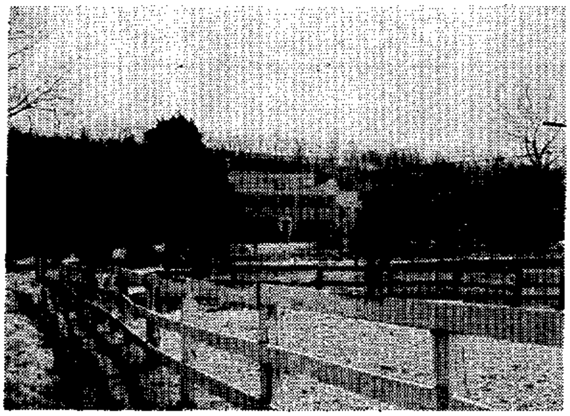


c.) Jessamine Creek - Summer

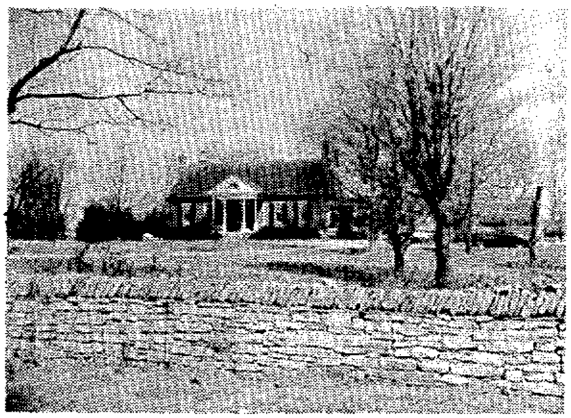


d.) Clear Creek - Spring

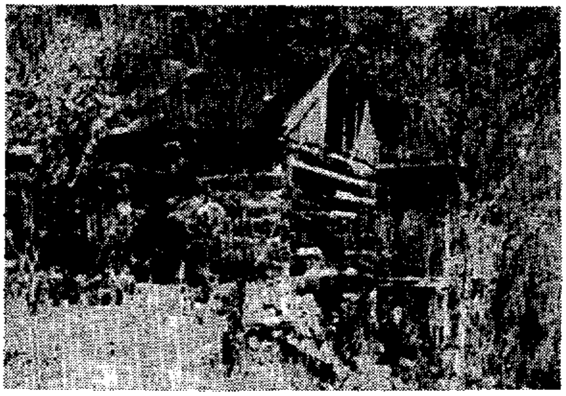
Figure 8. Natural Values (Climatic) - Seasons



a.) Grimes House - Boone Creek

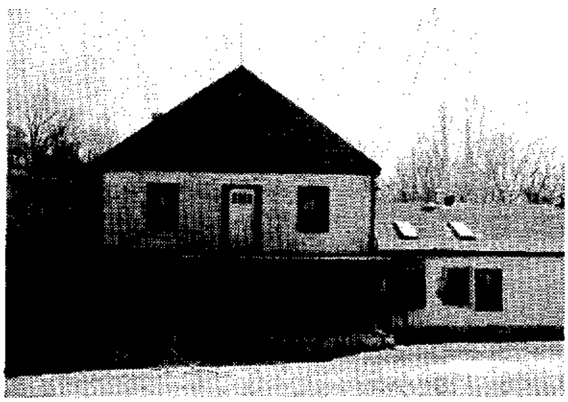


b.) Cleveland-Rogers House
Boone Creek



c.) Snyder Cabin - Boone Creek

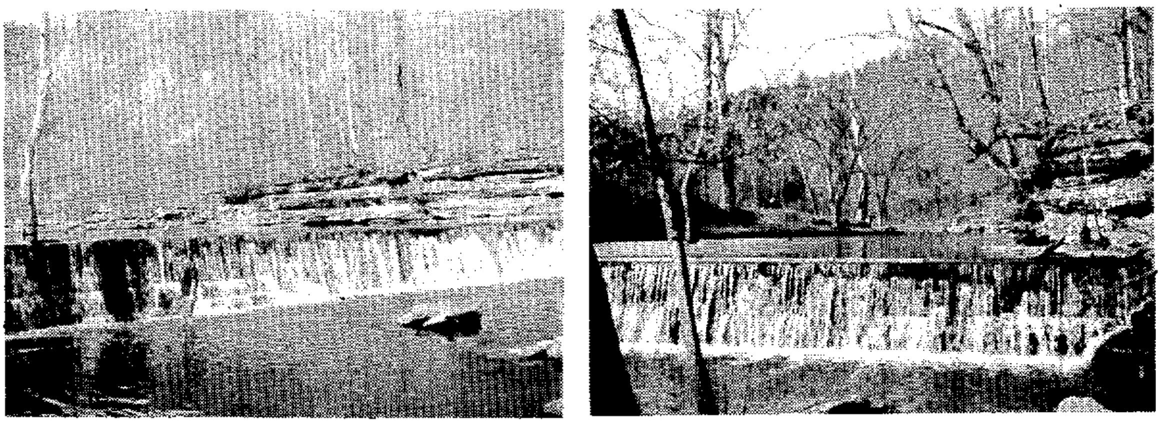
d.) Old Cabin and Barn
Hickman Creek



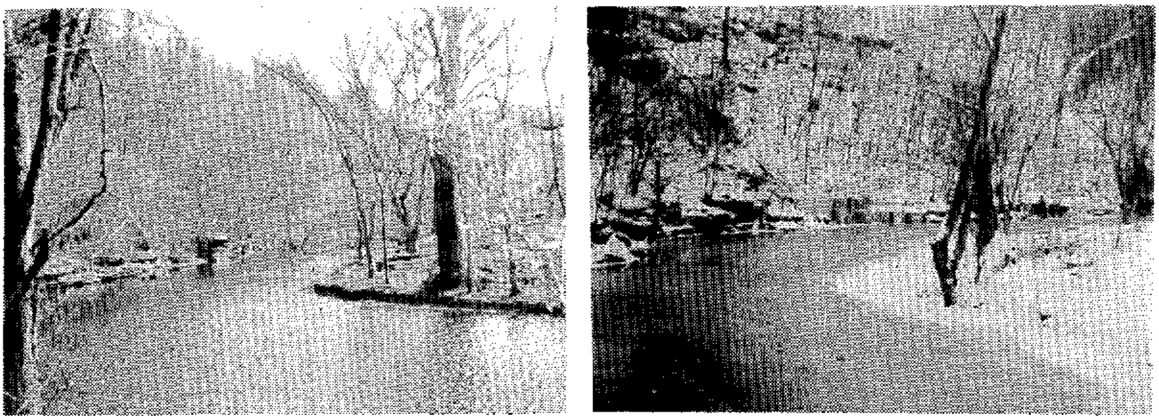
e.) Gentry Mill House
Boone Creek

f.) Grimes Mill House
Boone Creek

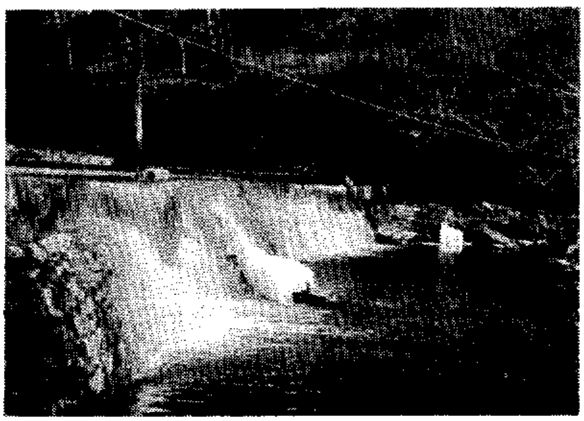
Figure 9. Historical Values - Old Buildings



a.) Glass Mill Dam (Restored) - Jessamine Creek

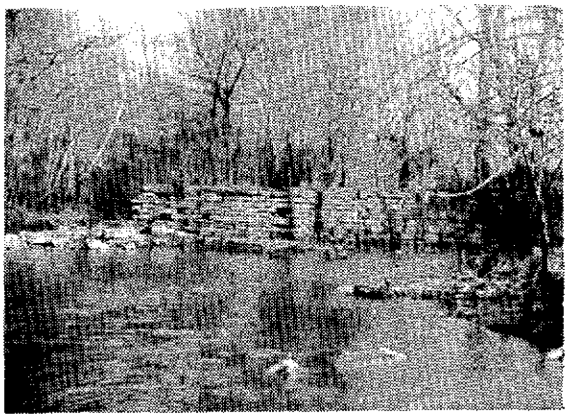


b.) Glass Mill Pond (Spring and Winter) - Jessamine Creek



c.) Gentry Mill Dam (Restored) - Boone Creek

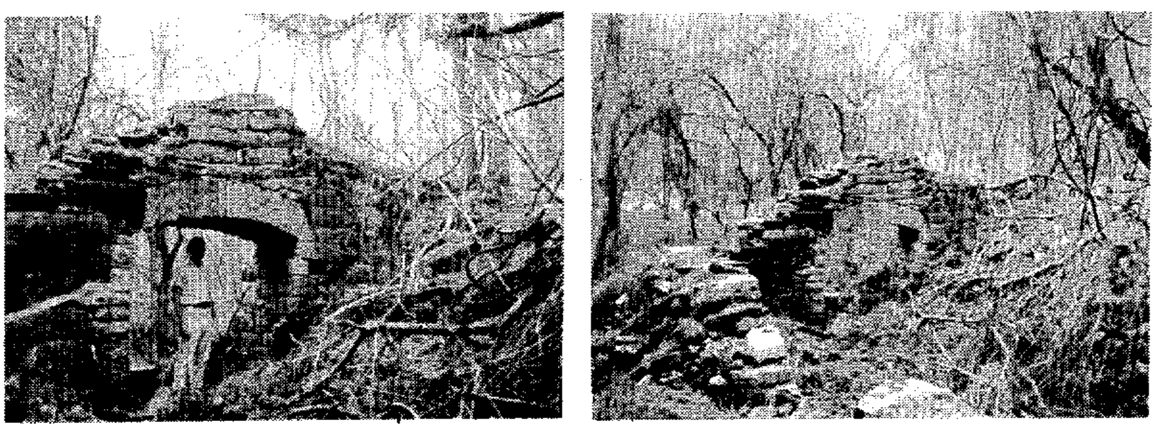
Figure 10. Historical Values - Mill Ponds and Dams



a.) Chrisman Mill Dam
Hickman Creek

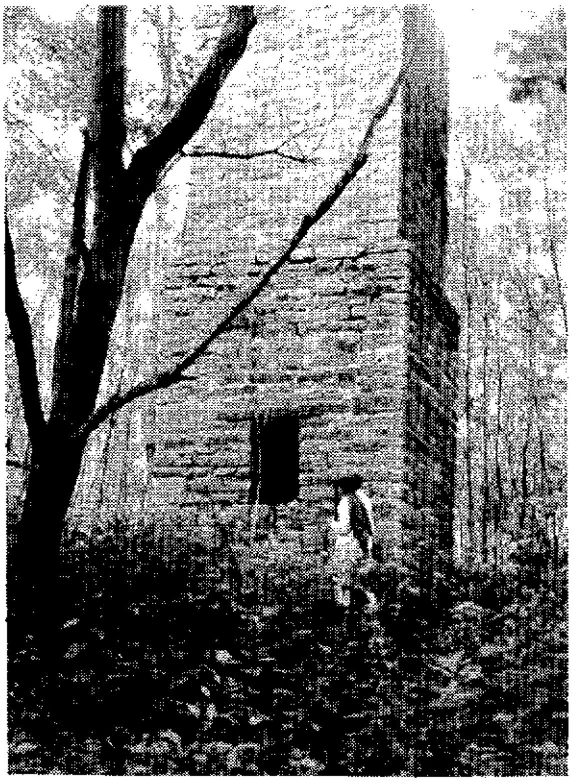
b.) Sluice Gate - Tributary of
Hickman Creek

c.) Crozier Mill House and Mill Stone - Jessamine Creek

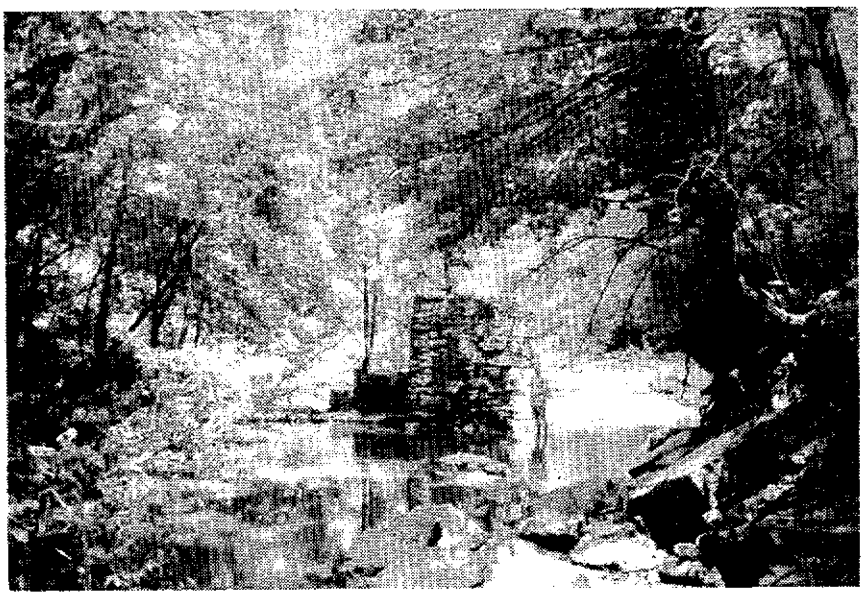


d.) Dry Stone Arch and Mill Ruins - Boone Creek

Figure 11. Historical Values - Old Mill Ruins



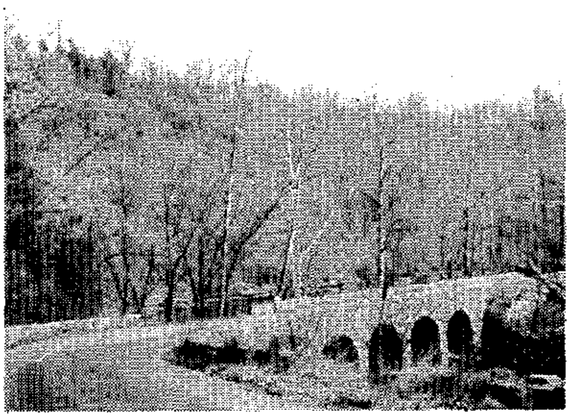
a.) Old Furnace and Chimney - Hickman Creek

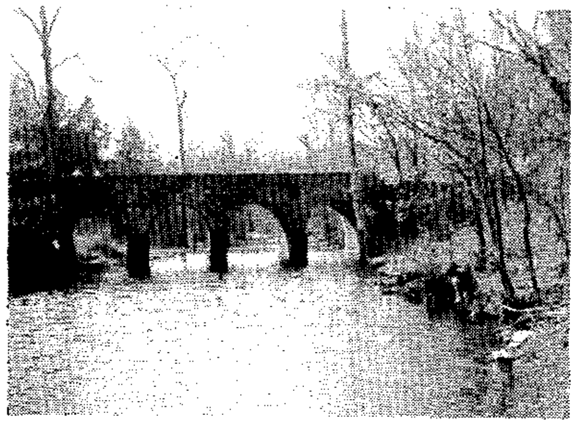


b.) Mill Dam Abutment (Glass Mill) - Jessamine Creek

Figure 12. Historical Values - Old Mill Ruins

a.) Road at the Narrows
Jessamine Creek



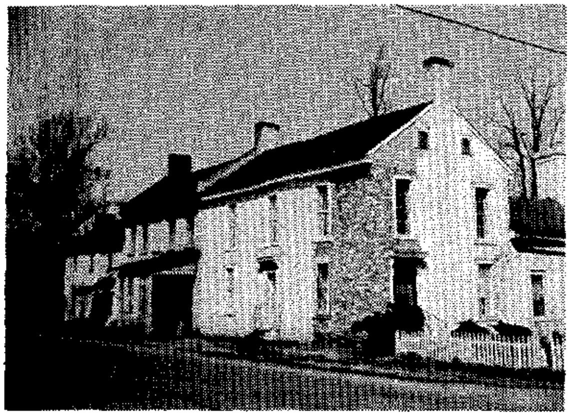


b.) Stone Arch Bridge - Jessamine Creek

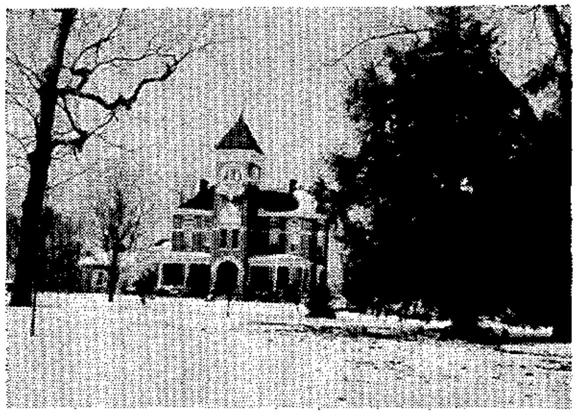
c.) Log Bridge at Mouth of
Jessamine Creek

d.) Stone Arch Culvert
Jessamine Creek

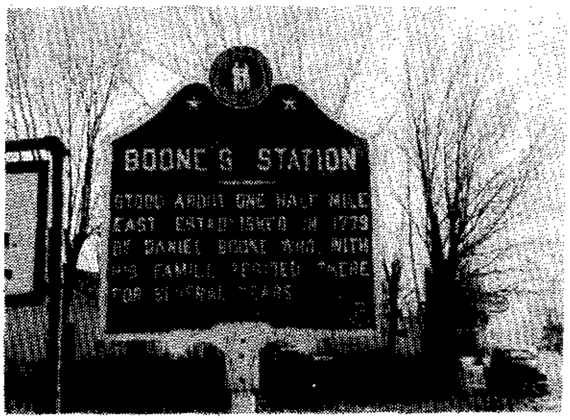
Figure 13, Historical Values - Roads and Bridges



a.) Old Village - Athens, Kentucky

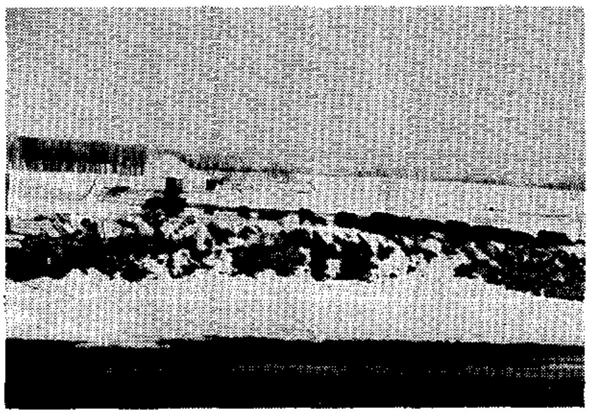


b.) Old Preserved Home



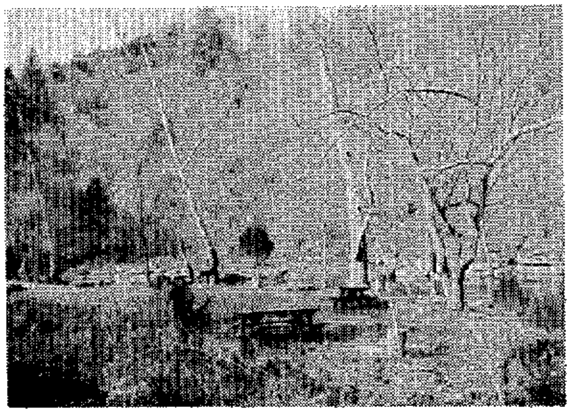
c.) Historical Marker

d.) Boone Family Graveyard



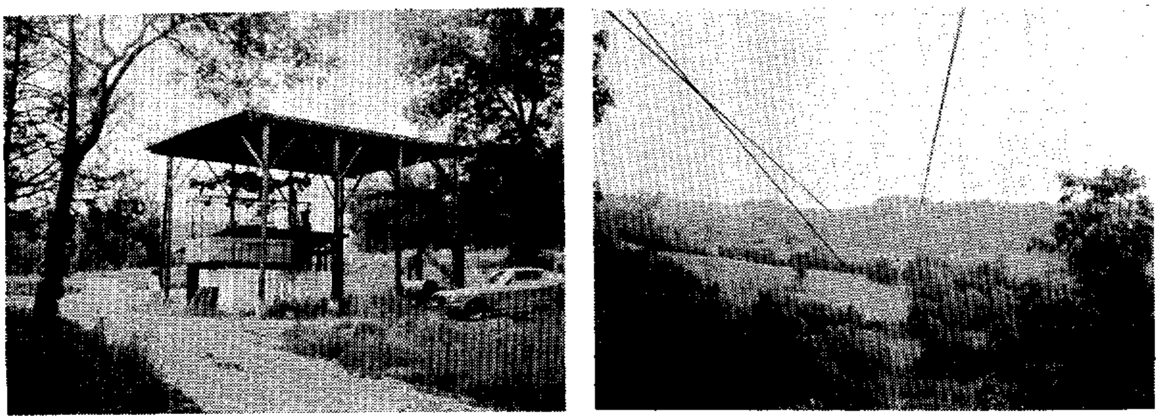
e.) Old Stone Fence

Figure 14. Historical Values

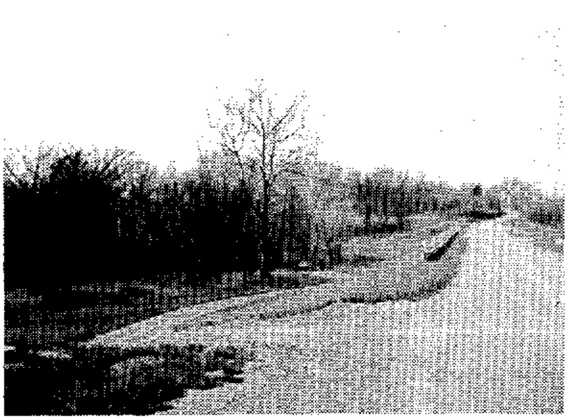


a.) Picnic Area - Glass Mill
Jessamine Creek

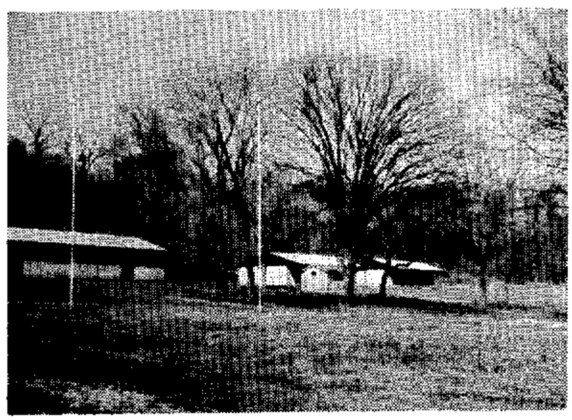
b.) Restaurant - Daniel Boone Cave
Hickman Creek



c.) Aerial Tramway - Daniel Boone Cave, Hickman Creek

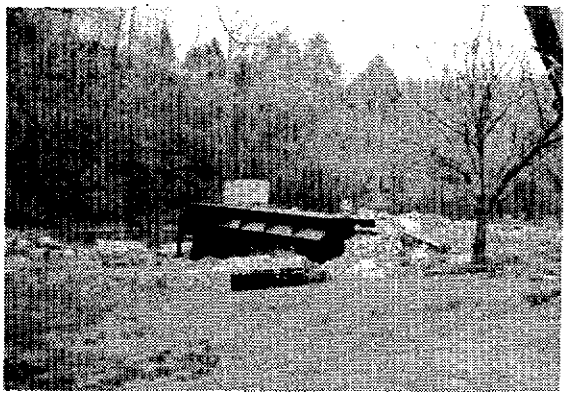


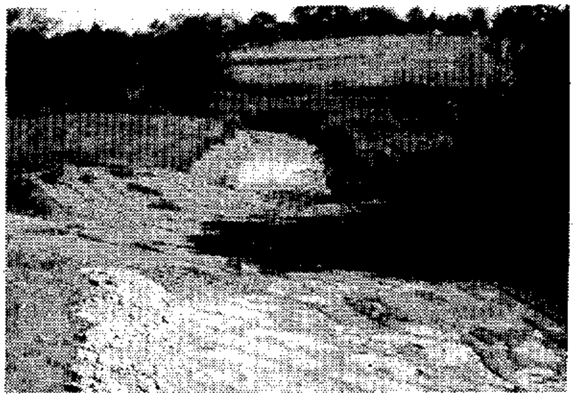
d.) Roadside Picnic Area
Clear Creek



c.) Church Camp - Gentry Mill
Boone Creek

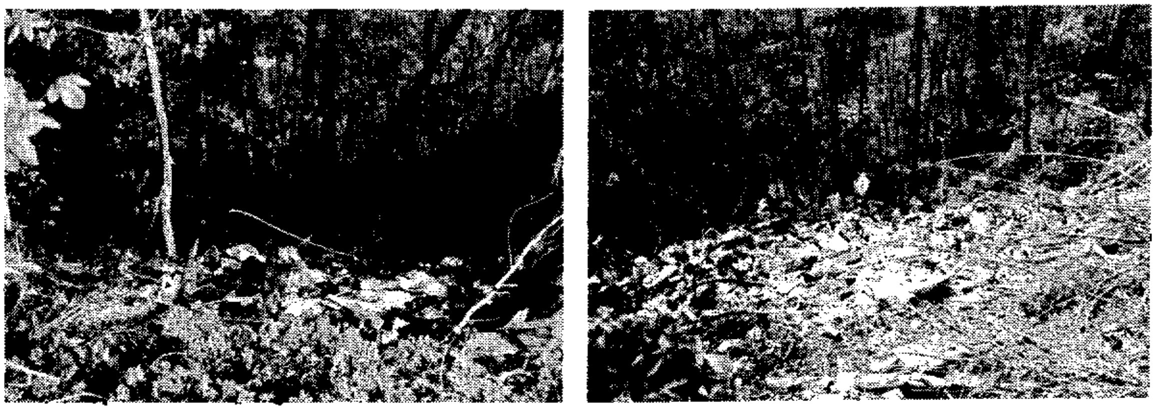
Figure 15. Existing Recreation Areas



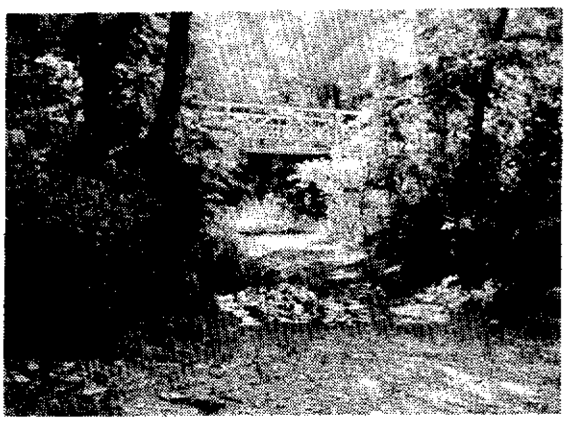


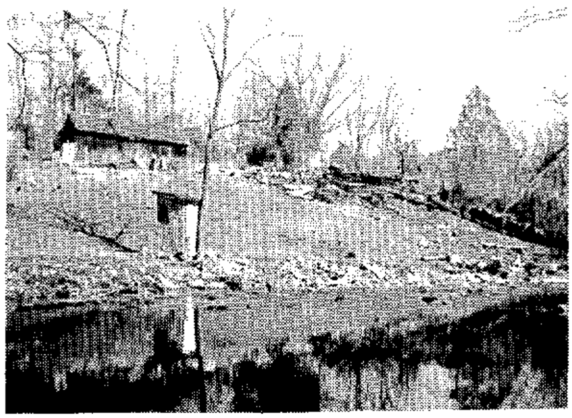
a.) Package Treatment Plant
Boone Creek

b.) Channelization - Clear Creek



c.) Community Dump at Narrows - Jessamine Creek





d.) Individual Dump - Boone Creek

e.) Privy and Family Dump
Boone Creek

Figure 16. Disvalues

represent the relative significance of the prevailing climatic conditions to the various recreational activities. Ratings for all activities are based on:

(1) length of season for a given activity;

Length of season (months)	Rating
1	1
2	2
3	3
4	3
5	4
6	5
7	6
8	7
9	8
10	8
11	9
12	10

(2) average seasonal temperature;

Temperature	Rating	Temperature	Rating
30°F	3	75°F	8
35°	4	80°	7
40°	5	85°	6
45°	6	90°	5
50°	7	95°	4
55°	8	100°	3
60°	9	110°	2
65°	10	115°	1
70°	9		

(3) average seasonal percentage of clear days;

Percentage	Rating
10%	1
20	2
30	3
40	4
50	6
60	8
70	10
80	5
90	3
100	1

(4) the occurrence and significance of favorable micro-climates along the stream;

Rating is judgmental, based on the occurrence of temperature and humidity conditions along the stream which are better suited to human comfort and natural ecology than those prevailing in the uplands during the extremes of summer or winter weather.

little difference;	0-4
some difference;	5-8
considerable difference;	9, 10

The relative weights to be used for each activity in computing the rating for Climate are:

		(1)	(2)	(3)	(4)*
Camping	Primitive	1	3	4	2
	Transient	1	3	4	2
	Group	2	2	4	2
Fishing - All types		3	2	2	3
Picnicking		2	3	4	1
Trail System	Hiking	1	2	4	3
	Horseback Riding	2	3	4	1
	Bicycling	1	3	5	1
	Auto Tour Routes	1	4	4	1
Esthetic Enjoyment	Sightseeing	2	3	4	1
	Nature Walks	1	2	4	3
	Walking for Pleasure	1	2	4	3

Scenery:

> Scenery, like art, is a thing which cannot be classified, tagged, and set apart from all human and other physical contacts and relationships. Scenic resources are living, dynamic, highly subject to the influences of man and all the elements.

This quotation, from a 1938 report of the TVA (62, p. v.), suggests the difficulties involved in trying objectively to evaluate a perception of quality that exists primarily in the mind of an individual.

*Heading numbers refer to the four climatic factors.

So it is necessary to assume that, in the present context (outdoor recreation), there exists a certain set of scenic values that would be perceived by most individuals as being "good" or "desirable". Considering the type of area (the small urban watershed) and the study locale (central U. S.) this set should include: natural values such as forests, cliffs and other rock formations; land husbandry values; measures of topographic ruggedness and those measures of stream size and dissection that are related to the specific activities and areas for which Scenery is a key element. Thus, Scenery is rated according to:

(1) the occurrence and quality of geologic values;
few occurrences of low quality; 0-4
several occurrences of medium to high quality; 5-8
many occurrences of medium to high quality, 9,10

(2) percentage of total watershed area in forest;
allow one point for each 10 percent.

(3) percentage of total watershed area in land use capability classes VI, VII and VIII;
allow one point for each 10 percent.

(4) percentage of total stream length in certain stream order categories; assign ratings for each category in the following manner:

a. stream orders ≥ 2[1];

< 45%;	0-4
46-54%;	5-7
> 55%;	8-10

---

[1]Based on the national average percentage in each stream order as computed from the data in Table 1.

b. stream orders ≥ 3[1];

< 20%; 0-4
21-29%; 5-7
> 30%; 8-10

c. stream orders ≥ 4[1];

0-5%; 0-2
6-10%; 3-5
11-14%; 6,7
> 15%; 8-10

(5) the occurrence and quality of land husbandry values;

few occurrences of low quality; 0-4
several occurrences of medium to high quality; 5-8
overall high quality; 9,10

Relative weights to be used for each activity or area in computing the Scenery ratings are:

		(1)	(2)	(3)	(4a)	(4b)	(4c)	(5)
Camping	Primitive	1	3	3			3	
	Transient		6		4			
	Group		4	2		4		
Picnicking		2	3	2		2		1
Trail System	Hiking	1	3	3		2		1
	Horseback Riding		3			3		4
	Bicycling		3			3		4
	Auto Tour Routes	2	2	2				4
Esthetic Enjoyment	Sightseeing	3	2	1		1		3
	Nature Walks	1	4	3		2		
	Walking for Pleasure		4			3		3
	Natural Areas		4	4			2	
	Scenic Areas	2	2	2			2	2

Natural Environment: In rating this element, emphasis is placed on the present and potential quality of the area as a natural habitat for

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[1] Based on the national average percentage in each stream order as computed from the data in Table 1.

wild plants and animals. As with Scenery, forest cover and ruggedness are considered significant values. Abandoned, overgrown pastures and croplands are also recognized as habitats suitable for certain species of flora and fauna. The Natural Environment is rated according to:

(1) percentage of the total watershed area in forest; allow one point for each 5 percent up to a maximum of 50 percent.

(2) percentage of the total watershed area in abandoned fields; allow one point for each 5 percent up to a maximum of 50 percent.

(3) percentage of the total watershed area in land use capability classes VI, VII and VIII; allow one point for each 10 percent.

(4) occurrence and relative abundance of various species of trees, shrubs, wildflowers, ferns, mosses or other vegetation;

sparsely populated and little variety;	0-4
average populations and varieties;	5-8
abundant populations, great variety;	9,10

(5) occurrence and relative abundance of various species of wildlife (other than fishes) such as birds, mammals, reptiles, insects, etc.;

sparsely populated and little variety;	0-4
average populations and varities;	5-8
abundant, balanced population;	9,10

(6) occurrence of unusual, unique or rare natural species and/or habitats (plant or animal);

none - 0
one or more - 10

Relative weights to be used for each activity or area in computing the Natural Environment ratings are:

		(1)	(2)	(3)	(4)	(5)	(6)
Camping	Primitive	3	3	2	1	1	
Trail System	Hiking	3	2	3	1	1	
	Horseback Riding	5	5				
	Bicycling	5	5				
	Auto Tour Routes	3	2	3	2		
Esthetic Enjoyment	Sightseeing				5		5
	Nature Walks	1	1	2	2	2	2
	Walking for Pleasure	4	4	2			
	Natural Areas	2	2	2	2	1	1
	Scenic Areas	4		4	2		

Historical Values: Rated from one to ten according to the occurrence and quality of historic sites, buildings etc. which are of:

(1) local significance; 1-10

(2) regional significance; 1-10

(3) national significance; 1-10

The relative weights to be used for the activities and areas in computing the Historical Values Ratings are:

	(1)	(2)	(3)
Auto Tour Routes	3	3	4
Sightseeing	2	3	5
Historical Areas	2	3	5

Soils: The Soils element rating includes the assumption that average ground slope, as a surficial expression of soil and parent material properties, is a limiting factor in the development of some types of recreational facilities. The capabilities of the area's soils and rocks for ground water supply, sewage disposal and building and road foundations are estimated from the inventory data and are expressed as probabilities in the rating computations. Soils are rated according to:

(1) percentage of the total watershed area in average slope

categories of:

a. $\leq$ 10% (fmst)

b. $\leq$ 20% (fmst, st)

Allow one point of a or b as noted below for each 10 percent.

(2) the estimated probability of obtaining a dependable supply of potable ground water; allow one point for each 10 percent probability.

(3) the estimated probability of dependable septic tank drain field operation; allow one point for each 10 percent probability.

(4) the estimated probability of encountering soil and parent material conditions favorable to the construction and maintenance of roads, trails and small buildings; allow one point for each 10 percent probability.

The relative weights to be used for the activities in computing the Soils ratings are:

	(1a)	(1b)	(2)	(3)	(4)
Camping - Transient	3		3	3	1
Camping - Group	2		3	3	2
Picnicking		3	4	2	1
Horseback Riding		6			4
Bicycling	6				4
Auto Tour Routes					10

Water Quality: Measures of value used to estimate the Water Quality rating are those which pertain to esthetics and the quality of the aquatic habitat. Suitability of the stream as a source of drinking water or for swimming is incidental. Water Quality is rated according to an adaptation of "New York State Classes and Standards for Fresh Surface Waters" (15). (See Appendix A):

(1) dissolved oxygen in mg/liter:

$<$ 3.0; 0-4
4.0; 5-8
$\geq$ 5.0; 9,10

(2) coliform bacteria median per 100 ml.:

> 5000;	0-2
> 2400 < 5000;	3,4
> 50 < 2400;	5-8
< 50;	9,10

(3) pH:

> 8.5 or < 6.5;	0-5
6.5 to 8.5;	6-10

(4) pollutants affecting color, temperature, taste and odor:

sufficient to prevent fish survival and impair water usage; 0-2

not sufficient to be injurious to fish life or impair any usage; 9,10

(5) occurrence of floating solids, settleable solids, and oil and sludge deposits:

frequent visible occurrences attributable to various permanent pollution sources; 0-2

infrequent visible occurrences attributable to accidental or intermittent pollution sources; 3,4

none readily visible and attributable to various pollution sources; 5-9

none; 10

Relative weights to be used for each activity or area in computing the Water Quality ratings are:

		(1)	(2)	(3)	(4)	(5)
Camping	Primitive		2		4	4
	Transient	1	2	1	3	3
	Group	1	3	1	3	2
Fishing	Pan and Rough	3		2	3	2
	Game	4		1	3	2
	Natural Areas	3		2	3	2

Water Quantity: The chief concern here is with the effects of extremely low or high flows on the quality of the camping and picnicking experience, the appearance of the stream, maintenance of facilities and the aquatic habitat. The element is rated according to:

(1) the estimated probability that there will generally be enough water in the stream to maintain a continuous, visible flow; allow one point for each 10 percent probability.

(2) the estimated probability that the average annual frequency of flood flows damaging to recreation facilities or fish habitats at specific sites on the stream will not exceed 0.04 (equivalent to the probability of a "25-year flood" occurring in a one year risk interval); allow one point for each 10 percent probability.

(3) the estimated probability that there will generally be enough water in the stream to maintain normal populations of pan, rough and game fishes, allow one point for each 10 percent probability.

Relative weights to be used for each activity in computing the Water Quahtity ratings are:

		(1)	(2)	(3)
Camping	Primitive	3	4	3
	Transient	3	6	1
	Group	3	5	2
Fishing	Pan and Rough			10
	Game	3	1	6
Picnicking		4	4	2

Fish Populations: The aquatic habitat is evaluated under the preceding sections on Water Quality and Quantity. Assuming that under those criteria a suitable and reasonably stable habitat exists, Fish Populations are rated in accordance with the occurrence and relative abundance of pan, rough and game fish species and the management possibilities that prevail due to the physical makeup of the stream and its watershed:

(1) pan and rough fishes:[1]

rare;	0-2
infrequent;	3-5
frequent	6-8
abundant;	9,10

(2) game fishes:[1]

rare;	0-2
infrequent;	3-5
frequent;	6-8
abundant;	9,10

(3) percentage of total stream length in stream order categories ≥ 4;[2]

0-5%;	0-2
6-10%;	3-5
11-15%	6,7
> 15%	8-10

(4) frequency of occurrence of permanent pools in stream segments of order ≥ 4;

Number per mile:

0-0.5;	0-4
0.5-1.5;	5-8
> 1.5;	9,10

Relative weights to be used for each activity or area in computing the Fish Populations rating are:

		(1)	(2)	(3)	(4)
Fishing	Pan and Rough	5		2	3
	Game		4	4	2
	Natural Areas	2	2	3	3

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[1]Species included in these categories are listed in the tabulations for the case studies.

[2]Based on the national average percentage in each stream order as computed from the data in Table 1.

Population Characteristics - Age, Occupation and Income Level: The size and distribution of population within the local influence area are considered to have the same effect on each recreational activity. This factor (one aspect of the recreation supply-demand problem) is discussed in a subsequent chapter of this report and is not used as a key element in the evaluation process.

Results of the National Recreation Survey (39) show, however, that within a given population, the characteristics of age, occupation and income level are important determinants of participation rates in the various kinds of recreational activities.

In the present study, activities for which each of the population characteristics is a key element are indicated in Table 1. The rationale for estimating the element ratings is based on the extent that local population characteristics vary from national averages:

(1) Age: Add or deduct one point for each one percent by which the percentage of the local population in a certain age group is above or below the national average percentage in the same age group. The national average percentage is assigned a rating of five.

Age groups pertinent to the various activities are:

Camping	Primitive	15-29 years
	Group	under 15 years
Trail System	Hiking	15-29 years
	Horseback Riding	15-44 years
	Bicycling	15-29 years

(2) Occupation: Add or deduct one point for each one percent by which the percentage of the local population in a certain occupational category is above or below the national average percentage in that category. The national average percentage is assigned a rating of five.

Occupation categories pertinent to the various activities are:

Camping -	Primitive;	Professional workers
Fishing -	Pan and Rough;	Skilled and unskilled workers
Fishing -	Game;	Professional and skilled workers
Trail System	Hiking;	Professional workers
	Horseback Riding;	Professional workers
	Bicycling;	Professional workers
Esthetic Enjoyment	Nature Walks;	Professional workers
	Walking for Pleasure;	Professional workers

(3) Income Level: Add or deduct one point for each $500.00 by which the local median income is above or below the national median income. The national median income is assigned a rating of five.

Access - Local Roads: The accessibility to the urban area residents of those portions of the watershed best suited for the various activities and areas is rated according to a qualitative appraisal of road network and classification data recorded on the Resource, Transportation, Land Use and Land Use Capability Map. Key factors in the appraisal are: directness of travel from census tract centroids to the recreation sites, adequacy of road surface and geometrics, and those attributes especially significant to a particular activity or area.

Local roads are rated as follows:

poor;	0-4
good;	5-8
excellent;	9, 10

Access-Tourist Routes: The presence within or near the watershed of one or more through highways of the primary or interstate classifications is necessary for a successful transient camping operation. It is also important, to a lesser degree, for pleasure driving, sightseeing and visitations to natural, scenic and historic areas.

The element is rated on the occurrence of Tourist Routes in or near the watershed and the proximity of such routes to existing or potential recreation sites:

no primary or interstate highways within 15 minutes driving time; 0-4

adequate state or federal primary highway within 15 minutes driving time; 5-8

important federal primary or interstate highway within 15 minutes driving time; 9,10

Disvalues: Negative ratings expressing the effects of permanent or temporary disvalues not implied in any of the above ratings are scaled according to the degree to which they (the disvalues) detract from the enjoyment of a specific activity or the preservation and maintenance of a natural, scenic or historic area.

Disvalue ratings for the activities and areas are:

little or no detraction;	(-) 0-4
moderate detraction;	(-) 5-8
extreme detraction;	(-) 9-10

SUMMARY AND COMMENTS

To summarize, the methodology consists essentially of computing a number or "score" which represents the suitability of the watershed for each of several selected recreational activities or areas. The computations are made using pairs of numbers ("multipliers" and "ratings") obtained from the three dimensional activity/area - key element-rating matrix. Since there are some empty cells in the matrix (indicating non-significance or non-applicability), the maximum possible scores for the different combinations will not necessarily be the same. The final scores are therefore standardized by reducing them to percentages. The results of test applications of the methodology are described in subsequent chapters which deal with the case studies.

It should be emphasized that the procedure described above is based on the premise that the entire watershed is to be evaluated. Thus scores for some activities or areas will be rather low. If the same system is used to evaluate a selected portion of the watershed (the semi-wild lower reaches of the case study streams, for example), the result will be higher scores that more truly represent the potential of the smaller area. Interpretation of the validity of such scores should still be tempered, however, by recognizing the effects of pollution or other deterioration of portions of the watershed upstream from the section being evaluated.

Chapter III

APPLICATION OF METHODOLOGY

INTRODUCTION

Case studies of the Boone and Jessamine Creek Watersheds are presented in this chapter. The purpose of these studies is to illustrate the application of the methodology for evaluating the quality of a recreation area outlined in Chapter II and to compare the results obtained for the two watersheds.

The watersheds are similar in size (28,340 acres and 26,852 acres) but differ considerably in shape. Boone Creek Watershed is more nearly circular and has a less sinuous boundary than Jessamine Creek. This may be expressed numerically by comparing the respective circularity ratios (0.52 and 0.37)[1] and perimeters (32.6 miles and 37.7 miles)

INVENTORY PHASE

NATURAL FEATURES

Topography: For both creeks the upland topography can be described as a gently rolling peneplain. Proceeding down the main streams of both creeks, the shallow, U shaped valleys in the upper reaches of the watersheds become steep ravines with prominent, dissected bluffs and precipitous cliffs.

Boone Creek, flowing for a distance of 16.9 miles, has a total elevation difference of 450 feet from its source to its confluence with the Kentucky River near Clay's Ferry. The cliff areas along Boone Creek extend for a total distance of 45,000

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[1]The circularity ratio is defined as the area of the drainage basin divided by the area of a circle whose circumference equals the perimeter of the drainage basin (54).

feet, 19,000 feet of which form a total of 9,500 feet or 1.8 miles of gorge. The cliffs range from 150 to 250 feet in height.

Jessamine Creek has a total elevation difference of 430 feet and is 19.2 miles long. The cliffs, from 200 to 300 feet high, total 56,400 feet in length. Cliffs, occurring on both sides of the creek, form gorges for a total distance of 13,000 feet or 2.5 miles.

Comparison of the two watersheds shows that Boone Creek is shorter and has less cliff area, less gorge area, and greater total relief than Jessamine Creek. Figures 17 and 18 are long profiles of each creek which indicate the relief, length of flow, and gradient. The topography of both watersheds is represented graphically on the respective Slope Maps.[1] The acreages of each watershed included in the various slope categories, as delineated on the Slope Maps, are listed in Tables 3 and 4.

[1] Maps for both watersheds are grouped in Appendix B.

TABLE 3

SLOPE CATEGORIES IN BOONE CREEK WATERSHED

Slope Categories	Symbol	Acreage	Percent of Watershed
0 - 10%	fmst	18762	68.8
10 - 20%	st	7664	28.0
> 20%	vst	597	2.2
Cliffs	C	273	1.0

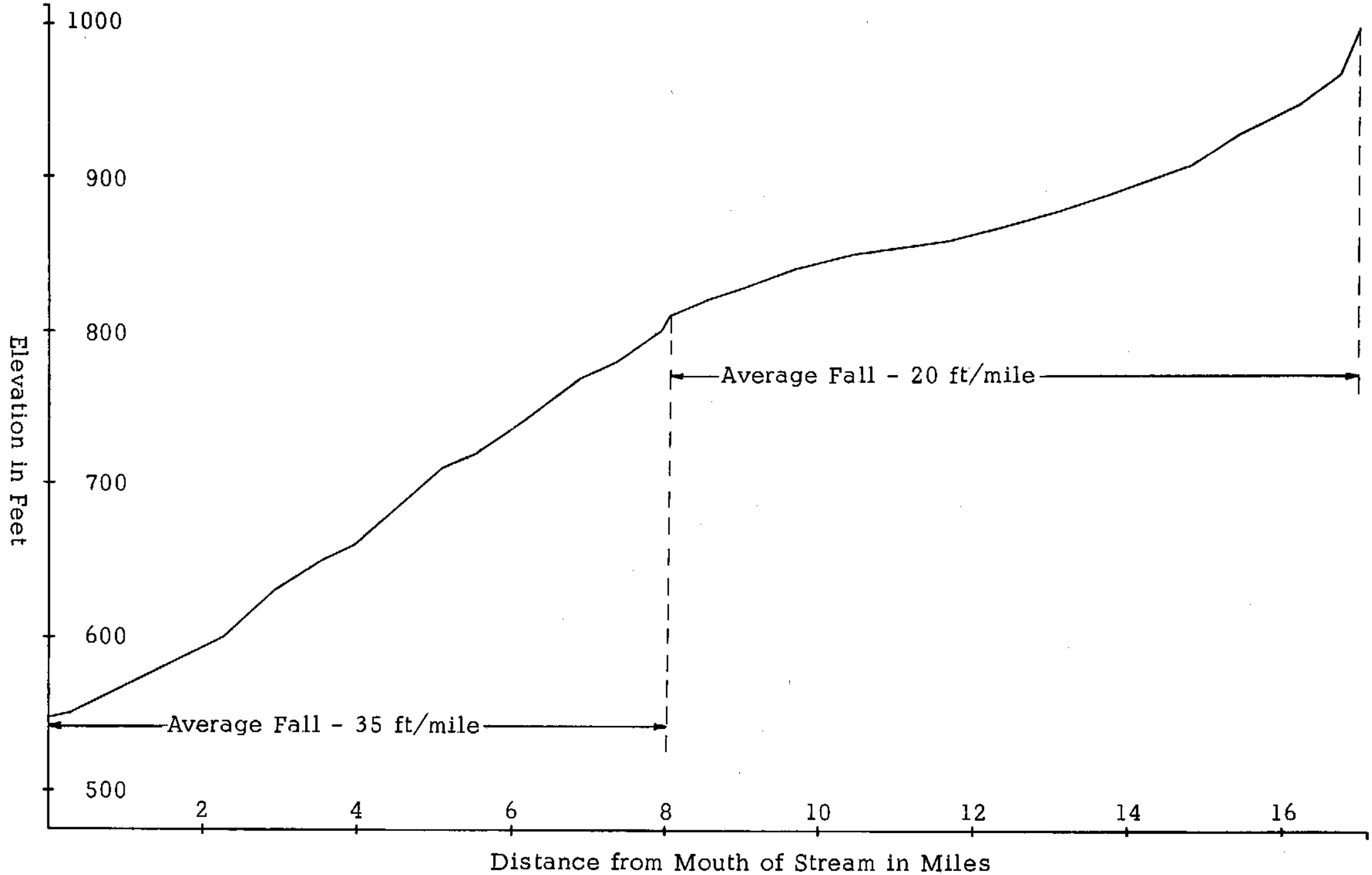

Figure 17. Long Profile of Boone Creek - Main Stream

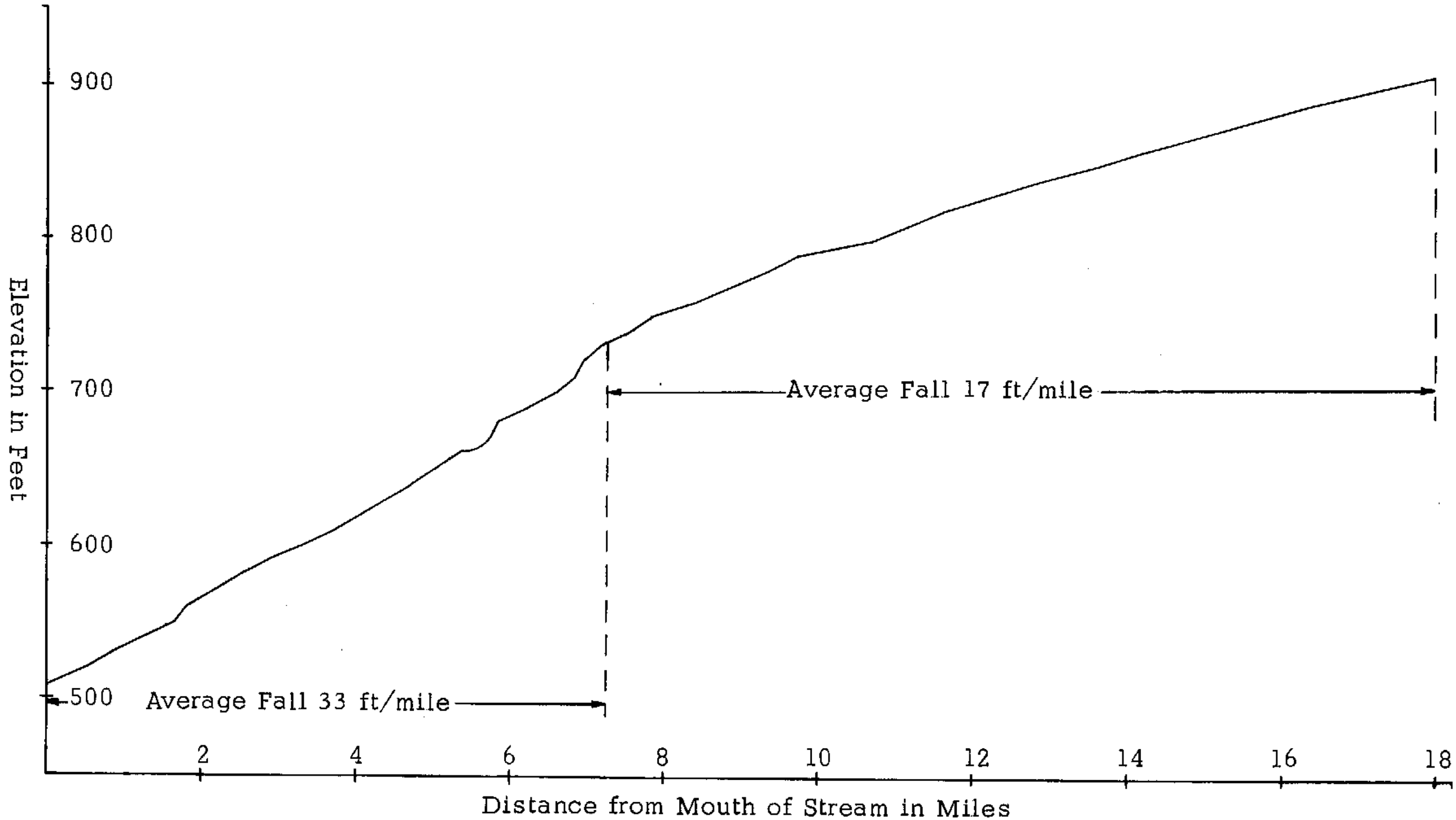

Figure 18. Long Profile of Jessamine Creek - Main Stream

TABLE 4

SLOPE CATEGORIES IN JESSAMINE CREEK WATERSHED

Slope Categories	Symbol	Acreage	Percent of Watershed
0 - 10%	fmst	21362	79.6
10 - 20%	st	4309	16.0
> 20%	vst	865	3.2
Cliffs	C	316	1.2

Geology: Both watersheds are underlain by sedimentary limestones of the Middle Ordovician Series formed during the Paleozoic Era. These formations, the oldest in the state, are estimated to be from 425 to 500 million years old.

The Middle Ordovician Series of limestones is further divided into the Cynthiana, Lexington, and Highbridge Groups, occurring as shown on the Geological Maps of the watersheds. It can be seen from these maps that the Cynthiana Group, the youngest of the three, occupies the higher elevations in the northern part of each watershed. The Lexington formation is the parent material for the remaining upland areas of each watershed. The parent material of the steep, rockland and gorge areas along each creek is of the Highbridge Group, the oldest of the three groups of limestones. Highbridge limestone is found at the lowest elevations of the watersheds. Although faults are common in the general area, none occur in the actual drainage basins.

Geologic formations of esthetic or recreational interest are located on the Resource, Transportation, Land Use, and Land Use

Capability Maps and are indicated by a numbered symbol ⬡ keyed to Tables 5 and 6 which give a brief description of these formations for both watersheds.

Pedology: According to "Kentucky Soils" (5), the upper portion of Boone Creek Watershed is located in the physiographic region known as the Inner Bluegrass. The lower section extends into an area termed the Hills of the Bluegrass. The primary soil associations found in these regions within the boundaries of the Boone Creek Watershed are the Hampshire-Mercer, Maury-McAfee-Salvisa, and the McAfee-Salvisa-Ashwood associations (72), (20).

TABLE 5

INVENTORY OF GEOLOGIC FORMATIONS IN BOONE CREEK WATERSHED

Map No.	Name or Identity	Description
2	Cave	Small cavern, situated high upon a scenic cliff wall. See figure 6b.
3 and 6	Rock Houses	Overhanging limestone with some cave-like aspects-good primitive camp sites.
4 and 7	Abandoned Meanders	These former stream beds have become grown over with trees, grass, and wild flowers and provide a unique naturalistic setting. See figure 4 e .
8	Waterfall	Cascading water down a steep tree-lined gorge. See figure 5b.

TABLE 6

INVENTORY OF GEOLOGIC FORMATIONS
IN JESSAMINE CREEK WATERSHED

Map No.	Name or Identity	Description
1	Chimney Rock	Extends approximately 40 feet upward from its base and is located halfway up a vertical cliff on Kentucky River opposite the mouth of the creek.
2	Overstreet Cave	Has a large entrance and is a natural bat habitat.
3 and 4	Waterfalls	Both are in scenic tree-lined gorges with the latter falling for a distance of 50 to 60 feet. See figure 5a.
5	Chrisman's Cave	Natural rock pillars appear at the small entrance. This cave is three or four miles long. See figure 6c.
9	" The Narrows "	Narrow precipitous ridge formed by an entrenched meander of the creek.
10	" Little Mountain "	A knob standing out separately from the surrounding cliffs.

The Hampshire-Mercer association consists for the most part of undulating deep, or moderately deep, well-drained or moderately drained soils on broad ridge tops and in shallow valleys, underlain by the Cynthiana limestone. Nearly all of these medium textured fertile soils have been cleared of trees and presently support large expanses of bluegrass pasture interspersed with cultivated fields and hayfields. Growing tobacco and raising livestock are the major farm enterprises, with some corn, truck crops, and fruit also being grown. The Unified Soil Classifications for the Hampshire-Mercer soils are mostly CL and CH with soaked CBR[1] values of four to fifteen (55).

The Maury-McAfee-Salvisa association occupies the gentle slopes on the broad ridgetops, the steeper slopes adjacent to drainageways, and the slopes around sinkholes in the uplands. These soils, usually high in phosphate, are deep or moderately deep, well-drained and occur over the Lexington limestone. Practically all areas of these soils produce high yields of pasture, burley tobacco, corn, small grains, and hay. The soaked CBR values range from three to fourteen with isolated values as high as twenty. The Unified Soil Classifications are ML-CL, CL, and CH.

The McAfee-Salvisa-Ashwood Association consists mostly of strongly to steeply sloping, droughty soils of the uplands. The shallow to moderately deep, clayey soils, underlain by Highbridge limestone, are deeply dissected by Boone Creek. Predominately steep slopes and nearness of bedrock to the surface make most soils of this association poorly suited for cultivation. Those areas not covered with trees are mainly used for pasture. In some instances, however, negligent or improper management has caused the grazing areas to become overgrown with weeds and bushes. The soaked CBR values are about the same as those for the Maury-McAfee-Salvisa association. The Unified Soil Classifications are MH, CL, and CH.

Rock Land generally occurs on slopes of twenty percent or more. The soils (Ashwood Soils Series), usually associated with rock land,

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[1]California Bearing Ratio; a measure of the shear strength of soil.

are shallow and have a low moisture-supplying capacity. Consequently only small economic returns are made on this land type by growing low quality hardwood and red cedar trees.

For the first three soil associations, the subsurface soils become very plastic and impervious when compacted. These are significant engineering characteristics for some types of recreation development and must be considered in planning such facilities.

The availability of ground water is also significant. As indicated by the USGS hydrologic maps for the area, drilled wells will not produce enough water for domestic purposes along either side of the main stream in the southern portion of the Boone Creek Watershed. This is also true of a very small area located in the northern part of the watershed. In the remaining area, drilled wells will produce a domestic water supply with a power pump and in most instances with a hand pump. The term "drilled well" refers to a well less than 100 feet deep. The water, however, is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

The soils found in the Jessamine Creek Watershed are the Maury, Salvisa, and Huntington series and Rock Land (1). Of these the Huntington series is the only one not previously discussed for the Boone Creek Watershed.

The Huntington series comprise the deep, well-drained soils of the bottom lands. Occurring in the bottom lands along the main creek and its major tributaries, this alluvial soil is easily tilled and is well suited for row and forage crops. The Unified Soil Classifications are CL or ML-CL.

Drilled wells will produce a domestic water supply in most of the watershed, the only exception being the area near the Kentucky River.

Generally the soils of the two watersheds are very similar in type, ground water availability, and engineering characteristics. The major differences are in the percentages of the drainage basin areas covered by corresponding soil associations. The soil types for both watersheds occur as shown and classified on the Soils Maps. Table 7 estimates the degree to which soil conditions affect land use capability and the development of various recreational facilities.

Hydrology: The dendritic pattern of drainageways for each creek may be described as well integrated, uniform, non-oriented, and of medium density (3.67 Mi/Sq.Mi. for Boone Creek and 3.58 Mi/Sq. Mi. for Jessamine Creek). A "Horton Analysis" and a "texture ratio" computation was made for each watershed. In the Horton analysis, the smallest streams having a topographic expression on 1:20000 scale aerial photographs were classified as first order streams. The stream order classifications are shown on the Stream Order and Vegetation Maps. The Horton analysis and texture ratios are summarized in Tables 8 and 9.

Both creeks are made up of a series of pools and riffles. The pools along Boone Creek range from 30 to 400 feet in length, 15 to 60 feet in width, and 3 to 7 feet in depth. The Jessamine Creek pools range from 60 to 250 feet in length, 20 to 70 feet in width, and 3 to 6 feet in depth. Some of the upstream tributaries in both watersheds disappear into sinkholes and reappear as springs. The pool inventories and location of "ever flowing" springs are presented on the Resource, Transportation, Land Use, and Land Use Capability Maps. Pools are distinguished by a numbered symbol (▭) and springs by a numbered symbol (⬡) . Numbers one and five (Boone Creek) and six and seven (Jessamine Creek) represent the respective spring locations. From the above it can be seen that

TABLE 7

ESTIMATED DEGREE OF SOILS LIMITATION FOR RECREATIONAL USES

Soil Associations	Soil Series	Land Use Capability Units*	Camping Uses: Transient Slope	Camping Uses: Transient Suitability	Camping Uses: Group Slope	Camping Uses: Group Suitability	Picnic Areas Slope	Picnic Areas Suitability
Hampshire Mercer Association	Hampshire	IIe-2 and IIIe-2	fmst	Good	fmst	Good	fmst	Good
	Mercer	IIe-6 and IIIe-8	fmst	Good	fmst	Good	fmst	Good
Maury, McAfee, Salvisa Association	Maury	IIe-1 and IIIe-1	fmst	Good	fmst	Good	fmst	Good
	McAfee	IVe-6 and	fmst	Good	fmst	Good	fmst, st	Good
		VIe-1	st	Poor	st	Poor		
	Salvisa	VIe-4 and IVe-6	fmst	Good	fmst	Poor	fmst	Good
McAfee, Salvisa, Ashwood Association	McAfee	IIIe-10	fmst	Good	fmst	Good	fmst, st	Good
		IVe-6 and VIe-1	st	Poor	st	Poor		
	Salvisa	IVe-6 and VIe-4	fmst	Good	fmst	Poor	fmst	Good
	Ashwood	VIs-1 and	fmst	Good	fmst	Poor	fmst, st	Good
		VIIs-2	st	Poor	st, vst	Unsuitable	vst	Unsuitable
			vst	Unsuitable				
Rockland		VIIs-5	vst, C	Unsuitable	vst, C	Unsuitable	vst, C	Unsuitable
	Huntington	I-1 and IIs-5	fmst	Good	fmst	Poor	fmst	Good

*See Appendix A.

TABLE 7 - Continued

Soil Associations	Soil Series	Trial Systems Bicycling Slope	Suitability	Horseback Riding Slope	Suitability	Auto Tour Routes Slope	Suitability
Hampshire Mercer Association	Hampshire	fmst	Good	fmst	Excellent	fmst	Good
	Mercer	fmst	Good	fmst	Excellent	fmst	Good
Maury, McAfee, Salvisa Association	Maury	fmst	Good	fmst	Excellent	fmst	Good
	McAfee	fmst	Good	fmst	Excellent	fmst	Good
		st	Unsuitable	st	Good	st	Poor
	Salvisa	fmst	Good	fmst	Excellent	fmst	Good
McAfee, Salvisa, Ashwood Association	McAfee	fmst	Good	fmst	Excellent	fmst	Good
		st	Unsuitable	st	Good	st	Poor
	Salvisa	fmst	Good	fmst	Excellent	fmst	Good
	Ashwood	fmst	Good	fmst	Good	fmst	Good
		st,vst	Unsuitable	st	Poor	st,vst	Poor
				vst	Unsuitable		
Rockland		vst,C	Unsuitable	vst,C	Unsuitable	vst,C	Unsuitable
	Huntington	fmst	Good	fmst	Excellent	fmst	Good

TABLE 8

HORTON ANALYSIS OF BOONE CREEK

Stream Order	Number	Length (Miles)	Percentage
I	294	81.76	50.21
II	76	35.93	22.26
III	18	19.56	12.01
IV	6	10.80	6.63
V	1	14.77	9.07

stream density = 3.67 miles /sq.mi.
stream frequency = 8.92 streams/sq.mi.
texture ratio = 2.00

TABLE 9

HORTON ANALYSIS OF JESSAMINE CREEK

Stream Order	Number	Length (Miles)	Percentage
I	290	76.59	51.00
II	80	33.11	22.04
III	20	17.93	11.93
IV	2	13.26	8.82
V	1	9.28	6.17

stream density = 3.58 miles /sq.mi.
stream frequency ≐ 9.60 streams/sq.mi.
texture ratio = 1.95

there is hydrologically very little difference in the two drainage systems.

Vegetation: The only extensive forests are located in the Highbridge limestone area of each watershed where the topography is such that the land cannot be easily farmed. These second and third generation forests, remnants of the southern hardwood forest, contain over fifty species of mixed hardwood types.

Of the total area in Boone Creek Watershed, only 1963 acres or 6.93 percent of the total is covered by trees. Intermixed with the forested areas are abandoned fields that through neglect or misuse have been taken over by bushes, vines, and briers. Abandoned fields cover 250 acres of 0.88 percent of the total area in the watershed.

The forests of Jessamine Creek Watershed cover 1418 acres or 5.38 percent of the total area with no significant areas of abandoned fields occurring.

The location, size, and density of these forests and a general indication of the tree types found in them are shown on the Stream Order and Vegetation Maps.

Many species of shrubs, vines, bushes, grasses, wildflowers, and other types of natural vegetation are found in these watersheds. Table 10 is a partial listing of the flora native to Boone and Jessamine Creek Watersheds as inventoried by Beckett (6), McFarland (33), and Guhardja (17).

Fish and Wildlife: Table 11 lists the common names of those species of fishes, mammals, reptiles, and birds native to the Boone and Jessamine Creek Watersheds. These lists are extracted from those compiled by Kuehne (26) and Funkhouser (12). When possible, the relative abundance of the species is also reported by the same symbols used for flora on Table 10. Other pertinent data on fauna

TABLE 10

SIGNIFICANT SPECIES OF FLORA FOUND IN THE BOONE AND JESSAMINE CREEK WATERSHEDS

Trees and Shrubs			
Red Cedar	C*	Common Elder	
Swamp Hickory	C	Kentucky Coffee Tree	F
Shumard's Red Oak	C	Yellow Chestnut Oak	C
Sycamore	C	Papaw	F
Wild Black Cherry	C	White Ash	F
Black Locust	C	Red Ash	I
Burning Bush	C	Blue Ash	F
Ash-Leaved Maple	C	White, Silver-Leaved Poplar	
Sugar Maple	C	Wild Hydrangea	
Ohio Buckeye	C	Witch Hazel	
Carolina Buckthorn	C	Red-Fruited Thorn	
Black Willow		Redbud	
Black Walnut	F	Prickly Ash	
Shagbark-Hickory	I	Silver Maple	
White Oak	I	Heart-Leaved Willow	
Mossey-Cup Oak	F	Pignut Hickory	
Slippery Elm		Big Shellbark Kingnut	
Hackberry	F	Ironwood	
Red Mulberry		Beech	
White Mulberry	R	Flowering Dogwood	
Wild Flowers			
Pokeweed	C	Whitlow Grass	C
Bouncing Bet	C	Early Saxifrage	C
Rocket-Larkspur	C	Midland Wild Senna	C
Pepperroot	C	Cream Violet	C

*When known, the relative abundance of the species is represented by the following:

R - Rare
I - Infrequent
F - Frequent
C - Common

TABLE 10 - Continued

Wild Flowers (Continued)			
Field-Pansy	C	Rock Cress	
Poison-Hemlock	C	Red Clover	
Queen Annes-Lace	C	Lady's Sorrel	
Parsnip	C	Pale Touch-me-not	F
Cotton Milkweed	C	Milkweed	F
Big-Root Morning Glory	C	Morning-Glory	
Horse-Nettle	C	Tall Ironweed	C
Motherwort	C	Rice-Grass	F
Mullein	C	Yellow Adder's-Tongue	F
Star Bellflower	C	White Dogs-Tooth-Violet	F
Ragweed	C	Nap-at-Noon	I
May-Weed	C	Knotweed	I
Frost Flower	C	Lady's-Thumb	F
Field Daisy	C	Bluebells	F
Chicory	C	Goldenrod	F
Jerusalem Artichokes	C	Honeysuckle	C
Dandelion	C	Common Winter-Cress	C
Kidneyleaf-Buttercup		White Sweet-Clover	C
Spring-Beauty	F	Tawny Day-Lily	
Devil's-Darning-Needle	I	Solomon-Plume	
Dwarf Larkspur	F	Catbrier	
Wood-Poppy	F	Lizard-Tail	
Dutchman's Breeches	I	Yellow Melitot	
Bitter Cress	F	Wood Geranium	
Cinquefoil	R	Cheese Mallow	
Climbing Buttersweet		Smooth Yellow Violet	
Violet		Dooryard Violet	
Waterleaf	F	Princes-Feather	
Dayflower		Wild Four-o'clock	
Wild Hyacinth	R	Starry Cerastium	
Garden Asparagus	R	Midland Isopyrum	
Jumpseed	F	Tall Meadow-Rue	
Black Bindweed		Woodland Phlox	
Squaw-Root		Spring Polemonium	
May Weed		Rosette Sage	
Tall Bellflower		Eastern Columbine	
Bloodroot	F	Shooting Star	
Penny-Cress	F	Great BlueLobelia	
Spring-cress			

TABLE 11

SIGNIFICANT SPECIES OF FISHES AND OTHER WILDLIFE
FOUND IN THE BOONE AND JESSAMINE CREEK WATERSHEDS

Fish Species	Stream Order 1	2	3	4	5
White Sucker			R	R	
Hog Sucker			R	C	R
Black Redhorse Sucker					R
Golden Redhorse Sucker					R
Stoneroller			C	C	C
Silverjaw Minnow			C	C	R
Big Eye Chub					R
River Chub					R
Rosyfin Shiner				R	C
Common Shiner				R	C
Silver Shiner					C
Rosface Shiner					R
Spotfin Shiner					C
Caged Shiner				C	C
Bluntnose Minnow			R	C	C
Creek Chub		C	C	C	C
Brook Silverside					R
Rock Bass				R	F
Longear Sunfish				R	R
Smallmouth Bass				R	F
Greenside Darter			R	R	R
Rainbow Darter			C	R	C
Fan Tail Darter			R	R	C
Johnny Darter			C	C	R
Arrow Darter			C	R	R
Blacksided Darter					R
Rainbow Trout*					R

*Stocked in Boone Creek only

TABLE 11 - Continued

Mammals	
Opossum	Mole Shrew
Rabbit	Brown Shrew
Jumping Mouse	Mole
Muskrat	Little Brown Bat
Field Mouse	Say's Bat
Deer Mouse	Red Bat
Ground-hog	Raccoon
Chipmunk	Skunk
Gray Squirrel	Mink
Fox Squirrel	Red Fox
Flying Squirrel	
Reptiles	
Snapping Turtle	Banded Water Snake
Musk Turtle (Rare)	Red-Bellied Water Snake
Box Turtle	Blacksnake
Fence Lizard	Fox Snake
Blue-Tailed Lizard	Green Snake
Common Garter Snake	Milk Snake
Ribbon Snake	Worm Snake
Queen Snake	Copperhead
Common Water Snake	
Birds	
Permanent Residents:	
Red-Bellowed Woodpecker	Kentucky Cardinal
Yellow-Hammar	Killdeer
Blue Jay	Turtle Dove
Crow	Buzzard
Meadow Lark	Chicken Hawk
English Sparrow	Cooper's Hawk
Goldfinch	Red-Tailed Hawk
Chipping Sparrow	Red-Shouldered Hawk
Field Sparrow	Sparrow Hawk
Towhee	Long-Eared Owl

TABLE 11 - Continued

Birds (Continued)	
Permanent Residents:	
Short-Eared Owl	Carolina Wren
Hoot Owl	Bewick's Wren
Screech Owl	Tufted Titmouse
Hairy Woodpecker	Carolina Chickadee
Southern Downy Woodpecker	Robin
Cedar Waxwing	Blue Bird (Rare)
Summer Residents:	
Red-Headed Woodpecker	Barn Sparrow
Whip-por-will	Rain Crow
Nighthawk	Belted Kingfisher
Chimney Swift	Red-Eyed Vireo
Ruby-Throated Humming Bird	Warbling Vireo
Kingbird	White-Eyed Vireo
Crested Flycatcher	Black and White Warbler
Phoebe	Yellow Warbler
Wood Pewee	Cerulean Warbler
Green Flycatcher	Kentucky Warbler
Cowbird	Maryland Yellow-Throat
Red-Winged Blackbird	Yellow-Breasted Chat
Orchard Oriole	Redstart
Baltimore Oriole	Mockingbird
Crow Blackbird	Catbird
Grass-Hopper Sparrow	Brown Thrasher
Indigo Bunting	Blue-Gray Gnatcatcher
Summer Tanager	Wood Thrush
Purple Martin	Pileated Woodpecker
Winter Residents:	
Yellow-Bellied Sapsucker	Song Sparrow
White-Throated Sparrow	Myrtle Warbler
Tree Sparrow	

have been presented by Caudill (7) and Slack (53). These latter two studies were made on the Isopoda and Amphipoda (two large orders of small Malacostracan crustaceans) and crayfish found in Boone Creek.

Climate: The climate of the Bluegrass Area can be described as "humid continental with warm summers" and is characterized by abundant precipitation, relatively long growing seasons, and a rather wide range of temperatures.

The annual average precipitation is 44.7 inches, distributed fairly evenly throughout the year. Late summer is normally the driest part of the year. Thunderstorms may occur at any time, but are most frequent from March through September. Occasionally, these storms are accompanied by hail; this happens, however, on the average of less than once a year.

Winds from the south and west prevail during most months of the year at average velocities of six to thirteen miles per hour with a maximum of thirty to forty miles per hour during storms.

For an average of at least fifty-two percent of the year sunshine prevails. The highest percentages of possible sunshine occur from May through October. The average temperature, precipitation, and percent possible sunshine are listed by month for the Bluegrass Area in Table 12. All data were taken from the records on monthly averages for state climate divisions (length of record thirty years) (76) and the United States Meteorological yearbooks (length of record fifteen years) (77).

CULTURAL FEATURES

Land Use and Land Use Capability: The land use and land use capabilities of each watershed were classified and symbolized by using

TABLE 12

CLIMATIC SUMMARY FOR THE BLUEGRASS AREA

Months	Temperature (F°)	Precipitation (in.)	Percent Possible Sunshine
January	35.9	4.99	40
February	37.5	3.87	45
March	44.6	5.02	54
April	55.5	4.13	56
May	64.8	4.12	66
June	73.4	3.86	68
July	76.7	3.97	73
August	75.5	3.39	71
September	69.4	3.06	69
October	58.4	2.61	63
November	45.4	3.79	48
December	37.1	3.81	40

adaptations of three different systems. Present land uses were classified by the interpretation of recent aerial photographs and were symbolized according to MacConnell's (31) system. Land use capabilities of the fringe areas around the urban communities in each watershed were determined by the method of classification suggested by Kiefer (25).

The remaining land use capability categories were determined by using the previously reported topographic, geologic, and pedologic information and are symbolized according to the USDA capability classification system (71). The land use and land use capability categories occur in each watershed as shown on the Resource, Transportation, Land Use, and Land Use Capability Maps; a solid boundary on the maps indicates present land uses, while a dashed boundary indicates land use capability or best potential use.

Tables 13 and 14 give the respective acreages and percentages of the total watersheds in each capability category.

These maps and tables actually represent a summary of a much more detailed land use analysis. They were extracted from drafting film overlays of fully interpreted aerial photographs. The amount of detail appearing on the maps and tables is that deemed to be sufficient for estimating the effects of land use and land use capability on the watershed's esthetic and recreational development potential.

Transportation Network: The transportation network of Boone Creek Watershed is highly developed. Interstate Highway 75, U. S. 25, and U. S. 60 are the major routes that cross the area. Interstate 64 also passes close to the headwaters of the creek. Most parts of the watershed are well connected by rural secondary roads and a high density of farm roads is present throughout the area. This suggests that nearly all sections of Boone Creek are reasonably accessible by automobile, especially if a limited amount of road construction were done. One railroad, the Chesapeake and Ohio, crosses the upper drainage basin in an east-west direction.

The Jessamine Creek Watershed contains no Interstate highways and has only two major routes crossing it; U. S. 27 and U. S. 68. State Routes 29, 39, and 169 are important local and intercounty roads. A high density of farm roads indicates that most sections of Jessamine Creek are accessible by car except for that area of few roads and rough topography near the lower portion of the creek. One major electric power transmission line and one railroad (the Southern) cross the watershed.

Comparison of the two transportation networks indicates that the Boone Creek Watershed has better roads and is generally more accessible, especially to important tourist routes. The Resource,

TABLE 13

LAND USE AND LAND USE CAPABILITIES
BOONE CREEK WATERSHED

Category	Acreage	% of Watershed
II and III	9535	33.64
III and IV	10294	36.32
VI	6385	22.52
VII	1539	5.43
Ind. and Com.	287	1.01
Res.	161	0.56
Res. and Com.	75	0.25
UC/UR*	64	0.22

*indicates present land use

TABLE 14

LAND USE AND LAND USE CAPABILITIES
JESSAMINE CREEK WATERSHED

Category	Acreage	% of Watershed
II and III	13519	50.35
III and IV	5657	21.07
VI	3890	14.49
VII	984	3.66
Res.	756	2.82
Ind. and Com.	395	1.47
Ind.	186	0.69
UC/UR*	1336	4.98
UED*	78	0.29
RG*	37	0.14
RA*	14	0.05

*indicates present land use

Transportation, Land Use, and Land Use Capability Maps present the transportation networks and road classifications.

Water Quality and Quantity: Boone Creek, having no cities located along its course, is generally free from pollution. The only possible pollution sources are farms, the Christian Church Camp, and the Iroquois Hunt Club. Jessamine Creek has two small urban areas (Wilmore and Nicholasville) located within the watershed, both of which discharge the effluent from their sewage treatment plants into the creek. The only other pollution sources along Jessamine Creek are farms. These present pollution sources on each creek have had little effect on physical water quality, but the existence of some visual pollution is made evident by the old cans, auto parts, tires, broken glass, and debris that litter the streams and their banks. Since neither creek contains any toxic substances and each has adequate dissolved oxygen and proper acidity even during periods of low flow, they provide a good habitat for fish and other aquatic life. These creeks are also generally free from long lasting turbidity, since the land in each watershed is mostly grassy pasture.

This pasture land however also promotes rapid runoff of surface water following rains and sometimes results in flash flood conditions in the streams followed by periods of reduced flow. At times, Boone Creek becomes almost dry except for a small trickle connecting the permanent pools of the stream. This condition is especially prevalent in the upper portion of the creek during the dry months of the year. Jessamine Creek, on the other hand, flows continuously throughout the year due to its spring fed origins.

Table 15 lists the low flow discharges, estimated high flows for several return periods, pH values, and dissolved oxygen content for both streams. The dissolved oxygen content and pH were

TABLE 15

SUMMARY OF WATER QUALITY AND QUANTITY
FOR BOONE AND JESSAMINE CREEKS

	Boone Creek	Jessamine Creek
Low flow discharge	0	10-20 cfs
Dissolved oxygen content	6-9.5 ppm	7.5-9.5 ppm
pH range	7.5-8	7.5-8
Estimate flood discharges		
10yr. return period	3335 cfs	3118 cfs
25yr. return period	3910 cfs	3655 cfs
50yr. return period	4370 cfs	4085 cfs

measured during low flow periods. The peak flows were estimated using a method developed by McCabe (32) and the low flows were observed during a recent dry period.

The difference in the dissolved oxygen content range for the two creeks is accounted for by the fact that, at the time the samples were taken, Jessamine Creek was flowing and Boone Creek was not. The small difference in estimated flood discharges is due to the difference in the areas of the watersheds.

History: Originally both Boone and Jessamine Creeks were within the territorial limits of Fayette County which at the time of its formation included the present counties of Bourbon, Clark, Woodford, Jessamine, and Fayette.

Boone Creek was named after Daniel Boone who in 1783 settled Boone Station, third settlement in Fayette County and located on the creek near present-day Athens. Among the early settlers in this watershed were David Watts and Richard Spurr who are supposed to have settled within the present limits of Athens about 1780 or 1781. However, the town of Athens, then known as Cross Plains, was not actually laid out as a village until 1826 (45).

Jessamine Creek was named after the Jessamine flower, which at that time grew in abundance along the banks of the creek. Along the upper portion of this creek lay a course commonly taken by hunters in traveling from Harrodsburg to the waters of the Licking River. The early settlers on Jessamine Creek were mostly German Protestants from Pennsylvania and Maryland. Many of their descendants still reside in the area.

In 1798 initial steps were taken to locate Nicholasville, the first town in the watershed. Nicholasville was named after the Honorable George Nicholas. It was located at its present site because of the existence of four large springs and the intersection of the early roads passing from Lexington to Danville and from East Hickman Creek to Jessamine Creek. Wilmore, the only other town in the watershed, was not started until almost 100 years later with the founding of Asbury College in 1890 (82).

Both creeks are rich in historical values. Locations of many of the old mills, homes, roads, villages, graves, etc. are shown by a numbered symbol (⬭) on the Resource, Transportation, Land Use, and Land Use Capability Maps and described in Tables 16 and 17 and some of the photographs in Chapter II (Figures 9 through 14).

Demographic and Socio-Economic: The demand for all types of recreational developments and activities depends on the size and socio-economic characteristics of the population of potential participants in the immediate area. The population of and approximate distances to the counties surrounding the Lexington urban area are given in Appendix D. The population of Lexington and Fayette County, subdivided into census tracts, is tabulated in Chapter IV.

TABLE 16

INVENTORY OF HISTORICAL VALUES IN THE BOONE CREEK WATERSHED

Map No.	Name or Identity of Area	Location	Description of Area
1	Log cabin ruins	Snyder's farm	The remains of this wooden structure stand amid scenic cliffs, cedars and wildflowers overlooking the Creek. See Figure 9c.
2	Mill Ruins	Snyder's farm	All that remains of the mill is a stone arch, an outline of the foundation, and a small portion of the dam abutment. The builder is unknown. See Figure 11d.
3	Cleveland-Rogers Home	Old Richmond Road	Erected in 1819 by Joseph and Jeremiah Rogers, the brick residence stands about fifteen to twenty yards due east of the Eli Cleveland Cabins which were built about 1786. See Figure 9b.
4	Grimes House	Grimes Mill Road	This is the finest old stone house existing in Fayette County and is situated on a high bluff overlooking the Creek. It was built in 1813 of stone quarried near the site by Charles Grimes. See Figure 9a.
5	Grimes Mill House	Grimes Mill Road	Built in 1803, the mill house has been restored and presently serves as a private clubhouse for the members of the Iroquois Hunt Club. See Figure 9f.
6	Grimes Mill Dam	Grimes Mill Road	The mill dam was destroyed by a flood in 1848 and was never restored. Remains of the dam exist on both sides of the creek and now provide a popular spot for loafing.

TABLE 16 - Continued

Map No.	Name or Identity of Area	Location	Description of Area
7	Gentry Mill House	Athens-Boonesboro Road	Referred to in history books as Pettit's Mill, the house is used as a cafeteria for the Blue Grass Christian Church Camp. See Figure 9e.
8	Gentry Mill Dam	Athens-Boonesboro Road	Restored in semi-arched form with a sluice gate in the middle. The dam was rebuilt to provide a swimming pool for campers at the Christian Church Camp which now owns the site. See Figure 10c.
9	Historical Marker	Athens-Boonesboro Road	Indicates the location of Boone's Station, established in 1779. See Figure 14c.
10	Village	Athens	Very old row houses. See Figure 14a.
11	Boone Creek Baptist Church	Athens	Organized between 1785 and 1790 by Elders Taylor and Tanner, the church has been rebuilt at least three times.
12	Old Graves	Athens	Small Boone cemetery with the graves of Israel, Edward, Samuel, Sarah Day, and Thomas, who were: the son of Daniel, brother of Daniel, brother of Daniel, wife of Samuel, and the son of Samuel and Sarah, respectively. See Figure 14d.
13	Cleveland Road	Southwest Portion of the Watershed	One of the first roads through the Boone Creek Watershed, it was then considered to be a high quality turnpike.

TABLE 16 - Continued

Map No.	Name or Identity of Area	Location	Description of Area
14	Watt's House	Just off the Cleveland Road	A distinctive, two story log house, somewhat restored. It was built about 1790.
15	Hayes House	Corner of the Cleveland and Sulphur Well Roads	Built in 1854, the small portico has octagonal stone piers incorporated with traceried tudor arches and railing around the upper deck.
16	Woodstock	Below intersection of the Todd's and Cleveland Roads	A restored, story-and-a-half, brick house containing large drawing and dining rooms was built in 1812 with the west wing being added in 1820.
17	McCann House	Todd's Road	A typical, two storied, rectangular, frame, house probably begun by Neal McCann about 1797 .
18	Rock Quarry	Grimes Mill Road	The stone for Henry Clay's Monument in the Lexington Cemetery was quarried at this site.

TABLE 17

INVENTORY OF HISTORICAL VALUES IN THE JESSAMINE CREEK WATERSHED

Map No.	Name or Identity of Area	Location	Description of Area
1	Glass Mill House	Figg Lane	Built here in 1782 by John Lewis, it is the oldest mill in the county. Only the foundation and a stone wall along side of the mill house remain today.
2	Glass Mill Dam	Glass Mill Road	The restored, stone dam supporting a large pool of water is a popular and ideal spot for fishing, swimming, picnicking, and loafing, presently owned by John Conway. See Figure 10a.
3	Stone Arch Bridge	Glass Mill Road	Old stone arch bridge, a good example of the diminishing art of wet stone masonry. See Figure 13b.
4	Glass Mill Dam	Glass Mill Road	Site of the original mill dam. The dam is intact today except for a large hole through the cliff-side abutment. The millrace is virtually intact. See Figure 12b.
5	Crozier's Mill	About one mile above Glass Mill	Half stone and half wood, the mill was built by David Crozier. Part of the stone walls still stand. See Figure 11c.
6 and 7	Stone Arch Culverts	Glass Mill Road	One of several old stone arch culverts along the Glass Mill Road. They are replicas of the above mentioned multiple arch bridge.

TABLE 17 - Continued

Map No.	Name or Identity of Area	Location	Description of Area
8	Grow's Mill	About two miles upstream from Glass Mill	Since no evident remains could be found, the exact location of the mill is questionable, however, the site is located as shown in an old atlas of the county.
9	Old Grave and Tombstone	Just off U.S. 68 in Western portion of the watershed	Although the evidence is not conclusive, it is thought that this is the grave of Joseph Drake, the son of the 4th Baronet, also named Sir Francis Drake after his illustrious forebear.
10	Chaumiere Du Prairie	Catnip Hill Road	One of the most beautiful and attractive country estates in America, it was established in 1796 by David Meade.
11	Stone Arch Culvert	Figg Lane	Another of the matching culverts, near the remains of the Glass Mill House. See Figure 13d.

Socio-economic characteristics of the population influence the demand for specific recreational activities. Age, occupation, and income levels have been found to be the most important of these characteristics (69, p. 14), and they are tabulated for the Lexington-Fayette County Area and compared to the corresponding average U. S. characteristics in Table 18. In these tabulations the term "white collar workers" includes those in professional, technical, managerial, clerical, and other sales occupations while "blue collar workers" includes craftsmen, foremen, operaters, private household, and other personal service workers, and laborers (common laborers and farm foremen).

The above data are subsequently used in Chapter IV in the derivation of a visitation prediction equation, the estimation of future demand for recreation in the Lexington area, and an analysis of the possible economic and esthetic benefits to be accrued from recreational development and preservation of the study watersheds. The analyses of Chapter IV are included as a logical extension of the evaluation methodology and would form the basis for justifying implementation of developmental and/or preservational proposals.

Also of importance are existing recreation facilities. At present, there are in the Lexington-Fayette County area 39 public parks, containing a total of 505 acres of land, to serve the recreational needs of 155,000 people. This amounts to about 3.2 acres for each 1000 people in the area. Since the accepted minimum standard is 10 acres for each 1000 people (10, p. 147), the scarcity of recreational facilities is apparent. Existing outdoor recreation facilities in each watershed are shown on the Resource, Transportation, Land Use, and Land Use Capability Maps by a numbered symbol (☐) and are described in Tables 19 and 20. The facilities

TABLE 18

SUMMARY OF POPULATION CHARACTERISTICS OF THE LEXINGTON-FAYETTE COUNTY AREA

	AGE		
	Percent of Population in Age Classes		
	15-29	30-44	45 and over
Fayette County (local area of influence)	22.7	20.7	27.3
U. S. Average	19.5	20.2	29.1
	OCCUPATION		
	Percent of employed who are		
	White Collar		Blue Collar
	Professional	Other	
Fayette County (local area of influence)	14.7	35.0	50.5
U. S. Average	11.2	33.8	55.0
	INCOME		
Fayette County Median Family Income	$5377		
U. S. Median Family Income	$5660		

Source: (73, 74).

listed for the Boone Creek Watershed are for the most part private clubs and are used only by the members. Consequently they do very little to offset the scarcity of public facilities.

Present Recreational Use of Small Streams: In an attempt to obtain some measure of the informal recreational use of Boone and Jessamine Creeks, persons encountered during randomly scheduled walks along each stream were interviewed. Most of these people were encountered during the weekends, and more than 95 percent of

TABLE 19

RECREATION DEVELOPMENTS LOCATED IN
BOONE CREEK WATERSHED

Map No.	Name or Identity	Description
1	Iroquois Hunt Club	A place of leisure, swimming, socializing and fox hunting. See Figure 9f.
2	Riding School	Located on a scenic farm with large barns and stables
3	Private picnic grounds	Contains two tables, and one large double grill.
4	Christian Church Camp	Available facilities include a swimming pool, four large cabins for sleeping, and a mess hall. See Figure 15c.

TABLE 20

RECREATION DEVELOPMENTS LOCATED IN
JESSAMINE CREEK WATERSHED

Map No.	Name or Identity	Description
1	Picnic grounds	Facilities include three tables and two grills. 75 cents and 50 cents per person are charged for picnicking and fishing respectively. See Figure 15a.
2	Golf course	Nine hole golf course operated by Asbury College.

them came from distances less than 15 miles. During the period from the latter part of May to the beginning of September, 1967, 127 people were interviewed on Boone Creek and 87 on Jessamine Creek. Results of these interviews are presented in Figures 19 through 26 according to age group, income levels, activities, and occupation.

Questionnaires were also mailed to all Boy Scout, Cub Scout, and Explorer Troops in the immediate area. These questionnaires were worded not only to determine the informal recreational use by these groups of Boone and Jessamine Creeks but also for Clear and Hickman Creeks. Of the 182 questionnaires mailed only 40 (22 percent) were returned. Of the 40 returned only 25 percent indicated that they visited any of the four mentioned creeks. Table 21 gives a summary of these mailed questionnaires. As indicated by the questionnaires, these groups participated mostly in camping and hiking activities.

It is apparent that both Boone and Hickman Creeks are visited by the Boy Scouts more than are Clear and Jessamine Creeks. This is probably due to the relative nearness and accessibility of these creeks to the urban area.

TABLE 21

SUMMARY OF THE BOY SCOUT QUESTIONNAIRES FOR ALL FOUR CREEKS

Creeks	Range of Activity Days for Camping and Hiking
Boone Creek	315 to 450
Jessamine Creek	40 to 60
Hickman Creek	380 to 515
Clear Creek	40 to 100

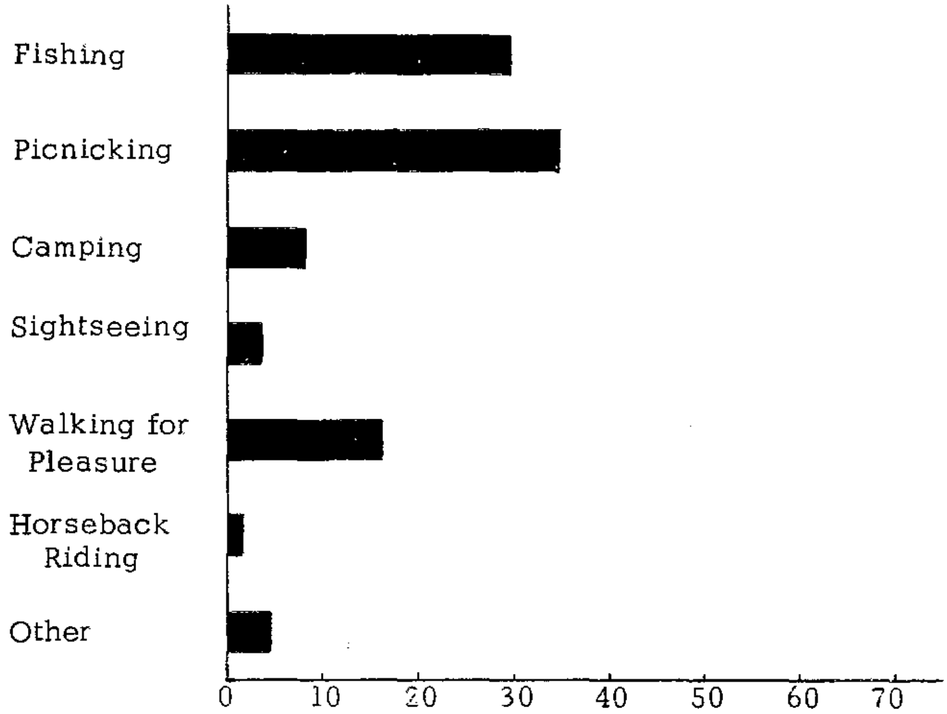

Figure 19. Percent of Informal Participation at Boone Creek by Activity for User Sample

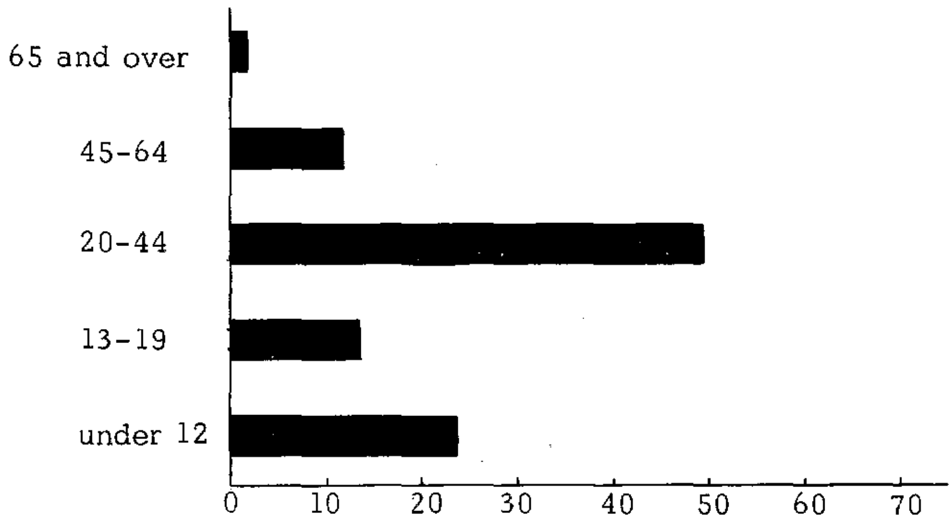

Figure 20. Percent of Informal Participation at Boone Creek by Age Group for User Sample

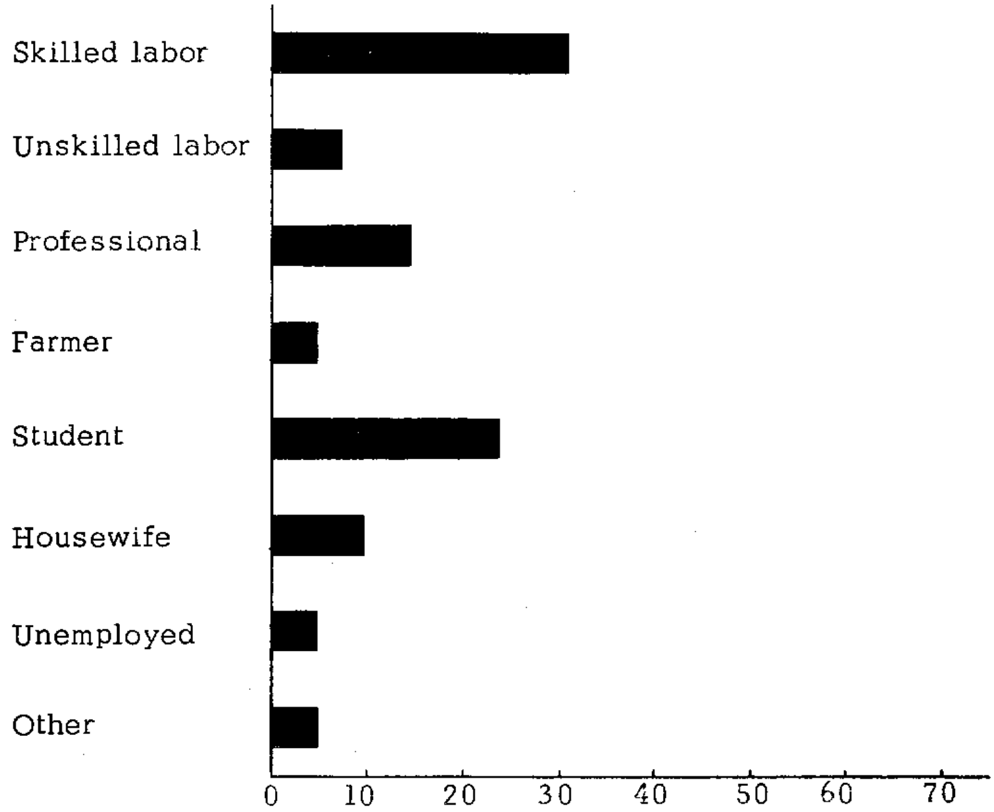

Figure 21. Percent of Informal Participation at Boone Creek by Occupation for User Sample

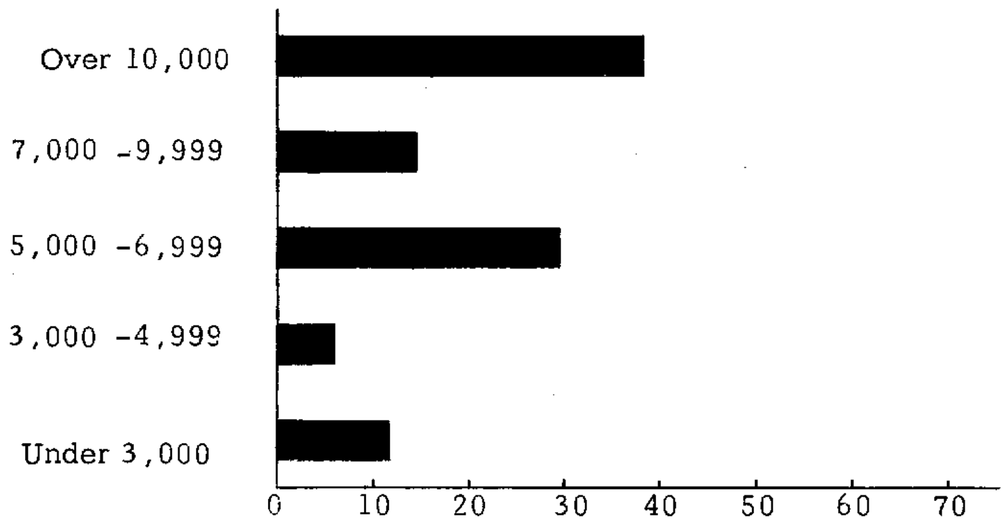

Figure 22. Percent of Informal Participation at Boone Creek by Income Level for User Sample

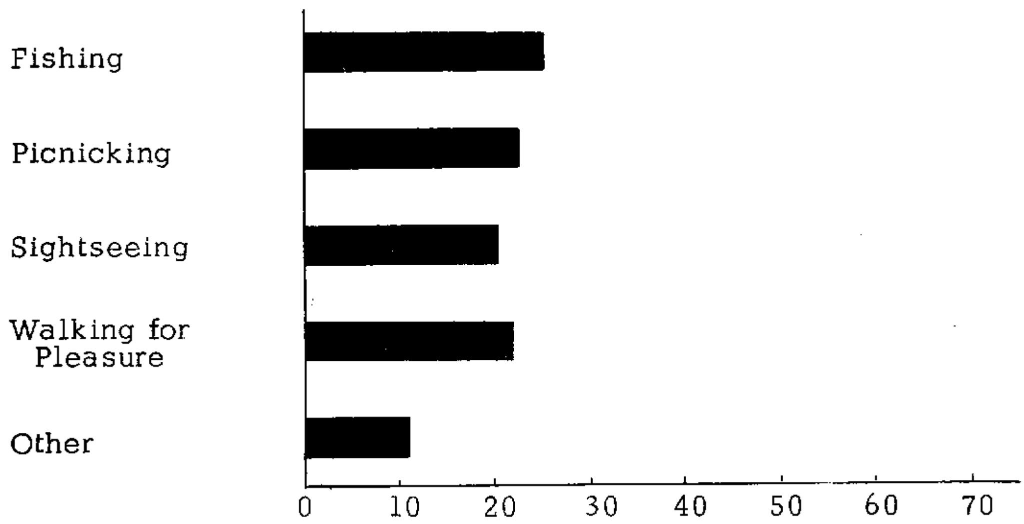

Figure 23. Percent of Informal Participation at Jessamine Creek by Activity for User Sample

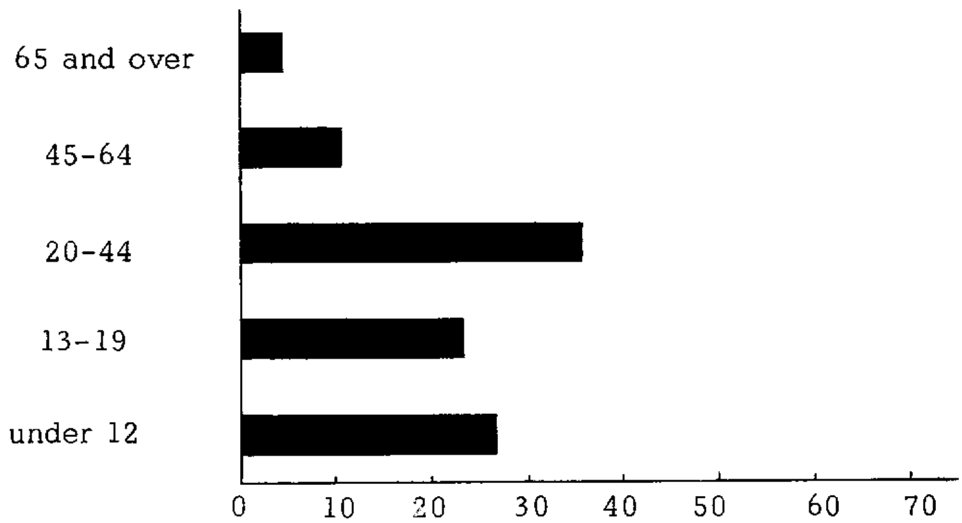

Figure 24. Percent of Informal Participation at Jessamine Creek by Age Group for User Sample

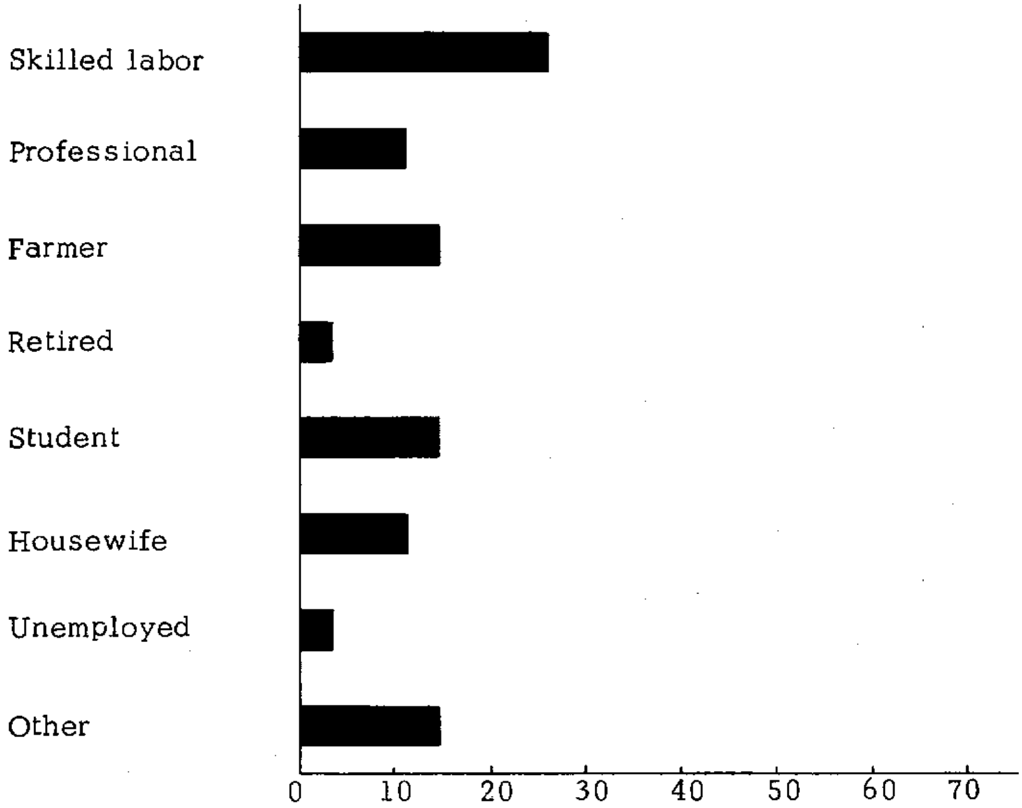

Figure 25. Percent of Informal Participation at Jessamine Creek by Occupation for User Sample

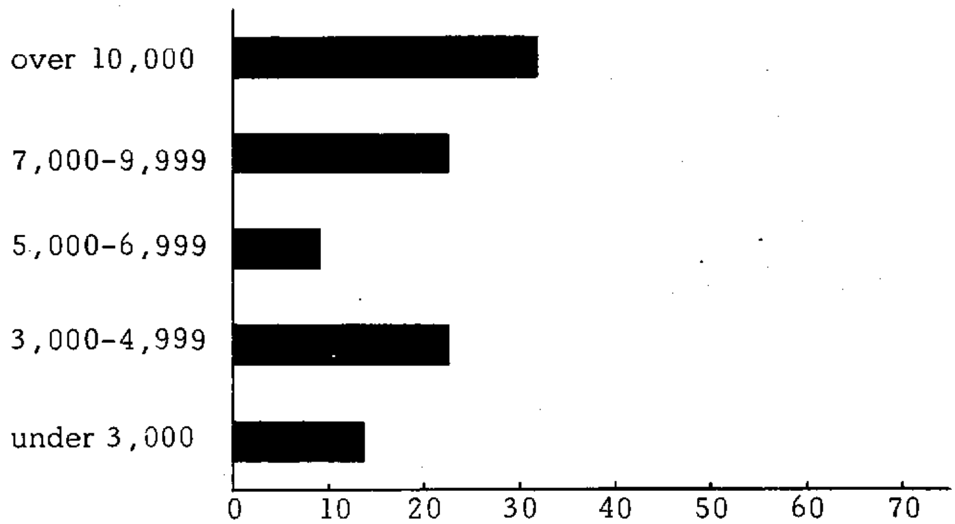

Figure 26. Percent of Informal Participation at Jessamine Creek by Income Level for User Sample

In general, the majority of people interviewed and most of the questionnaires received from the Scout groups indicated a desire for the preservation of the naturalistic qualities of the streams and implied that only moderate development of recreational facilities should be undertaken in these watersheds. Several suggestions were made by the people and groups questioned as to the type of development needed and ways of protecting the natural qualities in the watersheds. Some of these suggestions were considered in preparing the preliminary development plans for Boone and Jessamine Creeks. Sketch maps showing development possibilities are at the end of this chapter.

Disvalues and Land Husbandry: Disvalues found in both watersheds are shown on the Resource, Transportation, Land Use, and Land Use Capability Maps and are described in Table 22. The rural slums

TABLE 22

DISVALUES LOCATED IN BOONE AND JESSAMINE CREEK WATERSHEDS

Map No.	Location	Description
1	Boone Creek	Private privy and dump on edge of creek. See Figure 16e.
1	Jessamine Creek	Community dump at the narrows. See Figure 16c.
2	Jessamine Creek	Rural slums in "the pocket"
3 and 4	Jessamine Creek	Auto graveyards
1	Jessamine Creek	Sewage disposal plant at Wilmore empties effluent into tributary of Jessamine Creek.
2	Jessamine Creek	Sewage disposal plant at Nicholasville empties effluent into Town Fork (tributary of Jessamine Creek).

and dumps are identified by a numbered △ and the sewage disposal plants by a numbered ⏢. Land husbandry values are also located on the same maps and are identified by a numbered ⌔. Most of the recorded land husbandry values are well-kept farms.

ANALYSIS AND EVALUATION PHASE

Using the method developed and described in the latter part of Chapter II, the esthetic and recreational potential for the selected activities and areas was computed for each watershed. The numbers found which express the potential for a particular type activity or area were converted to percentages so that a comparison of the various potentials could be more easily made. Based on percentages, the relative degrees of potential are assumed to be:

Low potential	0-33%
Medium potential	34-66%
High potential	67-100%

A summary of the potentials for both watersheds is found in Table 23. The detailed calculations of these potential ratings or "scores" are in Appendix C.

As a further test of the developed methodology, potential ratings (also presented in Table 23) were calculated for camping, a trail system, picnicking, nature walks, walking for pleasure, and natural areas in the Hickman and Clear Creek Watersheds.[1]

Due to the relatively small percentages of land in Classes VI, VII, VIII, and in forest, the potential values for the four watersheds fall generally within the medium potential range. None of the

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[1]The data used were obtained from the results of a semester problem performed during the Spring Semesters of 1967 and 1968 by University of Kentucky seniors and graduate students in C.E. 521 (Engineering Aspects of Surficial Soils and Landforms).

TABLE 23

SUMMARY OF ESTHETIC AND RECREATIONAL POTENTIALS

Recreational Activities or Areas		Boone Creek	Jessamine Creek	Hickman Creek	Clear Creek
Camping	Primitive	55%	51%	55%	49%
	Transient	72%	59%	71%	58%
	Group	65%	64%	64%	63%
Fishing	Pan and Rough	74%	74%	-	-
	Game	75%	71%	-	-
Picnicking		63%	56%	61%	55%
Trail System	Hiking	54%	48%	49%	46%
	Horseback Riding	63%	62%	62%	61%
	Bicycling	65%	67%	64%	66%
	Auto Tour Routes	59%	53%	60%	58%
Esthetic Enjoyment	Sightseeing	62%	54%	-	-
	Nature Walks	34%	47%	33%	46%
	Walking for Pleasure	50%	50%	48%	48%
Natural Scenic and Historic Areas	Natural Areas	44%	43%	44%	40%
	Scenic Areas	46%	44%	-	-
	Historic Areas	67%	46%	-	-

potential values was in the low range. Several, however, were in the high potential range indicating that these watersheds offer medium to high esthetic and recreational potential for the selected areas and activities. The highest potentials found were those for fishing, which is due primarily to the present high quality of the aquatic habitat afforded by these streams. Due to their accessibility to major travel routes, the potentials for transient camping in both Boone and Hickman Creek Watersheds were in the high range. Since many of the activities and areas were generally not restricted or limited to one specific part of the watersheds, their potentials fell near the dividing point between the high and medium potential ranges. These activities and areas include bicycling, group camping, horseback riding, sightseeing, and historic areas. The lowest potentials were those for nature walks and natural areas. These potentials were low mainly because of the small percentages of land in capability classes VI and VII, abandoned fields, and forest.

Based on the potential ratings, Boone Creek Watershed has the best potential for possible development and preservation with Hickman, Jessamine, and Clear Creek Watersheds following in that order. It is reasonable to expect that the potentials would be much higher for the same activities, if the methodology was applied to selected small park sites along each creek. This is demonstrated in the next section of this chapter.

PRELIMINARY DEVELOPMENT PLAN

As an illustration of the practical use of the above evaluations, preliminary sketch plans were prepared to show some of the possibilities for development in the Boone and Jessamine Creek Watersheds. These sketches outline proposed areas along each creek which are thought to be suitable for a park type development, a proposed trail system within and connecting these areas, and auto and bicycle tour routes along the existing road network. The areas and routes selected in each watershed are shown on the Preliminary Development Plans in Appendix B. The boundaries around the suggested areas for development have little meaning other than to generally locate the areas. For both watersheds a brief description of the areas, trails, and auto tour routes, and their points of interest are presented in Tables 24 through 26.

For an example application of the evaluation procedure to small individual sites, one of the possible park type areas was

TABLE 24

BOONE AND JESSAMINE CREEK SUGGESTED DEVELOPMENT AREAS

Areas	Acreage	Description
BOONE CREEK		
A	244	Of this area, covering the lower portion of the creek, approximately 9.2 acres is suitable for picnic tables, grills, and other facilities which require relatively flat land. The significant natural features in the area are two abandoned meanders, two rock houses, a spring, several large fishing pools, picturesque gorge areas, a small waterfall, and various species of flora and fauna. Significant historical features include the Cleveland-Rogers Home, the Snyder Cabin, old mill ruins, and stone fences. This area is well suited for picnicking and camping, particularly primitive and transient.
B	400	Generally, this area is bounded by the Grimes Mill Road, McCalls Mill Road, and Ky. 418. Since the land is not as steep as that in Area A, about 40 acres of good bottom land exists and is well suited for picnic tables and grills, or primitive and group camping. The largest fishing pool on Boone Creek, about 400 feet in length, is included in this area along with three forested gorge areas (tributaries of Boone Creek).
JESSAMINE CREEK		
C	387	Area C, located at the mouth of the creek, includes 40 acres of excellent bottom land

TABLE 24 - Continued

JESSAMINE CREEK - Continued		
Areas	Acreage	Description
		along the Kentucky River and Jessamine Creek gorges, which might be used for picnicking and primitive or group camping. Several excellent fishing pools and a variety of flora and fauna are found along the creek.
D	338	Points of interest in this area are Chrisman's Cave, a number of springs emerging from crevices in the limestone cliffs, and the "Narrows," an unusual erosional landscape. Fifteen acres of the area is well suited for picnicking and primitive camping.
E	53	Located above Glass Mill, this area's major attraction is the ruins of Crozier's Mill. Surrounding the mill site are ten acres of bottom land suited for picnicking and/or camping (primitive and group).

chosen from each watershed. Areas A (Boone Creek) and D (the "Narrows," Jessamine Creek) were selected, and the recreational potentials for camping and picnicking were calculated for these areas. The results are shown in Table 27. As expected the computed potentials are in the high range, especially for the primitive and transient camping activities. Lack of sufficiently detailed data prevented the determination of the potential scores for the other appropriate activities and areas listed in Table 2. However, it is reasonable to assume that, due to the relative increase in the heavily weighted rating factors such as percentage of class VI and

TABLE 25

BOONE AND JESSAMINE CREEK TRAIL SYSTEM
FOR WALKING, HIKING, AND HORSEBACK RIDING

BOONE CREEK		
Trail No.	Miles	Description
1	5.1	Beginning at its junction with Trail No. 2 just above the first abandoned meander, Trail No. 1 follows the creek passing by a rock house and waterfall in Area A. Continuing up the creek, it passes Grimes Mill House (Iroquois Hunt Club) and connects Areas A and B. In Area B, it makes a loop, following Boggs Fork, McCalls Mill Road, a farm track back to Boone Creek, and finally down the creek to Boggs Fork again.
2	3.7	Trail No. 2, beginning at the Snyder House, makes a loop around the first abandoned meander, passing an old mill ruins and the Synder Cabin. Following the creek towards the mouth, it leads past a natural rock house, then cuts across the uplands along a farm track to the Grimes Mill Road. It follows this road until it junctions with Trail No. 1 just above Grimes Mill.
3	0.2	This trail is a small side trail of Trail No. 1 making a loop around the second abandoned meander. This meander is heavily forested and is covered by a carpet of wildflowers during the spring.
4	2.4	Trail No. 4, making a loop in the western part of Area B, follows Grimes Mill Road, cuts across upland fields to Boone Creek, where it meets Trail No. 1. It then travels upstream by the large fishing pool and joins with the other leg between Grimes Mill Road and the creek.

TABLE 25 - Continued

JESSAMINE CREEK		
Trail No.	Miles	Description
1	7.2	Beginning at the Handy's Bend Road, this trail follows a farm track along the Kentucky River Gorge, down the steep cliffs to the mouth of the creek. Here it crosses a log bridge, continuing up the creek past Overstreet Cave, a high waterfall, and "little mountain" to Area D. In Area D, it passes Chrisman's Cave and runs along the ridge of the "Narrows" to Figgs Lane. Following Figgs Lane to the Glass Mill Road, it passes Glass Mill Dam (Restored) and crossing a stone arch bridge, it forms a connecting link between the three proposed development areas. In Area E, the trail makes a loop, going past the Crozier's Mill ruins and down the creek again to Glass Mill.
2	0.9	This trail, forming a "Y" with Trail No. 1 near the Kentucky River, cuts across the upland fields to a tributary of the creek, then follows a tributary to Jessamine Creek, where it again joins Trail No. 1 just above Overstreet Cave.
3	2.0	A side trail of Trail No. 1, this trail, beginning at the log bridge above the creek's mouth, runs up the Kentucky River, cuts across the open fields on the ridges, and down a small tributary to the main stream joining with Trail No. 1.
4	4.5	Trail No. 4 begins at the Overstreet Cave. It runs around "little mountain," up Corman Lane by several farm houses, and down a tributary to Jessamine Creek. Here it junctions with Trail No. 1 at the "Narrows".

Portions of the trails in both watersheds are well suited for nature walks, casual strolls (walking for pleasure), hiking, and horseback riding. Horseback riding would probably be limited to Trails No. 1, 2, and 4 (Area B) in Boone Creek Watershed. In the Jessamine Creek Watershed horseback riding would be limited to Trails No. 1 (Area C, and between the "Narrows" and Area E) and 3.

TABLE 26

BOONE AND JESSAMINE CREEKS
AUTO AND BICYCLE TOUR ROUTES

BOONE CREEK		
Route	Miles	Description
1	10.5	In the lower part of the watershed, beginning at the Athens-Boonesboro Interchange on I-75, follow Ky. 418 southeast, approximately 4 miles through historic Athens, and past Gentry Mill (Blue Grass Church Camp) to the Grimes Mill Road. Follow Grimes Mill Road through the Boone Creek gorge area past Grimes Mill and Grimes House to U.S. 25 (4 miles). Take U.S. 25 southeast (2.5 miles) past the old Cleveland-Rogers Home and Cabins to Interstate 75 above Clays-Ferry. Just before the interchange, a scenic view of the Boone Creek cliffs and abandoned meander may be seen.
2	10.2	In the upper part of the watershed, Route No. 2 begins at the interchange on I-64 north of the watershed and follows Ky. 859 south (1.5 miles) to U.S. 60. Then take U.S. 60 west (1.0 miles) to the Cleveland Road (one of the first built in the watershed) and follow it south (3 miles) to the Todds Road (another early road) at Nihizer-town. Take the Todds Road west (2.1 miles) past Woodstock and McCann Houses to Pine Grove. Here the Combs Ferry Road can be taken north (1.6 miles) to U.S. 60 and finally a 1.0 mile jog west along U.S. 60 to Ky. 859 finishes the loop. Other points of interest are the well-kept cattle and horse farms along this loop.

For those wishing to travel both loops, the Cleveland Road is a connecting link between the loops. Points of interest along or near this road are the Hayes House, Watts Cabin, Boone Family Graves, and the Boone Creek Baptist Church.

TABLE 26 - Continued

JESSAMINE CREEK		
Route	Miles	Description
1	23	Route No. 1 is formed in the watershed by the Catnip Hill Road, U.S. 27, U.S. 68, and Route 1268. Starting at the junction of the Catnip Hill Road and U.S. 27, follow the Catnip Hill Road west (3 miles) past Chaumiere du Prarie to U.S. 68. Follow U.S. 68 southwest (7 miles) past Asbury College to Route 1268 in the town of Wilmore. Take Route 1268 west (5 miles) passing through the Jessamine Creek gorge, by Glass Mill Dam and pond, over a stone arch bridge, and near to Chrisman's Cave and Crozier's Mill Ruins to U.S. 27. Follow U.S. 27 northeast (8 miles) back to the Catnip Hill Road which completes the loop. Other points of interest along this route are stone fences, old homes, and well-kept cattle and horse farms. Of particular interest is the Almahurst Horse Farm on U.S. 68.

All of these routes are well suited for automobiles, however, due to steepness, only certain portions are suited for bicycling. Bicycling would probably be limited to the Todds Road and Combs Ferry Road (Route No. 2) and to Ky, 418 and parts of the Grimes Mill Road (Route No. 1) in the Boone Creek Watershed. The Cleveland Road, connecting Routes No. 1 and 2, is also well suited for bicycling. In the Jessamine Creek Watershed bicycling would be limited to the Catnip Hill Road and parts of Route 1268. In either watershed it would be feasible to extend the mentioned routes over other existing back roads and farm tracks to obtain a better connecting network of bicycle trails or routes.

TABLE 27

POTENTIAL CAMPING AND PICNICKING SCORES FOR AREA A AND D IN BOONE AND JESSAMINE CREEK WATERSHEDS

Recreational Activity		Boone Creek Area A	Jessamine Creek Area D
	Primitive	79%	85%
Camping	Transient	85%	71%
	Group	69%	75%
Picnicking		74%	67%

VII land, etc., the scores for scenic areas, natural areas and nature walks would be much higher than those obtained for the entire watershed.

LAND ACQUISITION AND PROPERTY OWNERS OPINION SURVEY

It is obvious that to maintain any natural or scenic areas or recreational developments along these creeks there would have to be some protection provided against the effects of land misuse and environmental pollution by zoning, scenic easements, governmental tax relief policies, outright purchase or other means. For this reason, it would be desirable for the state or county to purchase or preserve by obtaining scenic easements all of the class VII land adjacent to the streams for their entire length. This would amount to about 1500 acres and 1000 acres respectively for Boone and Jessamine Creeks (see the Resource, Transportation, Land Use and Land Use Capability Maps for the two watersheds).

The major problem in applying any land acquisition procedure or protective measure is the reluctance of the property owner to have his land used for public recreation. To evaluate the significance of this problem in the case studies the property owners whose land adjoined the main streams of Boone and Jessamine Creeks were interviewed. The Owner's Questionnaire (Appendix A) was used as a guide. The purpose of these interviews was to determine the attitude of the owners toward having their land use for recreational purposes. The results indicated that the owners along Boone Creek were definitely against the use of their land for public purposes (particularly by the Federal Government), while the people along Jessamine Creek felt the opposite way. This difference of opinion can possibly be explained by the type of people living along these creeks. The land owners on Boone Creek include some people who work in the city or live in suburban areas near or within the watershed and do little or no farming; consequently they recognize the fact that although the steeper portions of the watershed are of little agricultural value, they possess an unique natural beauty which should be protected and preserved. They think this can best be done by keeping the land in private ownership. On the other hand, property owners along Jessamine Creek are mostly farmers, who seem to have less interest in preserving natural beauty than promoting land uses that may yield a profit. Most of these Jessamine Creek owners interviewed seemed willing to sell their land for recreational development, public or private. There are, at present (1968), no significant zoning regulations in effect in Jessamine County.

SUMMARY

The evaluation methodology was applied in detail to the Boone and Jessamine Creek Watersheds for all of the activities and areas listed in Table 2. Somewhat less inclusive evaluations were made for the Clear and Hickman Creek Watersheds and smaller, individual sites on Boone and Jessamine Creeks were evaluated for selected recreational activities. Very preliminary development plans for park sites and trail systems were outlined for the middle and lower sections of Boone and Jessamine Creeks. These sketch plans form the basis for applying the visitation prediction equations, demand estimates and economic analysis procedures developed in the next chapter.

Chapter IV

ECONOMIC ANALYSIS OF THE RECREATION SITES

INTRODUCTION

The main objectives of this chapter are:

1.) To develop a general equation for estimating the number of visitor-days of recreation use naturalistic areas, such as Boone or Jessamine Creeks, would attract providing they were developed. The data used to derive a visitation prediction equation must come from an existing recreation area similar in type, size, location, and activities and facilities available to the contemplated development along these two creeks.

2.) To predict the total demand for the previously defined outdoor recreation activities regardless of site generated by a given urban population of under one million in a standard metropolitan area. The prediction is made for persons 12 years of age and older in Fayette County, located in central Kentucky, during the period of June through August when participation in most activities is greatest. Projection of this prediction into future years will give some idea as to the future use of facilities developed in naturalistic areas.

3.) To estimate what percentage of this future demand might be satisfied by a particular creek site providing it were developed.

FACTORS AFFECTING DEMAND

The demand for outdoor recreation as measured by the number of participating visitors is difficult to predict because it depends on many interrelated factors which are difficult to measure and evaluate. As described by Clawson (10), the following factors influence the attendance at recreational sites:

1.) "Factors relating to the potential recreation users as individuals:

   (a) their total number in the surrounding area;
   (b) their geographic distribution within this area - how many are relatively near, how many are relatively far, etc.;
   (c) their socioeconomic characteristics, such as age, sex, occupation, family size and composition, educational status, and race;
   (d) their average incomes, and the distribution of income among individuals;
   (e) their average leisure, and the time distribution of leisure;
   (f) their specific education, their past experiences, and present knowledge relating to outdoor recreation;
   (g) their tastes for outdoor recreation.

2.) Factors relating to characteristics of the recreation area:

   (a) its innate attractiveness, as judged by the average user;
   (b) the intensity and character of its management as a recreation area.
   (c) the availability of alternative recreation sites, and the degree to which they are substitutes for the area under study;

(d) the capacity of the area to accommodate recreationists;

(e) climate and weather characteristics of the area, the latter during the period under study.

3.) Relationships between potential users and the recreational area:

(a) the time required to travel from home to the area, and return;

(b) the comfort or discomfort of the travel;

(c) the monetary costs involved in a recreation visit to the area;

(d) the extent to which demand has been stimulated by advertising."

The measurement of recreation demand is further complicated by difficulty in establishing a precise and satisfactory unit of recreation use. However, an informal consensus exists whereby an individual visit on a single calendar day to a recreation site is known as a visitor-day. Each time a visitor spends all or part of a day at a site, a visitor-day is recorded. No differentiation is made with respect to why he went to the site, how long he was there, what he did while there, or how much satisfaction he gained from the experience.

THE DEMAND FOR RECREATION FACILITIES

Recent studies on recreation economics have used the classical approach of economists in analyzing consumer demand for goods and services by constructing a demand schedule in terms of a dollar value per unit of measurement to estimate the economic benefit resulting from outdoor recreation participation. Based on this concept, several methods of estimating recreational benefits have been proposed and developed in varying degrees. The most favorable of these methods involves the derivation and utilization of a simulated price visitation demand curve based on travel distance and cost of travel. A variation of this method was used in this study to compute a benefit associated with the predicted annual number of visitor-days.

Categories of visitor-days may be distinguished according to the number of other people participating in a particular activity at the same time, the kind of activity, the degree the individual participates, the length of time spent away from home, the distance traveled, and the quality of facilities at the site. Each category of visitor-day potentially has a different value to the user, but quantitative distinction among these values was not possible in this study.

After reviewing the factors presented by Clawson as potentially affecting the number of visits to recreation areas, only two, distance and population, were selected for use in deriving a visitation prediction equation. These two factors were chosen, because they have been found to explain most of the variation in visitation among origin areas for a selected recreation site (65, p. 149). The origin-area concept is employed by subdividing the total area contributing visitors to the site into small areas. Using each population and the distance between the origin area and the recreation site in question, the number of visitor-days may be estimated by an equation having the general form

$$V = KP/d^n \qquad (1)$$

where V is the estimated annual visitor-days spent at the site by those living in the origin area, P represents the population of the origin area, d equals the airline distance to the recreational facility from the origin area, n is an exponent describing the relationship between distance and visitation, and K is a constant relating the propensity of the individuals in the origin area to visit the site.

To apply this procedure, the K and n of the equation must first be statistically determined from available visitation data by origin area to comparable existing sites. Several regression equations relating V, P, and d are available in the literature. A number are reviewed and additional ones are developed by Tussey (65). Most of these equations are based on reservoir oriented recreation. Some of the studies have attempted to bring into the regression factors other than V, P, and d, but the effort has not been notably successful.

Two recreation visitation equations, closely related to the scope of this study but based on a different format, are part of a group of regression equations developed in a study of Indiana State Parks (67). These equations estimate visitation to a park in terms of trips per week-end. The number of picnic tables, the area of lake, and the number of hiking trails were the variables found which most influenced the trips per week-end to a particular park. By estimating the number of persons in each car and the number of days the average party stays at the site, trips per week-end are converted into visitor-days.

PARKS USED IN DERIVING EQUATION FOR THIS STUDY

Two sites, Otter Creek Park and Boonesboro Park, were chosen for obtaining statistical data for the development of a visitation-prediction equation suitable for application to naturalistic areas such as Boone and Jessamine Creeks. Otter Creek Park is located along the Ohio River in Meade County, Kentucky. Boonesboro State Park is located along the Kentucky River in Madison County, Kentucky. The geographical locations of both parks within Kentucky and air distances are presented in Figures 27 and 28. These parks were chosen because they, like Jessamine and Boone Creeks, are close to a metropolitan area. They are also similar in size, setting,

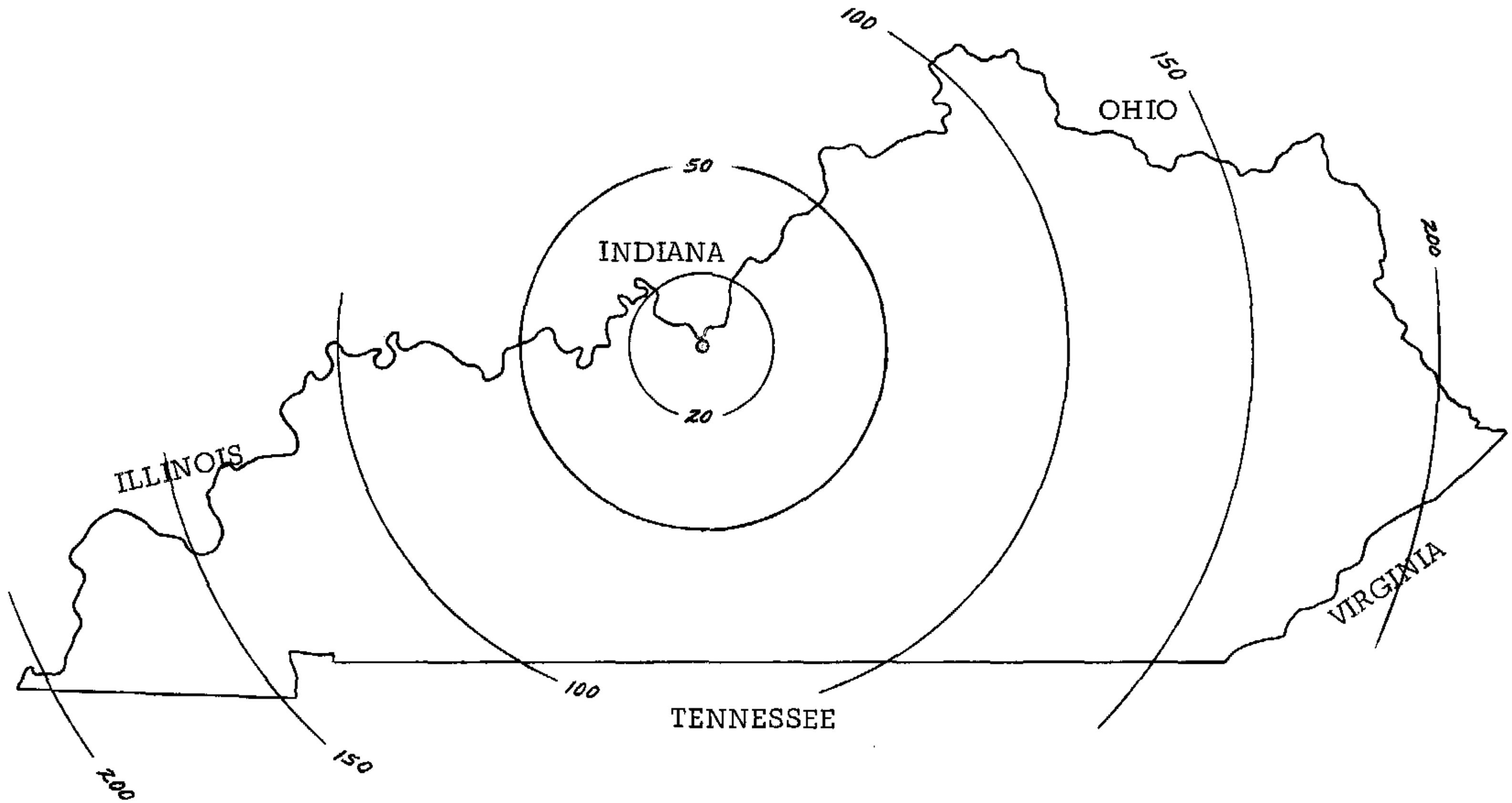

Figure 27. Location and Air Distance (miles) to Otter Creek Park

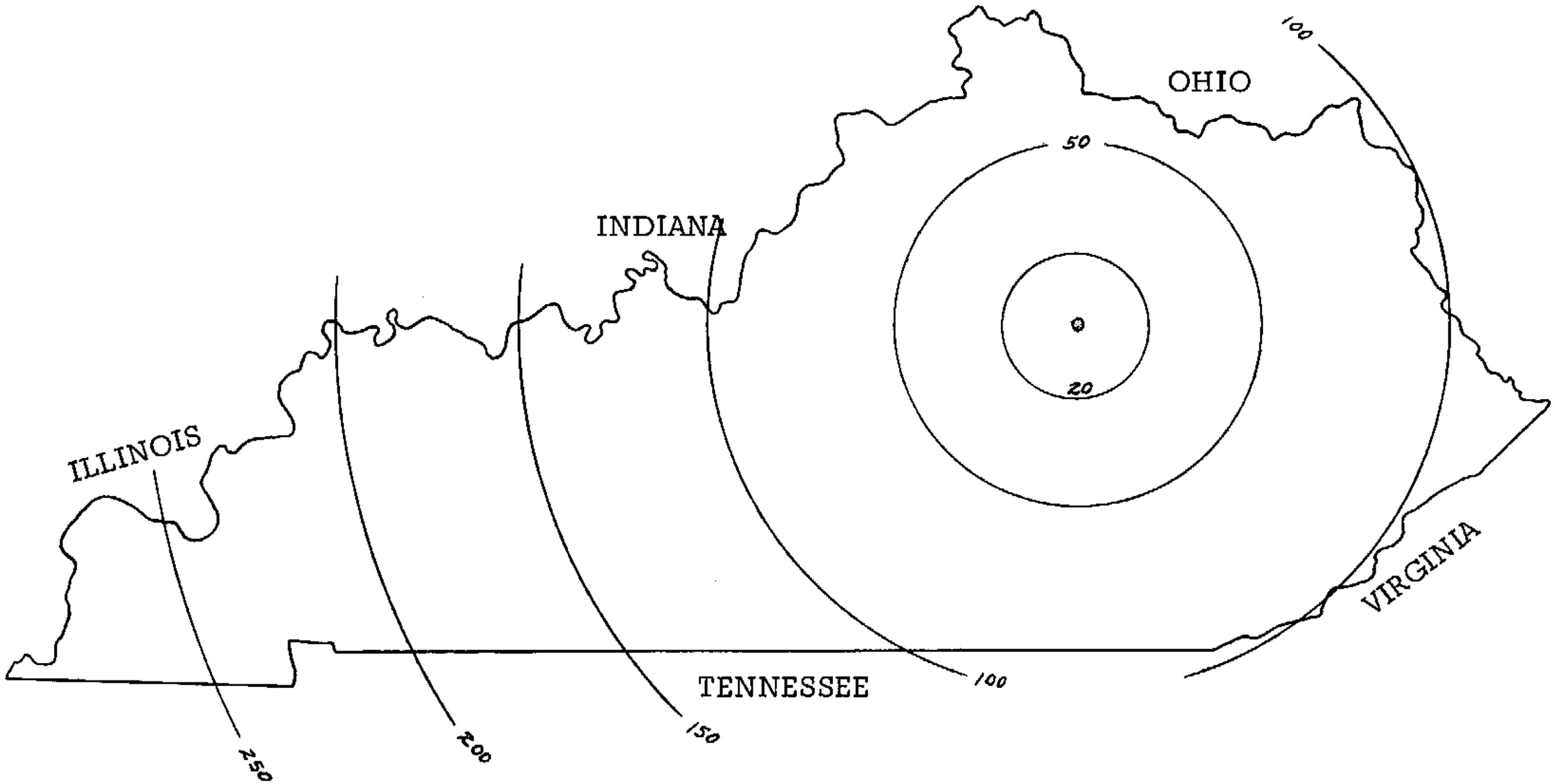

Figure 28. Location and Air Distance (miles) to Boonesboro State Park

facilities available, and activities offered. Both parks are relatively small and situated in a naturalistic area close to a standard metropolitan area of less than one million. Each park has parking, picnic tables, outdoor grills, camping facilities and sanitation facilities. In addition, at Otter Creek Park a trail system, swimming pools, field sport areas, scenic overlooks, fishing areas, and cave tours are provided. In addition, at Boonesboro State Park, boat launching, swimming, and fishing areas are provided. Both parks offer a wide variety of possible recreation activities as indicated by the available facilities. Boonesboro State Park falls within the immeidate area of study to make it an excellent source of data for developing a demand equation.

The major disadvantage in using these two parks as the basis for the statistical study was that data giving number of visitors by origin area was only available for camping. The time trend in camping data obtained from Boonesboro is indicative of the mushrooming increase in outdoor recreation in the study area as shown in Figures 29 and 30.

DERIVATION OF VISITATION PREDICTION EQUATION

For the analysis, 168 origin areas were defined: the 120 Kentucky counties, the 47 other states excluding Alaska and Hawaii, and the District of Columbia. Three kinds of data were needed for evaluating an average K and n: the number of visitors from each origin area to each previously chosen park, the population of each origin area, and the mean airline distance between each origin area and each park.

VISITATION DATA

To determine the total number of annual visitors by origin area to both Otter Creek Park and Boonesboro State Park, two types

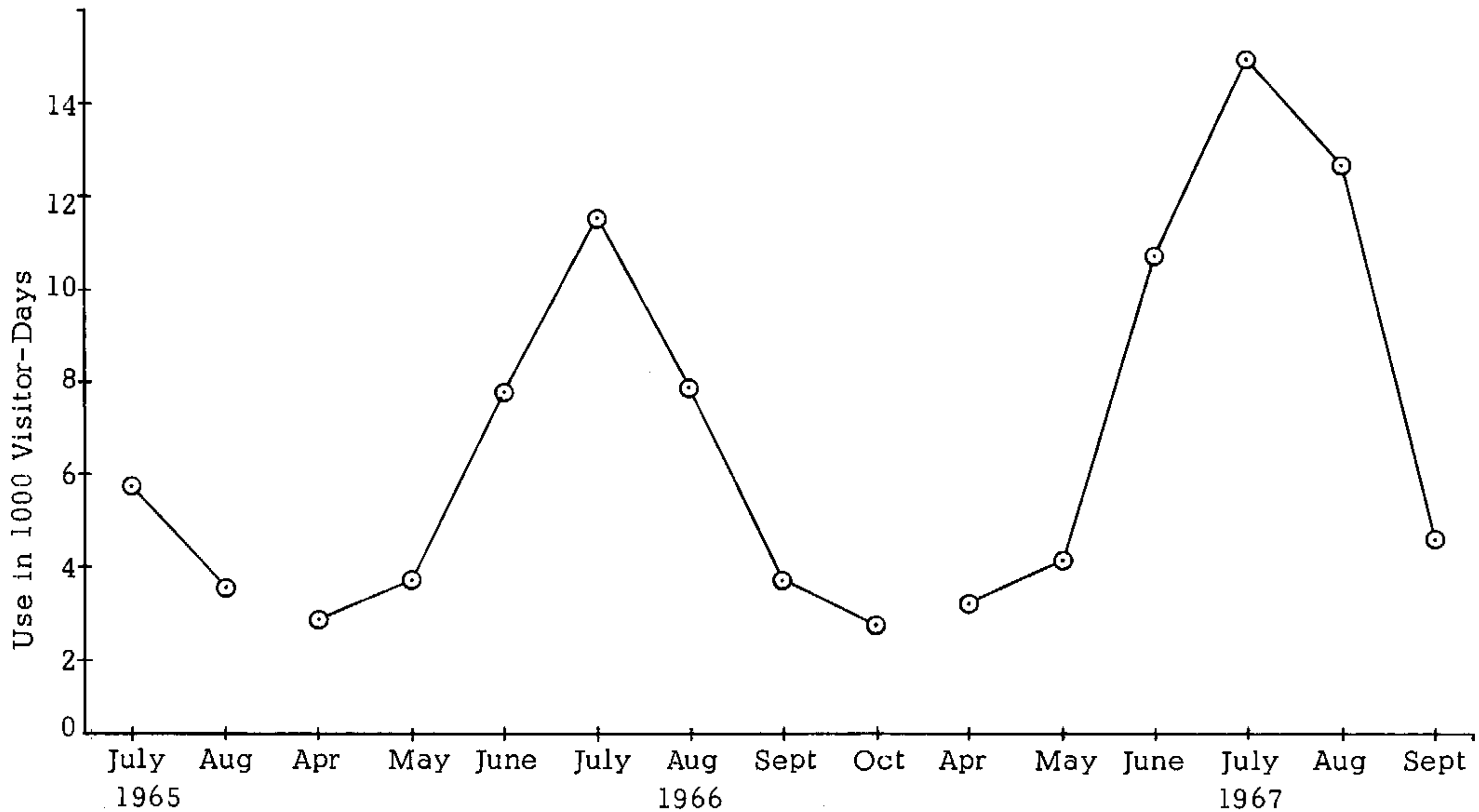

Figure 29. Total Monthly Campers at Boonesboro State Park

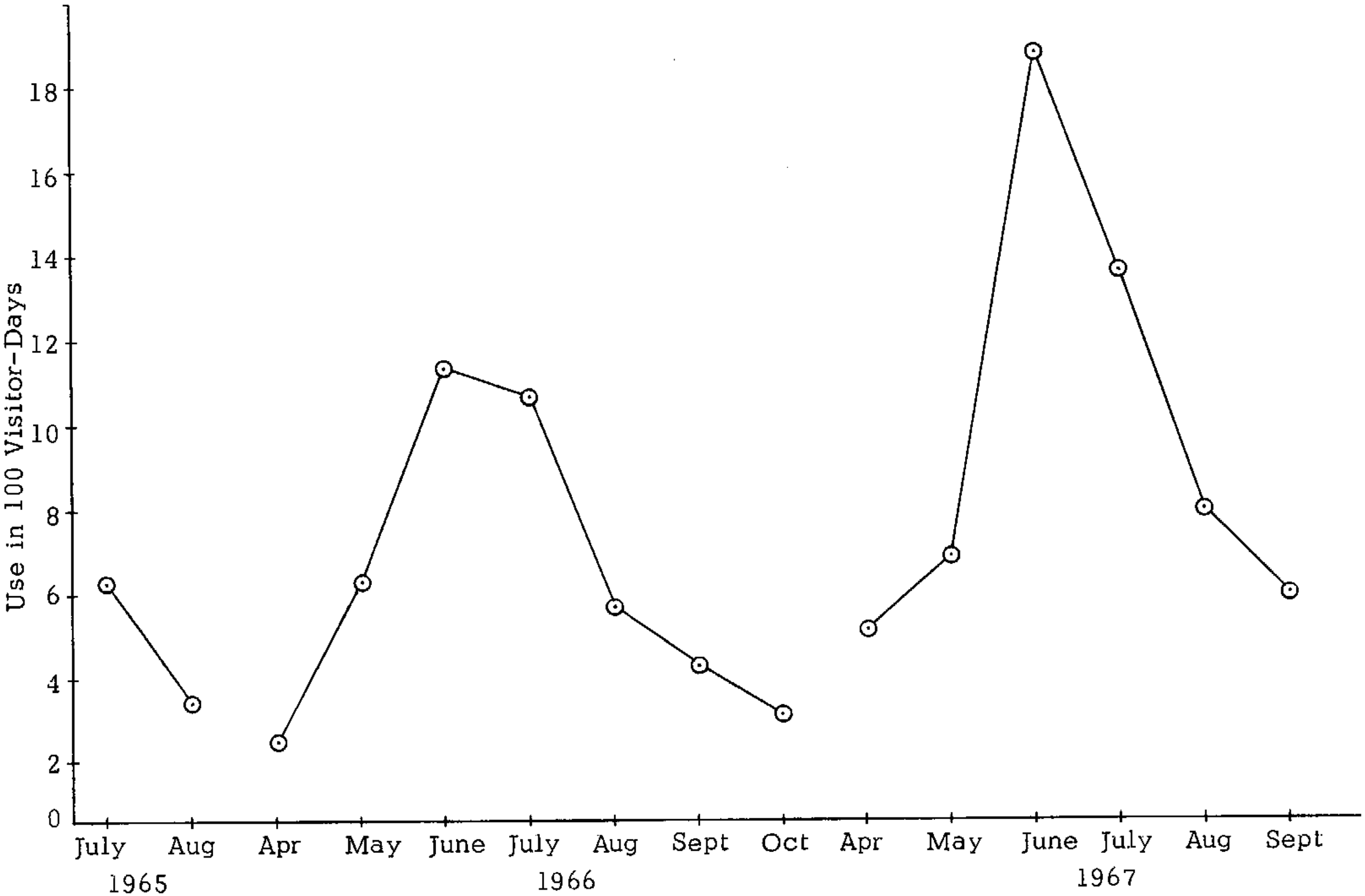

Figure 30. Total Monthly Campers from Fayette County at Boonesboro State Park

of visitation data were utilized. The first consisted of daily camping data indicating the home of each camper. Boonesboro State Park had a complete set of daily camping records beginning in July, 1965, and continuing through 1967. Otter Creek Park, however, only had daily camping records for 1965 and 1966; and within this interval, records were missing for various days. Camping visitation by origin area as obtained from daily camping data is shown in Appendix D.

The second type of data was obtained to relate total visitation to camping visitation and consisted of the total annual activity-days spent in camping, fishing, picnicking, and hiking at Otter Creek Park and Rough River Reservoir. Rough River Reservoir, 60 miles southwest of Louisville, is a different type of facility, but it does provide some indication of the relative participation in various kinds of outdoor recreation activities. Data were available beginning in 1963 through 1966 for Rough River Reservoir and from 1964 through 1966 for Otter Creek Park. The data used are shown on Tables 30 and 31. Also it should be pointed out that hiking at the two sites, Otter Creek Park and Rough River Reservoir, is not comparable to the definition of hiking as previously defined (p. 34). It is, however, comparable to what was called "walking for pleasure" and "nature walks."

POPULATION DATA

The population used for the 168 origin areas was that reported in the 1960 census. Since the daily camping data were collected in the years 1965 through 1967, origin-area population in the corresponding years might have been preferred; but population estimates between census years are less reliable and harder to obtain. Comparable estimates for all 168 origin areas were not available. Furthermore, census data is customarily used by planners in project analysis. Each origin-area population used is shown in Appendix D.

DISTANCE DATA

Each air distance was measured on a straight line from a centrally located point within the origin area to the entrance to the park in question. For most counties, the county seat was taken as the point within the origin area. For a few of the closest counties, the center of population was figured more exactly. For most states, a larger city near the center of the state was used. The cities within each state which were used were the same as those used by Tussey (65). For the closest states, a more detailed analysis of the population distribution within the state was made. The airline distance between each pair of points was measured scaling from maps of Kentucky and the United States respectively. Airline distance was used rather than time of travel or road distances, because it was found that air distance gave the best correlation. Tussey also found that air distance gave better correlation than did the other types of distances (65, p. 84). Each distance used is shown in Appendix D.

EQUATION FORMAT

The daily camping population, and distance data gathered for the two parks were used in a multiple linear regression model to estimate values for the coefficients n and K in equation 1. A log conversion was used to convert the exponential equation into linear form. A multiple regression model provides an objective fitting of a relationship, defining an independent variable from a number of dependent variables in such a manner that the sum of squares of the residuals about the fitted relationship is a minimum. In addition, the model enables an objective quantitative measure of the degree of dependence of the dependent on each independent variable.

DERIVATION OF EQUATION RELATING K, n, AND d

A University of Kentucky Computing Center Statistical Library Program entitled "Step-Wise Multiple Linear Regression Analysis - MULTR" (68) was used in deriving all camping visitation prediction equations produced in this study. The program uses read F values as a measure of the statistical significance to control the entry of nonsignificant dependent variables into the chosen equation, t tests to check the significance of the regression coefficients, and R^2 (multiple-correlation coefficient) as a measure of the overall correlation between the dependent and independent variables (37).

Before applying the model, Equation 1 had to be transformed to the following logarithmic form:

$$\log_{10} V/P = \log_{10} K - n\log_{10} d \qquad (2)$$

This was necessary to achieve the linear form required by least squares regression.

The model was applied in three different ways to each of two sets of daily camping data. They are as follows:

1.) All 168 origins were used in the regression. Origin areas having no recorded visitation could not be included directly in Equation 2 because the logarithm of zero is negative infinity. In order to overcome this difficulty, the population of origin areas without recorded visitation was added to the population of the nearest origin area with visitation. This was done to include in the equation the effect of the origin areas contributing zero visitors. Otherwise, the predicted visitation total would be too high.

2.) Only those origin areas with visitation were used in developing the equations. The resulting equation, as expected, predicted a much greater visitation than that obtained by (1) above.

3.) The camping data were arranged in distance rings around the park, and separate equations were developed for each ring by the procedure followed in the first method. The rings used were from 0-50 miles, 51-150 miles, and over 151 miles. The rings correspond roughly to the day-use, weekend use, and vacation use ranges.

A separate equation was developed for each year of camping data for both Otter Creek Park and Boonesboro State Park by multiple regression analysis. The yearly data for each Park was then summed and five more equations were derived. Each equation was used to predict camping visitation to each of the two parks. A summary of the equations, their statistical significance, correlation, and results is shown on Tables 28 and 29.

Of the three methods, development of separate prediction equations by distance rings gave the best results, as indicated by the graphical representation of chosen equations from Table 29 in Figure 31. However, the various methods produced a wide range of equations for each park, probably because of chance variations within the limited sample size.

SELECTION OF EQUATION FOR THIS STUDY

At this point, it was necessary to decide which of the derived visitation prediction equations should be used for predicting visitation to Boone and Jessamine Creeks. All the equations developed for Otter Creek Park were discarded since the data on which the correlation was based was too sparse to give consistent results. Also, since day-use facilities will probably predominate at the two small

TABLE 28

SUMMARY OF DEVELOPED EQUATIONS AND THEIR STATISTICAL SIGNIFICANCE FOR OTTER CREEK PARK

Year	Ring[d]	Equation $V = KP/d^n$		Actual Visitation	Predicted Visitation	R^2	F	T
		K	n					
1965	1	0.6579	2.422	457	377	-	-	-
1966	1	2.040	2.848	188	341	70.28	9.46	-3.08
Combined	1	4.175	3.024	1450	422	66.31	7.87	-2.81
1965	2	75.65	4.324	988	1	11.64[a]	0.26[a]	-0.51[a]
1966	2	0.00003185	0.0501	373	251	0.02[a]	0.0005[a]	-0.02[a]
Combined	2	0.000003233	0.5279	2503	3	0.96[a]	0.04[a]	0.20[a]
1965	3	0.00028	0.6382	1512	835	9.16[a]	2.52[a]	-1.59[a]
1966	3	0.00321	0.9229	562	1661	20.87[a]	9.76	-3.12
Combined	3	0.00211	0.7974	3885	2345	15.95[a]	7.40	-2.72
1965[b]		0.0032	1.028	2095	1224	45.55	25.93	-5.09
1966[b]		0.0070	1.052	3864	2344	61.97	78.21	-8.84
Combined[b]		0.0068	0.986	5959	3284	56.46	66.13	-8.13
1965[c]		0.0120	1.187	2095	1666	49.84	30.80	-5.55
1966[c]		0.0204	1.190	3864	3334	69.94	111.66	-10.57
Combined[c]		0.0221	1.143	5959	4253	67.41	105.48	-10.27

[a]Not significant at the 5% level

[b]1 - zero values included in data

[c]2 - zero values neglected in data

[d]Ring 1 - 0 to 50 miles

Ring 2 - 50 to 150 miles

Ring 3 - 150 miles and above

TABLE 29

SUMMARY OF DEVELOPED EQUATIONS AND THEIR STATISTICAL SIGNIFICANCE FOR BOONESBORO STATE PARK

Year	Ring[d]	Equation $V = KP/d^n$		Actual Visitation	Predicted Visitation	R^2	F	T
		K	n					
1965	1	2.915	2.636	1163	810	59.86	17.89	-4.23
1966	1	13.56	2.584	5703	4311	62.56	33.42	-5.78
1967	1	16.50	2.505	9160	6448	55.03	29.36	-5.42
Combined	1	38.38	2.603	16026	11613	56.94	34.38	-5.86
1965	2	0.02024	1.252	312	181	5.58[a]	0.47[a]	-0.69[a]
1966	2	0.02859	0.965	2248	888	4.46[a]	1.35[a]	-1.16[a]
1967	2	0.2266	1.354	3262	1310	8.48[a]	2.32[a]	-1.52[a]
Combined	2	0.2301	1.279	5822	1839	8.88[a]	3.51[a]	-1.87[a]
1965	3	0.5442	1.775	3560	2045	55.05	39.19	-6.26
1966	3	0.6127	1.560	16215	8054	51.79	55.86	-7.47
1967	3	0.0863	1.162	24897	11895	37.71	30.27	-5.50
Combined	3	1.460	1.518	44672	24545	52.53	58.65	-7.66

[a]Not significant at the 5% level

[d]Ring 1 - 0 to 50 miles
Ring 2 - 50 to 150 miles
Ring 3 - 150 miles and above

TABLE 29 - Continued

Year	Ring[d]	Equation $V = KP/d^n$ K	n	Actual Visitation	Predicted Visitation	R^2	F	T
1965[b]		0.0843	1.494	5035	2412	80.63	233.04	-15.27
1966[b]		0.3051	1.462	24166	10270	76.40	339.96	-18.44
1967[b]		0.3115	1.373	37319	16624	73.50	285.69	-16.90
Combined[b]		0.4880	1.368	66520	26737	72.41	312.34	-17.67
1965[c]		0.2192	1.596	5035	3337	84.33	301.26	-17.36
1966[c]		0.5636	1.544	24166	11904	79.12	397.76	-19.94
1967[c]		0.5752	1.455	37319	18983	78.43	374.62	-19.36
Combined[c]		0.7255	1.422	66520	29106	75.00	357.04	-18.90

[b] 1 - zero values included in data

[c] 2 - zero values neglected in data

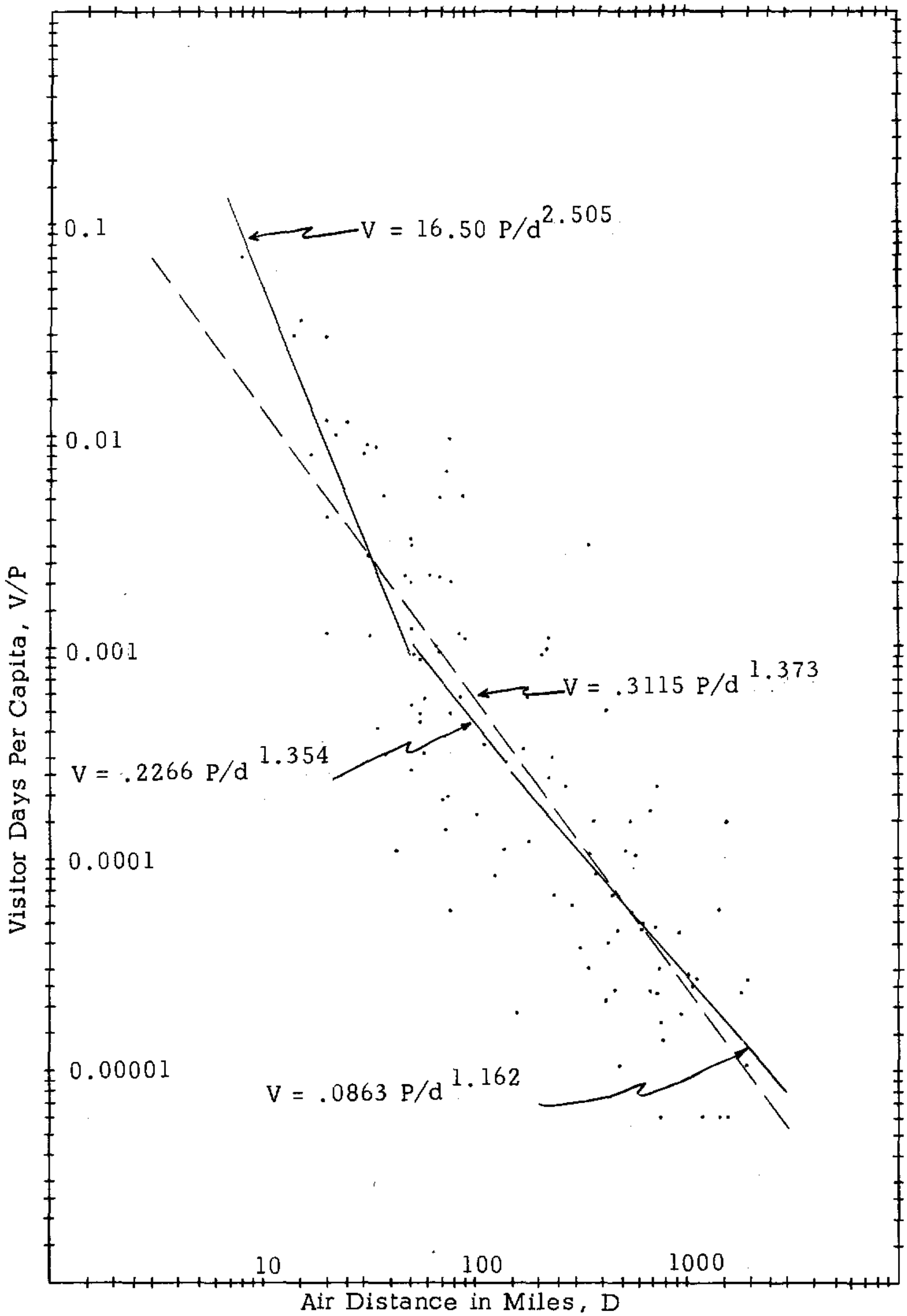

Figure 31. Plot of Visitation Per Capita as a Function of Distance

naturalistic sites near Lexington, the main concern of this study is the prediction of visitation from within the less than 50 mile range. Thus, the equations derived for the two outer most rings for Boonesboro State Park were discarded. Finally, in the inner most ring for Boonesboro State Park, the equations for the 1965 and combined camping data were discarded. The respective reasons for elimination were incomplete data and the fact that summing the data did not improve the correlation. The remaining two equations (1966 and 1967 camping data for Boonesboro State Park) were averaged to get:

$$V = 15.03\ C_f\ P/d^{2.545} \qquad (3)$$

where C_f is a constant which increases the visitation estimate to conform to the actual counted campers. The correction was made because the sum of the visitations predicted by the derived equation was substantially less than those recorded. The correction factor was estimated from recorded and estimated visitation data (Table 29) as:

$$C_f = \frac{(9160 + 5703)/2}{(6448 + 4311)/2} = 1.38$$

In order to expand Equation 3 to include visitors participating in other activities other than camping, it was assumed that participation in the various activities occurs in the same or nearly the same proportion regardless of the size of development. Based on this assumption, Equation 3 was multiplied by F_c. F_c is a constant estimated for this study from the combined number of visitors participating in the activities of camping, fishing, picnicking, and hiking at Otter Creek Park and Rough River Reservoir divided by the number participating in camping. Hiking at these two sites is comparable to nature walks and walking for pleasure as previously defined (p. 34). The visitation data used to calculate F_c is presented on Tables 30 and 31.

F_c was computed by averaging the total number of users divided by the total number of campers for each facility to be equal to 4.56. The relative number of campers was relatively higher at Otter Creek than at Rough River and was increasing with time at

TABLE 30

OTTER CREEK PARK ANNUAL ACTIVITY-DAYS BY ACTIVITY

Year	Campers	Picnickers, Fishermen and Hikers	Total Users	F_c
1964	36,594	105,317	141,911	3.88
1965	40,727	117,619	158,346	3.89
1966	57,313	149,757	207,070	3.61

TABLE 31

ROUGH RIVER RESERVOIR ANNUAL ACTIVITY-DAYS BY ACTIVITY

Year	Campers	Picnickers, Fishermen and Hikers	Total Users	F_c
1963	83,215	532,173*	615,388	7.40
1964	102,356	601,324*	703,680	6.87
1965	185,515	681,340*	866,855	4.67
1966	222,300	776,151*	998,451	4.49

*Note: Only one-half of the total counted fishermen were used due to the difference in quality of fishing at the reservoir and the park.

both sites. After including both factors the resulting equation for estimating total visitation is:

$$V = (15.03)\ (1.38)\ (4.56)\ P/d^{\ 2.545} \qquad (4)$$

APPLICATION OF VISITATION PREDICTION EQUATION

Equation 4 was used to estimate total annual number of visitor-days from each origin area within the day-use range defined as being within a 50 mile radius of Boonesboro State Park. Predicted visitation includes participation in the selected activities (camping, fishing, picnicking, walking for pleasure, and nature walks). Table 32 lists the results of Equation 4 for Boonesboro State Park by origin area.

At this point, using the same origin areas used for Boonesboro, Equation 4 was used to estimate the total annual number of visitor-days to selected areas for potential development on Boone and Jessamine Creeks. The "Narrows" (Area D) on Jessamine Creek and Area A near the mouth of Boone Creek were selected as the two potential development areas (Appendix B). Before applying Equation 4, it was necessary to calculate a set of distances between the origin areas and each selected potential development sites. Using these new distances in Equation 4, the total annual number of visitor-days were estimated for the selected sites for the activities of camping, fishing, picnicking, walking for pleasure, and nature walks. The distances and predicted visitations are shown on Table 33. The major disadvantage of equations like Equation 4 is that for short distances between the origin area and destination in question the equation tends to severely overestimate the number of visitor-days of that origin (52 , pp. 53-58).

TABLE 32

PREDICTED ANNUAL VISITATION TO
BOONESBORO STATE PARK

Origin	Actual Campers	Prediction	
		Equation 3	Equation 4
1. Anderson	85	23	103
2. Bath	68	33	150
3. Bourbon	144	184	840
4. Boyle	147	71	322
5. Breathitt	2	15	69
6. Clark	1213	2199	10028
7. Estill	25	126	576
8. Fayette	3849	2779	12674
9. Fleming	7	16	72
10. Franklin	139	62	284
11. Garrard	0	62	283
12. Grant	12	9	43
13. Harrison	67	42	191
14. Jackson	0	30	138
15. Jessamine	99	209	952
16. Laurel	75	25	112
17. Madison	772	841	3835
18. Menifee	0	12	55
19. Mercer	11	48	221
20. Montgomery	315	136	622
21. Nicholas	4	24	110
22. Owen	14	8	37
23. Owsley	0	9	40
24. Pendleton	16	10	45
25. Powell	14	60	272
26. Robertson	0	4	16
27. Rockcastle	20	30	137
28. Rowan	17	16	71
29. Scott	172	88	403
30. Washington	3	11	50
31. Wolfe	1	13	59
32. Woodford	139	95	432
TOTAL	7430	7290	33241

TABLE 33

PREDICTED ANNUAL VISITATION TO
BOONE AND JESSAMINE CREEKS

Origin	Boone Creek (Area A)		Jessamine Creek (Area D)	
	Distance	Visitor-Days	Distance	Visitor-Days
1. Anderson	30	142	17	602
2. Bath	32	127	50	41
3. Bourbon	18	1098	31	275
4. Boyle	29	382	14	2434
5. Breathitt	54	57	68	32
6. Clark	10	5683	28	414
7. Estill	24	362	37	120
8. Fayette	12	22364	15	12674
9. Fleming	44	68	60	31
10. Franklin	33	380	25	770
11. Garrard	23	316	14	1116
12. Grant	48	47	51	40
13. Harrison	31	208	40	108
14. Jackson	36	111	43	70
15. Jessamine	14	1560	6	14090
16. Laurel	53	96	55	88
17. Madison	15	3217	21	1366
18. Menifee	36	44	53	17
19. Mercer	28	286	11	3088
20. Montgomery	22	488	40	107
21. Nicholas	30	110	45	39
22. Owen	47	43	46	46
23. Owsley	45	31	56	18
24. Pendleton	48	50	56	34
25. Powell	25	175	41	50
26. Robertson	42	17	55	9
27. Rockcastle	37	119	35	137
28. Rowan	49	60	66	28
29. Scott	21	627	23	498
30. Washington	47	59	29	200
31. Wolfe	42	46	58	20
32. Woodford	22	432	13	1648
TOTAL		38805		40210

ESTIMATED ANNUAL BENEFITS

Using the data on Table 33, the annual recreation benefits for each creek may be approximated by using two equations presented by Sirles (52, pp. 60-61). The first equation is

$$\bar{D} = \Sigma DV / \Sigma V \qquad (5)$$

where $\bar{D}$ is the average airline travel distance, DV is the product of visitation from an area, and the distance to the area while V is the visitation. The second equation is

$$U_V = C\bar{D}/2 \qquad (6)$$

where U_V is the unit value of benefits per visitor-day, C is the average travel cost per mile per visitor-day, and $\bar{D}$ is the average airline travel distance. Tussey evaluated C to be $0.034 (65, p. 131). Based on the above equations, U_V turns out to be 24.4 and 22.1 cents per visitor-day for the Boone and Jessamine Creek sites, respectively. Multiplying these values by the visitation totals on Table 33 gives annual benefits of $9,468,42 and $8,886.41 respectively. Additional benefits would result if substantial visitation were attracted to the site from more distant locations. However, this benefit was not estimated for this study and is not too likely to be significant. The nationwide historical reputation of Boonesboro adds a greater degree of attraction to visitors from distant locations than could probably be developed along the two creeks.

EXISTING RECREATIONAL FACILITIES - INVESTMENT AND INCOME

In order to obtain some measure of the costs involved in and income that might be expected from a privately developed facility along a small naturalistic stream, the owners of two existing facilities were interviewed. The Private Facilities Questionnaire

(Appendix A) was used as a guide.

There are no privately operated, profit-making recreational developments on Boone Creek. On Jessamine Creek, there is only one private development, covering approximately five acres. This facility, a small country store, filling station, and picnic area, is located at Glass Mill. The picnic grounds contain three picnic tables and two grills. However, due to the existence of a low dam near the picnic site, fishing and limited swimming are possible. A small fee is collected by the owner of each of the three activities. The initial investment for the store and picnic ground, which have been in operation for five years, was $3000.00. The yearly gross income for the enterprise is about $1800.00.

There is on Hickman Creek another private development, covering about ten acres. This facility, a restaurant, dining room, lighted cave, and souvenir shop, is located near the mouth of the creek. The owners have invested $32,000 in the business and receive a yearly gross income of $38,000. This facility has been in operation since 1928.

When the owners of these facilities were asked if their business ventures had been profitable and if they would expand them if possible, they answered yes to both questions. The reasons listed for not expanding were the inability to purchase more land (Hickman Creek) and lack of capital (Jessamine Creek).

Based on the above limited sample, it is reasonable to assume that private developments, similar to those on Jessamine and Hickman Creeks, along small naturalistic streams would be profitable. This, however, would depend on several interrelated factors of which proper management plays a major role.

FUTURE DEMAND

For the purposes of reserving open space for the recreational needs of the future and preserving an esthetically suitable environment, future recreation visitation is of greater importance than present visitation. Methods for predicting the future outdoor recreation visitation include the extension of past trend lines, the satiety principle, and a method based primarily on estimates of the present relationships between various socio-economic factors. All of these methods, as outlined by Clawson (10), are limited by assumptions necessary to their execution.

The last of the three methods was presented by Clawson as being the most sophisticated and complete and was used in this study. This approach, as developed by the ORRRC evaluates outdoor recreation demand in terms of activity occasions or days. (An activity-day is the participation by one person in one outdoor recreation activity during all or part of one day. One person participating in several activities during a day would account for several activity-days).

Briefly, the technique was developed by first determining the current (1960) participation for each recreation activity according to known socio-economic characteristics of subclasses of the United States population. The National Recreation Survey (NRS) (39) presents the 1960 data on activity-days per capita for component regions of the nation and by place of residence. For the latter category, the participation rates reflect the degree of urbanization within the Standard Census Bureau classifications being employed. The classifications were taken as defined in the 1950 census.

Having the 1960 participation rates, the next step employed by the ORRRC was to estimate the gross changes in these rates between 1960 and the selected target dates (1976 and 2000) caused by changes in each of the five socio-economic factors - family income, education, occupation, place of residence, and age-sex. They did this by reweighting the 1960 rates according to the projected 1976 and 2000 distributions of each of the five factors. The gross effects were reduced to a net basis by adjustments developed through multivariate analysis. For an additional factor, leisure net effects were established directly. The composite effect of all six factors acting together was then estimated from the net effects to secure expected per cent changes in rates for each recreation activity to the selected target dates. A more detailed description of the method can be found in Clawson (10). The only available expected per cent changes in the 1960 participation rates are those calculated for the summer season (June-August) presented in ORRRC Study Report 26 (43) in Table 8. In a similar study by Wright (81), the demand for outdoor recreation generated by a metropolitan area in Kentucky was estimated in terms of the amount of money spent for recreation.

For the projection of recreation demand, the 28 census tracts in Lexington and Fayette County were defined as origin areas. The location of each tract is shown in Figures 32 and 33. Utilizing the Outdoor Recreational Resources Review Commission Reports, the data needed for the estimation of demand are the present and future populations (12 years of age and older) for each tract and the corresponding participation rates for the area.

POPULATION

The present population of each tract used was that reported in the 1960 census for ages of 12 years and older. The future population (1976) was obtained by projecting the total 1960 population of each tract and then adjusting the new populations to

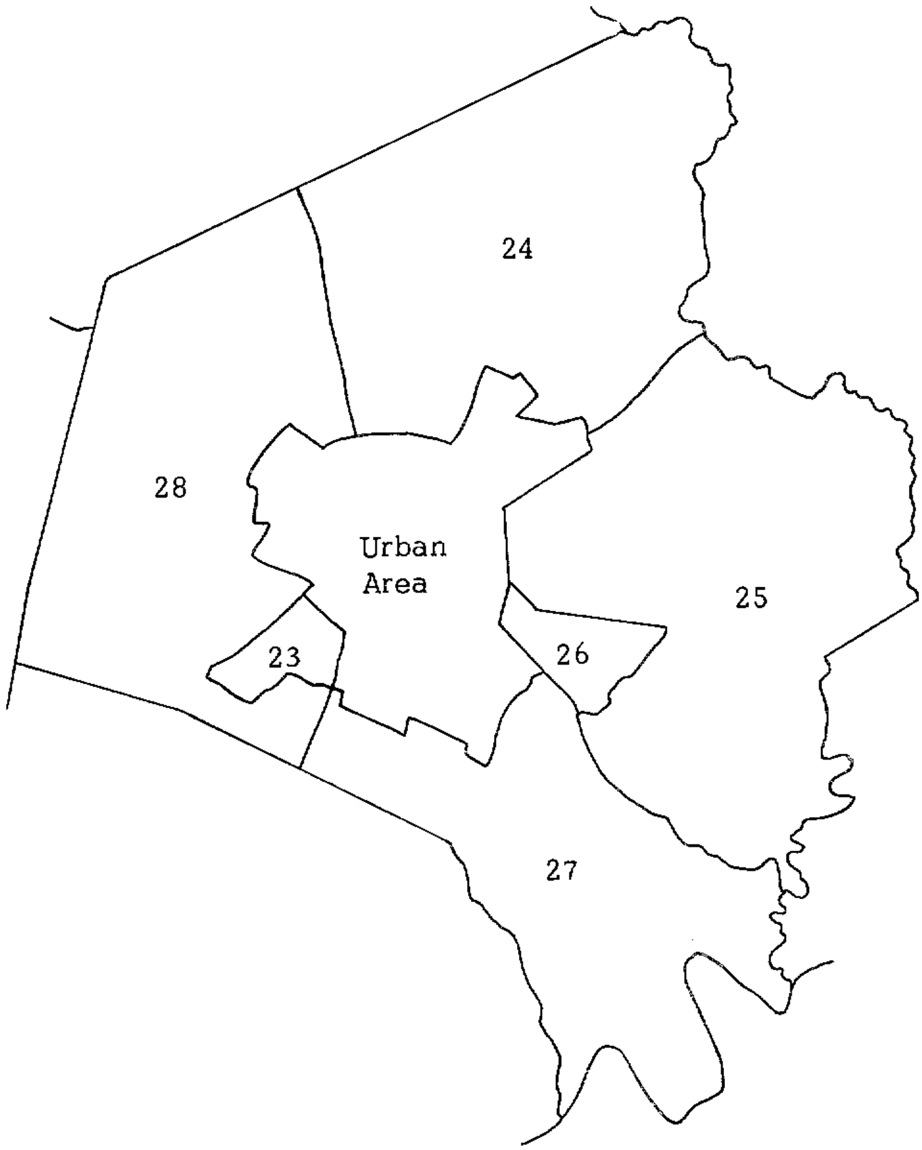

Figure 32. Rural Census Tracts (Fayette County, Kentucky)

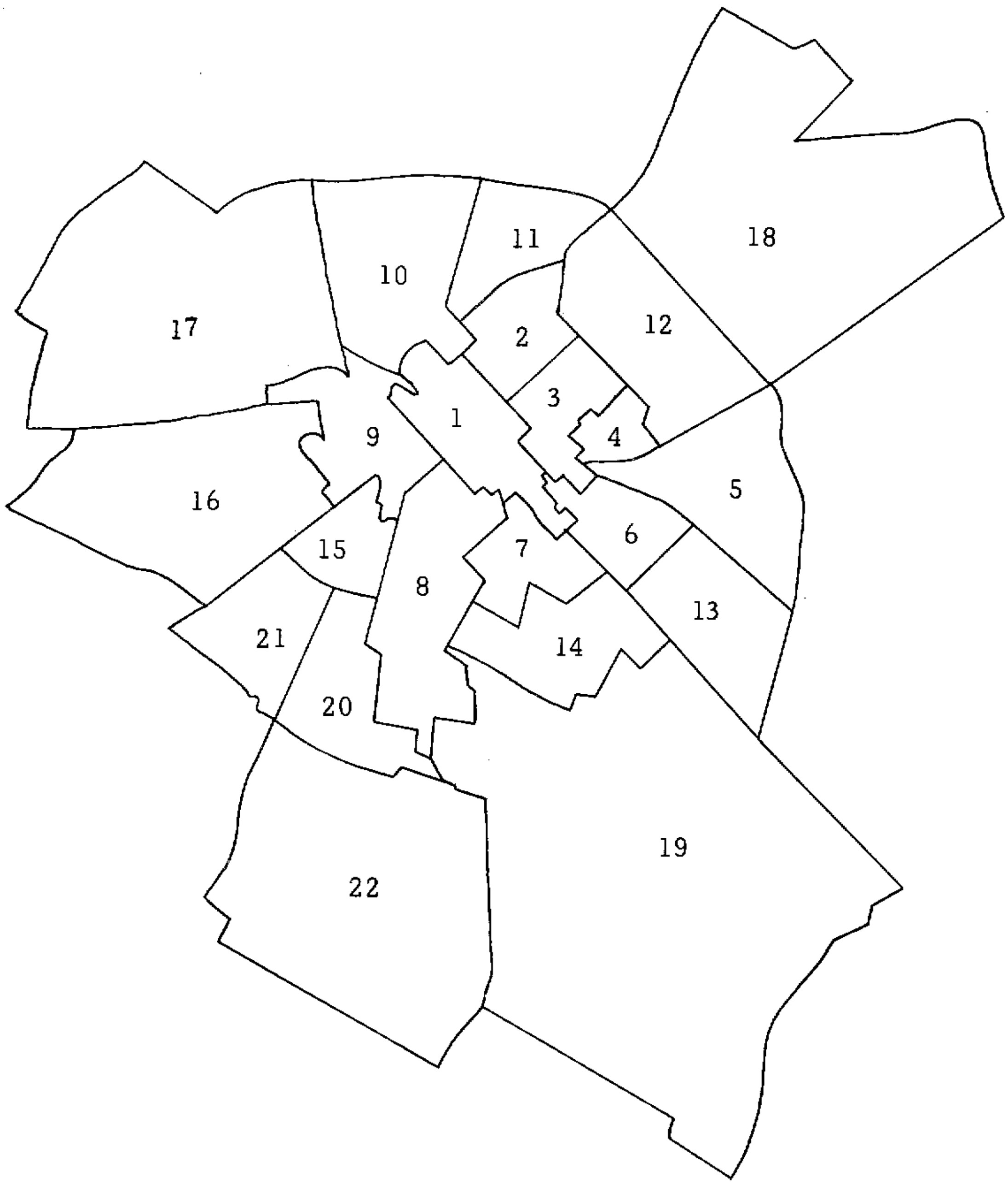

Figure 33. Urban Census Tracts (Fayette County, Kentucky)

include only those people 12 years of age and older. The projection was made by using judgment coupled with the average per cent change in population resulting from previous records. The judgment portion of the projection was based on the direction of growth of the metropolitan area. The adjustment was based on the assumption that the fraction of the population under 12 years of age would be nearly the same in 1976 as it was in 1960. Since projections become less accurate at more distant dates, the population was not projected beyond year 1976. Each population used is shown in Table 34.

PARTICIPATION RATES

Since Fayette County is classified as a Standard Metropolitan Area under one million by the 1950 census, the base 1960 participation rates for such an area in Table 1.03 of ORRRC Study Report 19 (39) apply and were adopted. It was not necessary to revise these base rates because Fayette County is typical of the areas for which the tabulated coefficients were derived. The future participation rates were found by applying the available expected percent changes in the base participation rates as calculated by the Commission. For this reason, the demand for only the summer season (June-August) could be estimated for the related recreation activities. The participation rates and expected percent changes used are shown on Table 35.

The total number of activity days or occasions is found by multiplying the participation rate by the corresponding population. For example, the total bicycling activity days for census tract No. 1 during the summer season in 1976 would be the rate (11.1) times the population (6824) = 7575 activity days. The total number of activity days for each census tract and activity is shown in Table 36.

TABLE 34

LEXINGTON-FAYETTE COUNTY METROPOLITAN AREA
POPULATION PROJECTIONS

Census Tracts	1960		1976	
	A*	B**	A*	B**
1	8590	6443	9098	6824
2	5420	4065	6576	4932
3	7780	5835	7224	5418
4	4320	3240	2858	2144
5	3670	2753	3833	2875
6	4910	3683	5134	3851
7	4110	3083	4566	3425
8	6740	5055	11234	8426
9	4990	3743	6430	4823
10	6080	4560	4865	3649
11	1700	1275	1420	1065
12	8980	6735	10718	8039
13	3200	2400	4019	3014
14	5150	3863	6362	4772
15	2950	2213	1740	1305
16	7640	5730	13570	10178
17	5990	4493	11091	8318
18	4620	3465	18747	14060
19	2070	1553	20660	15495
20	3870	2903	5459	4094
21	4280	3210	4763	3572
22	4090	3068	15701	11776
23	6600	4950	11720	8790
24	3530	2648	4120	3090
25	3320	2490	15926	11945
26	590	443	1570	1178
27	1910	1433	3748	2811
28	4840	3630	16848	12636
TOTAL	131940	98962	230000	172505

*Total Population

**Population 12 years old and over

TABLE 35

ACTIVITY DAY RATES FOR LEXINGTON-FAYETTE COUNTY, KENTUCKY

Activities	1960	% Change	1976
Bicycling	1.12	-1.0	1.11
Camping	0.50	44.2	0.72
Driving for Pleasure	7.78	17.1	9.11
Fishing	1.62	2.4	1.66
Hiking	0.17	44.2	0.25
Horseback Riding	0.19	13.3	0.22
Nature Walks	0.58	18.6	0.69
Picnicking	2.07	14.1	2.36
Sightseeing	2.38	20.7	2.87
Walking for Pleasure	4.12	14.9	4.73

Other present and future participation rates have been devised for component regions of the state of Kentucky. These rates are presented in Supplement No. 1 to the Kentucky Outdoor Recreation Plan (56) on Tables 3 and 4. For comparison the regional rates that would apply to Fayette County are shown on Table 37. The primary differences in the rates of this study and those devised in the Kentucky study are:

1.) The Kentucky study used the NRS regional (South) participation rates as a base, while this study uses as base rates those tabulated by population of place of residence. This implies a difference in the area covered by the respective rates.

2.) The future target dates were different (1976 in this study and 1970 and 1980 in the Kentucky study).

3.) The Kentucky study rates predict activity days for the entire year, while in this study they predict only for

TABLE 36

ESTIMATED ACTIVITY OCCASION DATA FOR FAYETTE COUNTY, KENTUCKY
BY CENSUS TRACT

Census Tract	Bicycling		Camping		Driving for Pleasure		Fishing		Hiking	
	1960	1976	1960	1976	1960	1976	1960	1976	1960	1976
1	7216	7575	3222	4913	50127	62167	10438	11328	1095	1706
2	4553	5475	2033	3551	31626	44931	6585	8187	691	1233
3	6535	6014	2918	3901	45396	49358	9453	8994	992	1355
4	3629	2380	1620	1544	25207	19532	5249	3559	551	536
5	3083	3191	1377	2070	21418	26191	4460	4773	468	719
6	4125	4275	1842	2773	28654	35083	5966	6393	626	963
7	3453	3802	1542	2466	23986	31202	4995	5686	524	856
8	5662	9353	2528	6067	39328	76760	8189	13987	859	2107
9	4192	5354	1872	3473	29121	43938	6064	8006	636	1206
10	5107	4050	2280	2627	35477	33242	7387	6057	775	912
11	1428	1182	638	767	9920	9702	2066	1768	217	266
12	7543	8923	3368	5788	52398	73235	10911	13345	1145	2010
13	2688	3346	1200	2170	18672	27458	3888	5003	408	754
14	4327	5297	1932	3436	30054	43473	6258	7922	657	1193
15	2479	1449	1107	940	17217	11889	3585	2166	296	326

TABLE 36 - Continued

Census Tracts	Bicycling		Camping		Driving for Pleasure		Fishing		Hiking	
	1960	1976	1960	1976	1960	1976	1960	1976	1960	1976
16	6418	11298	2865	7328	44579	92722	9283	16895	974	2545
17	5032	9233	2247	5989	34956	75777	7279	13808	764	2080
18	3881	15607	1733	10123	26958	128087	5613	23340	589	3515
19	1739	17199	777	11156	12082	141159	2516	25722	264	3874
20	3251	4544	1452	2948	22585	37296	4703	6796	494	1024
21	3595	3965	1605	2572	24974	32541	5200	5930	546	893
22	3436	13071	1534	8479	23869	107279	4970	19548	522	2944
23	5544	9757	2475	6329	38511	80077	8019	14591	842	2198
24	2966	3430	1324	2225	20601	28150	4290	5129	450	773
25	2789	13259	1245	8600	19372	108819	4034	19829	423	2986
26	496	1308	222	848	3447	10732	718	1955	75	295
27	1605	3120	717	2024	11149	25608	2321	4666	244	703
28	4066	14026	1815	9098	28241	115114	5881	20976	617	3159
TOTAL	110838	191483	49490	124205	769925	1571522	160321	286359	16744	43131

TABLE 36 - Continued

Census Tract	Horseback Riding		Nature Walks		Picnic		Sightseeing		Walking for Pleasure	
	1960	1976	1960	1976	1960	1976	1960	1976	1960	1976
1	1224	1501	3737	4709	13337	16105	15334	19585	26545	32278
2	772	1085	2358	3403	8415	11640	9675	14155	16748	23328
3	1109	1192	3384	3738	12078	12786	13887	15550	24040	25627
4	616	472	1879	1479	6707	5060	7711	6153	13349	10141
5	523	633	1597	1984	5699	6785	6552	8251	11342	13599
6	700	847	2136	2657	7624	9088	8766	11052	15174	18215
7	586	754	1788	3263	6382	8083	7338	10978	12702	16200
8	960	1854	2932	5814	10464	19885	12031	24183	20827	39855
9	711	1061	2171	3328	7748	11382	8908	13842	15421	22813
10	866	803	2645	2518	9439	8612	10853	10473	18787	17260
11	242	234	740	735	2639	2513	3035	3057	5253	5037
12	1280	1769	3906	5547	13941	18972	16029	23072	27748	38025
13	456	663	1392	2080	4968	7113	5712	8650	9888	14256
14	734	1050	2241	3293	7996	11262	9194	13696	15916	22572
15	421	287	1284	900	4581	3080	5267	3745	9118	6173

TABLE 36 - Continued

Census Tract	Horseback Riding 1960	Horseback Riding 1976	Nature Walks 1960	Nature Walks 1976	Picnic 1960	Picnic 1976	Sightseeing 1960	Sightseeing 1976	Walking for Pleasure 1960	Walking for Pleasure 1976
16	1089	2239	3323	7023	11861	24020	13637	29211	23608	48142
17	854	1830	2606	5739	9301	19630	10693	23873	18511	39344
18	658	3093	2010	9701	7173	33182	8247	40352	14276	66504
19	295	3409	901	10692	3215	36568	3696	44471	6398	73291
20	552	901	1684	2825	6009	9662	6909	11750	11960	19365
21	610	786	1862	2465	6645	8430	7640	10252	13225	16896
22	583	2591	1779	8125	6351	27791	7302	33797	12640	55700
23	941	1934	2871	6065	10247	20744	11781	25227	20394	41577
24	503	680	1536	2132	5481	7292	6302	8868	10910	14616
25	473	2628	1444	8242	5154	28190	5926	34282	10259	56500
26	84	259	257	813	917	2780	1054	3381	1825	5572
27	272	618	831	1940	2966	6634	3411	8068	5904	13296
28	690	2780	2105	8719	7514	29821	8639	36265	14956	59768
TOTALS	18804	37953	57399	119929	204852	407110	235529	496239	407724	815950

TABLE 37

ACTIVITY DAY RATES FOR REGION II
(KENTUCKY OUTDOOR RECREATION PLAN)

Activities	Activity Days Rates	
	1970	1980
Bicycling	7.98	9.87
Camping	1.20	1.48
Driving for Pleasure	28.98	35.86
Fishing	7.94	9.82
Hiking	0.53	0.65
Horseback Riding	2.21	2.73
Nature Walks	3.98	4.92
Picnicking	4.14	5.13
Sightseeing	7.63	9.44
Walking for Pleasure	21.96	27.18

Source (56).

the summer season (June-August).

These differences explain the large variation between the two sets of participation rates.

AMOUNT OF RECREATION DEVELOPMENT JUSTIFIED AT BOONE AND JESSAMINE CREEK SITES

The economic analysis presented in the preceding pages estimated the economic demand and probable recreation visitation to the Boone and Jessamine Creek natural areas provided they were developed to an extent comparable to the facilities provided at Boonesboro State Park. Implementing this development raises two questions. What amount of development would be required to serve the expected demand? Is this degree of development in harmony with preservation of the natural environment of the two sites?

An estimate of the area required to serve a given number of recreation visitors requires a judgment as to the maximum acceptable degree of crowding, the maximum acceptable frequency of crowding, and knowledge as to the time distribution over the course of the year of desired visitation. Furthermore, the various activities require distinct kinds of facilities in a specially reserved area. Of those activities which might be analyzed; picnicking and camping are the most demanding of space and can best be evaluated from available data.

The visitation at any hour of the year can be estimated using an equation presented by Sirles (52, p. 71). The equation is

$$V_i = A_a D_m D_d D_h \; 84/365 \qquad (7)$$

where V_i represents the hourly visitation of the hour whose annual, weekly, and daily distribution factors are represented by D_m, D_d, and D_h respectively and A_a is the total annual visitation. The planner must decide the order of the n^{th} highest hour for facility design. From this hourly visitation, the number of acres of land necessary to satisfy the demand can be computed by using activity capacity coefficients. Sirles lists several capacity coefficients in Table 6 (52, p. 40).

Using the present predicted annual visitation to Area A (Boone Creek) and Area D (Jessamine Creek), the hourly visitation of the peak hour was calculated for both areas. Normally some hour short of the annual peak should be used for facility design, but the peak provides an estimate of the maximum useful facility development. D_d and D_m, estimated by Sirles (52, p. 65, 69), were chosen for the fraction of the weekly visitation during the peak day of the week (0.521) and the fraction of the annual visitation during the peak month of the year (0.261). D_m, estimated for several activities, was chosen to represent both camping and picnicking, due to the relatively small difference in their values (52, p. 69). The peak hour of the day (D_h) has been found to have about 0.27 of the daily visitation present (52, p. 68). Knowing all the variables in Equation 7, the peak hourly visitation for the designated areas on Boone and Jessamine Creeks were found to be 328 and 340, respectively.

Since the annual totals and thus the computed hourly values include the activities of fishing, picnicking, camping, and hiking (walking for pleasure and nature walks), it is necessary for determining the area requirements to estimate individual hourly peak visitations for camping and picnicking. Based on the assumption that the participation in these activities would occur in the same proportion as those at Dewey Reservoir, the separation of total visitation into visitation for each activity was made based on data obtained by interviews by the Corps of Engineers. The proportions found and used were fishing (0.16), hiking (0.62), picnicking (0.27), and camping (0.11). Visitors engaged in more than one activity cause the total to exceed one. For Area A (Boone Creek) and Area D (Jessamine Creek), peak hour camping and picnicking visitation turn out to be (36 and 89) and (37 and 92) respectively. Using the appropriate capacity coefficients the acres of land necessary to satisfy the present annual camping and picnicking demand at these areas are 1.80 acres (camping) and 1.78 acres (picnicking) for Boone Creek while for Jessamine Creek they were 1.85 acres (camping) and 1.84 acres (picnicking).

While these acreages would satisfy present demand, future needs must also be considered. From the estimated future annual visitation, the number of acres of land necessary to satisfy the camping and picnicking demand can be found. In order to estimate the future annual visitation to Areas A and D which would be comparable to the previously used present annual visitation, it is necessary to assume that the counties surrounding Fayette are growing at or nearly at the same rate as Fayette. Having made this assumption, the future annual visitation (1976) can be estimated for camping and picnicking using the estimated present and future activity-days in Fayette County (Table 36) and the present annual visitor-days (Table 33). For example the future annual visitation (1976) for camping in Area A (Boone Creek) would be as follows:

$$\frac{49,490}{124,205} = \frac{(38,805)(0.11)}{x}$$

$$x = 10,714 \text{ visitor-days}$$

Then substituting x into Equation 7 for A_a, the 1976 peak hourly camping visitation is found, and by applying the capacity

EXAMPLE 1

SAMPLE CALCULATION OF ACTIVITY ACREAGE

This is a sample calculation to illustrate the computation of the number of acres of land necessary to satisfy present camping demand in Area A (Boone Creek).

1. $V_i = A_a D_m D_d D_h 84/365$

   $V_i = (38,805)(0.27)(.521)(.261)(84)/365$

   $V_i = 328$

2. V_i (camping) = (328)(0.11)

   V_i (camping) = 36

3. Camping Acreage = 36/20

   = 1.80 acres

coefficient the number of acres. Doing this for both activities in each area, for Boone Creek the acreages were 3.52 acres (picnicking) and 4.55 acres (camping) and for Jessamine Creek they were 3.64 acres (picnicking) and 4.70 acres (camping). These present and future acreages (picnicking and camping) were summed and compared to the measured number of acres suitable for camping and picnicking in each area. For Area A (Boone Creek), 3.58 acres are presently needed, and in 1976 8.07 acres will be needed to satisfy the demand. For Area D (Jessamine Creek), 3.69 acres are presently needed, while 8.34 acres will be needed in 1976 to satisfy the demand. As measured on the Preliminary Development Plans, Area A has 9.2 acres and Area D has 15 acres which are well suited for picnicking and camping. Consequently, if these areas were developed, they should completely satisfy the maximum visitation to the sites by visitors from within a fifty mile radius. Large numbers of visitors are not expected to these sites from greater distances. Also due to the nearness of the other suggested development areas, the estimated present and future acreages should roughly apply to all of these areas. This, being the case, the acreage of required development is sufficiently small that the facilities could be developed and still permit the watershed to retain most of its naturalistic features by proper land management.

PERCENTAGE OF THE PRESENT AND FUTURE DEMAND SATISFIED BY DEVELOPING A PARTICULAR CREEK SITE

The economic analysis and determination of required acreages presented above estimated the use and development needs at a particular site (for example, Jessamine Creek). Another way of viewing the problem is to consider the recreation demand generated by a particular population (for example, Fayette County). The two approaches can be coordinated by determining how well the various sites provide the total requirements of the population for recreation facilities.

Just because a particular site is developed sufficiently to accommodate all visitors wishing to use it does not mean the full recreation facility requirement of the population of a nearby county is provided. Many individuals may wish to camp but because of distance, taste, or other reasons not be attracted by a particular site. The above analysis shows that Boone Creek (Area A) would satisfy roughly 8.62 percent (10,714/124,205) of the future demand generated by the Lexington-Fayette County Area for camping and 5.11 percent for picnicking providing it were developed. Similarly, Jessamine Creek (Area D) would satisfy roughly 8.93 percent and 5.30 percent of the future demand generated by Lexington-Fayette County Area if it were developed. The balance of the future demand would have to be satisfied by other strategically located developments.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The results of this study can be grouped into two sections: (1) that concerned with the development of a methodology for evaluating the recreational quality of a small naturalistic area (Chapter II) and its test applications (Chapter III) and (2) that concerned with the economic benefit resulting from recreation development at such sites (Chapter IV). Each of these sections and certain of their subsections are critically summarized in the paragraphs that follow. Conclusions and recommendations for further research are listed at the end of the chapter.

THE EVALUATION METHODOLOGY - SUMMARY

INVENTORY PHASE

The objective of this phase was to collect and present in usable form all available data pertinent to the evaluation of the esthetic and recreational qualities of a small suburban watershed. The features inventoried were classified as either natural or cultural.

The natural features included topography, geology, pedology, hydrology, vegetation, native fauna and climate. The kinds of data assembled and their method of presentation were based on the premise that, at least in the regional location of the study, rugged topography and the existence of naturalistic conditions were equivalent to high esthetic quality and outdoor recreation potential. Furthermore, it was theorized that these same conditions were usually indicative of a restricted land use capability that would be less competitive with alternate uses such as agriculture, industry, etc. The watershed Slope Maps, the Stream Order and Vegetation Maps, the "Horton

Analysis," the texture ratio computations and, to some extent, the Geological and Soils Maps all served to express the extent of these optimum conditions for esthetic and recreational uses and also to define areas where other land uses might be appropriate.

The development of a slope map from a topographic map and the collection of data needed for the Horton Analyses were laborious and time-consuming. Reduction of the number of slope categories from five (Boone Creek) to four (Jessamine Creek) speeded up the process somewhat. (See Appendix B). Other short cuts were introduced in the inventories for Hickman and Clear Creeks with little apparent decrease in the reliability of the final product. Further study of the significance of the relationship between stream order and other natural and cultural features may enable a reduction in the work now needed to assemble the Horton data.

The cultural features inventoried included land use and land use capability, transportation facilities, water quality and quantity, historical sites, demographic and socio-economic factors, disvalues and land husbandry. The basic idea here was to collect data that would help determine: the effects of man's past and present occupancy of the watershed, the extent to which he had enhanced, preserved or damaged the quality of the area and what, in the light of an expanding urban population and social change, he might be expected to do in the future. Much of this information was presented in descriptive tables keyed by specific symbols to the Resource, Transportation, Land Use and Land Use Capability Maps.[1]

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[1] Location of certain natural features such as creek pools and interesting geologic formations were also indicated on these maps.

Aerial photographs were used extensively in the inventory phase of the study. For some features, more information was available on the photos than was needed in the evaluations. However, interpretation of features on or near heavily forested stream segments was difficult or impossible since all the photographs used (USDA) were made in the summer or early fall. This was particularly true of the pool inventory and the attempt to locate streamside dumps and other disvalues; consequently, some of this part of the inventory had to be done in the field.

Ground photographs and color transparencies were made of various natural and cultural features found in the study watersheds. The purpose of these pictures was to supplement the other modes of data presentation and to provide an impression of the quality of the study area which could readily be communicated to others.

The case studies of Boone and Jessamine Creeks also included collection of on-site interview data about the informal recreational use of the streams and their surroundings. These interviews (not actually a part of the generalized methodology) indicated that nearly all of the visitation occurred during weekends and originated less than fifteen miles from the creek site.

Answers to a mail questionnaire revealed that Boone and Hickman Creeks were used more by Boy Scouts for hiking and camping than were Jessamine and Clear Creeks. This was probably due to differences between the two streams in accessibility and distance from the city.

ANALYSIS AND EVALUATION PHASE

In the second phase of the methodology, the inventory data were used as input to an evaluation procedure designed to estimate a watershed's potential for the development of facilities for thirteen different recreational activities and the establishment of three types of areas: scenic, natural and historic. The evaluation was accomplished by determining a numerical rating for each of several key elements considered to be determinants of the quality of an activity or area. The sum of the products of the key element ratings and their corresponding multipliers, (weight numbers representing the relative importance of each key element to a given activity or area) formed, when expressed as a percentage of the maximum possible product sum, the potential "score" for that activity or area.

In adapting the evaluation procedure from the original SCS system (70) an attempt was made to reduce the use of subjective judgment in the determination of key element ratings. This was done by extracting from the inventory sets of values or measures of value for each of the fourteen key elements. A numerical rating ranging from zero to ten and based directly on inventory data (i.e.; average temperature, percentage of land in forest, percentage of the local population in a certain age group, etc.) was then assigned to each value. To express the significance of the values or measures of value to the activity or area for which the key element was being rated, a rating weight, varying with the type of activity or area, was assigned to each. Since the sum of the rating weights was made always to be ten, the final key element rating for an activity or area was formed by summing the products of the value ratings and the rating weights and dividing the result by ten.

During the development of the evaluation procedure, it became obvious that some form of subjective judgment would still be required in arriving at some of the value ratings. In rating climate, for example; what average temperature is optimum for a certain activity and what percentage of clear days should be given the highest rating? Answers to these questions were based, in part, as were others of like nature, on the regional locale of the study watersheds, i.e., for the central United States the best prevailing climate for outdoor recreation was assumed to be one with an average seasonal temperature of 65° F. and clear skies 70 percent of the time.

Other forms of subjectivity involved decisions as to whether some value was of "low, medium or high quality," was "poor, fair or excellent" or whether there were "few, several or many" occurrences of it. In making these decisions, emphasis was placed on fully utilizing the tables, maps and photographs of the inventory. Independent estimates of ratings for those values requiring subjective judgments were made by two persons familiar with the inventory data and the study watersheds; in no case did the ratings differ by more than one or two digits on the scale of ten.

The sensitivity of the potential scores to the ratings given the various values and key elements was briefly investigated. It was found that, as anticipated, the scores for scenic and natural areas and the ratings for the key elements, scenery and natural environment, were highly sensitive to variations in areal percentages of forests, abandoned fields and Class VI, VII and VIII land capabilities. For fishing, there was very little difference in the scores for the specie categories of game fish versus pan and rough fish. This was attributed to the overall high ratings for water quality in the study streams and therefore correctly reflected the true situation. The scores for transient camping, picnicking, auto tour routes, sightseeing and game fishing varied with watershed location because of the different levels of accessibility existing in these areas; of particular importance here was the proximity of major tourist routes to the watershed.

In general, the potential scores obtained by applying the methodology to the study watersheds and to selected areas along Boone and Jessamine Creeks were in the ranges expected. A major deficiency in the case studies was the physical similarity of the watersheds. This partially accounts for the nearly identical scores obtained for many of the activities. Exceptions to this, in addition to those differences caused by variations in accessibility, were found in the potential scores for historic areas (Boone Creek - 67%, Jessamine Creek - 46%) and nature walks (Boone and Hickman Creeks - about 33% and Jessamine and Clear Creeks - about 46%). The presence in the Boone Creek watershed of historic sites of national significance caused it to be rated higher than Jessamine Creek as a historic area. Disvalues and a lower quality natural environment resulting from their nearness to the urban area tended to reduce the potential of Boone and Hickman Creeks below that of Jessamine and Clear Creeks as sites for the development of nature walks.

To further examine the efficacy of the evaluation procedure, Preliminary Development Plans were prepared for Boone and Jessamine Creeks. These plans roughly delineated two or three areas in each watershed that appeared to be suitable for recreational development. Application of the methodology to two of these smaller sites (for the camping and picnicking activities only) resulted in much higher potential scores than those obtained when the entire watershed was evaluated. Sensitivity of the picnicking and transient camping activities to accessibility still prevailed, however, with the Boone Creek site being rated 14% and 7% higher, respectively, than the Jessamine Creek site.

ECONOMIC ANALYSIS OF THE RECREATION SITES - SUMMARY

This section of the research, a logical extension of the case studies, sought ways to: estimate the visitation to developed recreation sites on naturalistic streams, predict the future demand for short term outdoor recreation activities generated by an urban population and determine what proportion of an estimated future demand might be satisfied by a specific development. The effort was plagued by a lack of visitation and participation data relevant to recreation on small streams.

A visitation prediction equation was developed for sites on Boone and Jessamine Creeks from camping records collected over a three-year period at a nearby state park. The equation included only the parameters of distance and population of the origin area other factors having been found by a step-wise multiple regression technique to be relatively insignificant. Use of the equation was extended to activities other than camping (fishing, picnicking, pleasure walking and nature walks) by including in the equation relative participation factors obtained from information gathered during a previous recreational study of Rough River Reservoir.

After testing several alternates the equation finally used to predict annual visitation to the selected sites on Boone and Jessamine Creeks was one based on data collected from the 32 Kentucky counties within a 50 mile radius of the sites. As it happens with most prediction equations of the "gravity model" type, visitation was somewhat overestimated for origin areas close to the recreation sites.

The computed visitation to each stream in visitor-days was used, in a procedure devised by Sirles (52), to estimate the annual benefits that might be derived from the proposed developments. Benefits were estimated to be about 24 cents per visitor-day or about $9000 per year for each site with Boone Creek being slightly more attractive. The annual benefit estimate appeared reasonable in comparison with the income derived from one small privately operated development on Jessamine Creek.

The future (1976) participation in ten selected outdoor recreation activities was estimated for each of the 28 census tracts of Fayette County, Kentucky. Participation rates (and a method for estimating their rate of change with time) developed by the ORRRC (39) were used without modification. Since the ORRRC rates were based on summer time participation in outdoor recreation by persons 12 years of age and older the computed values for Fayette County reflect these same restrictions. This was not considered a serious fault since most of the demand for the selected activities originates in the over-12 age group and is at its highest during the summer months.

The usefulness of the participation estimates depends of course, on the accuracy of the population predictions as well as on the reliability of the participation rates. Increases in population for the Fayette County census tracts were estimated from past trends and probable changes in land use. The short range (1960-1976 of the predictions should make them reasonably correct. Long range estimates of participation were not made.

Slightly less than four acres of land developed at each site for camping and picnicking was estimated sufficient to accommodate the current demand at each site. About eight acres will be needed at each site by 1976. If the selected sites were developed on Boone and Jessamine Creeks, they would satisfy only about 18 percent and 10 percent of the total 1976 demand generated by the Lexington area for short-term camping and picnicking, respectively.

A variation of the above procedure enabled consideration of the recreational supply-demand problem from the viewpoint of available acreage for a activity versus the acreage required (assuming certain criteria for control of overuse and crowding were applied). These computations showed that the selected sites, when fully developed, would be of ample size to accommodate estimated present and future camping and picnicking visitation to those specific sites.

CONCLUSIONS

(1) There exist within the boundaries of a small watershed sets of values, measures of value and disvalues which can be identified and used objectively to estimate its potential for esthetic and recreational uses.

(2) For most small watersheds near urban areas, there are already available the information sources needed to identify and inventory many of the values and measures of value to be found in the watershed.

(3) Current aerial photographs are useful in supplementing and updating the inventory of values; they are also helpful in the planning and execution of field investigations.

(4) Soils, land use and capability classification systems developed by others for varying purposes are, in combination, readily applicable to the problem of succinctly expressing the location and significance of the natural and cultural values of small watershed or similar areas.

(5) The SCS method of estimating recreational potential, modified to suit the "values" concept and the type of area being studied, provides a means of arriving at fairly accurate esthetic and recreational evaluations for an entire watershed or some selected part of it.

(6) Judging from the results of the case studies many small naturalistic streams near urban areas may possess medium to high potential for camping, limited fishing, picnicking, the development of a trail system and some forms of esthetic enjoyment. Other streams or stream area segments may, when evaluated separately, also show high potential for the establishment of nature walks or for designation as a natural, scenic or historic area.

(7) The success of efforts aimed at estimating future visitation, participation demand and the economic benefits to be gained from the development of small stream recreation depends on the relevance and reliability of the basic data from which the estimating equations are derived. There is very little information of this type presently available. Considering the types and sources of the data used, the estimates made for the case study streams provide at least an approximate view of how some future recreational development might fare in these areas. The estimates of annual benefits and the acreage needed for camping and picnicking for sites on Boone and Jessamine Creeks were especially reasonable.

(8) The watersheds evaluated in this study, Boone, Jessamine, Hickman and Clear Creeks, all contain irreplacable esthetic, natural and historic values that would alone seem to justify their protection and preservation, their development potential and the increasing recreational demand generated by a growing city notwithstanding.

RECOMMENDATIONS FOR FURTHER RESEARCH

(1) Investigate ways of simplifying and expediting the inventory process. For example: (a) For interpretation purposes use large scale (1:6000 - 1:12000) aerial photographs made in the late fall or early spring. (b) Use a photogrammetric plotter (when diapositives are available and accurate topographic maps are not) to define slope category areas and procure the Horton data. (c) Find a way of measuring stream flow that is faster than conventional gaging methods.

(2) Perform additional tests of the evaluation methodology by applying it to streams near other urban areas in Kentucky. The size, relative location and configuration of small streams near four Kentucky cities were examined on topographic maps and nine were

selected as possible future test sites. Location of the four cities within the state is shown in Figure 34 and the selected streams are listed and briefly described on Table 38.

(3) Determine the modifications necessary to make the methodology applicable to small streams in other sections of the United States, especially those with climate, topography and socio-economic characteristics different from Kentucky's.

(4) Ascertain to what extent a preference survey or study might be useful in justifying the acquisition and/or preservation of a naturalistic stream or a scenic or historic area. One current opinion holds that insofar as land use planning and zoning are concerned, the public eventually gets what it wants. The purpose of this suggested extension of the research would be to find out whether or not there is really any significant desire on the part of the public to have available a nearby natural area or place for low key recreation. A psychometrics approach using photographs or slides showing both good and bad aspects has been used for evaluating residential neighborhoods (46); the same general procedure may be appropriate for small streams.

(5) Collect and analyze visitation, participation and economic benefit data for outdoor recreation areas near growing cities of medium size, concentrating on those recreational activities and types of areas that were considered in the present study. Such analyses would enable the development of better predictive methods than now exist for planning urban outdoor recreation areas.

TABLE 38

KENTUCKY CREEKS SUGGESTED FOR FUTURE EVALUATION

Urban Area	Creeks	Remarks
Louisville	Beargrass	Already partially developed. A large part of the lower reaches have been overrun by suburbs.

TABLE 38 - Continued

Urban Area	Creeks	Remarks
	Harrods	Though a little larger than the case study streams, this watershed is topographically very similar.
Covington	Mud Lick	Watershed area is about 100 square miles. However, the streamside topography is not as precipitous as the Bluegrass Creeks and the flood plains are more extensive.
	Gun Powder	Watershed very similar to that of Hickman Creek.
	Banklick	Very similar to the case study areas in all respects.
Ashland	Tygart's* and East	Both of these creeks' watersheds are much larger than the case study areas and flow through wide alluvial valleys. The upper reaches, however, are somewhat similar to the study areas as are many of the small tributaries of both creeks.
Pikeville	Shelby and Toler	Similar in size, however, the topography (Appalachia) is different. There are few cliffs and more knobby hills present.

*Tygart's Creek has already been recommended for preservation as a wild stream by the Kentucky Outdoor Recreation Plan (56). This plan also makes several other such recommendations for streams larger than those considered in this study.

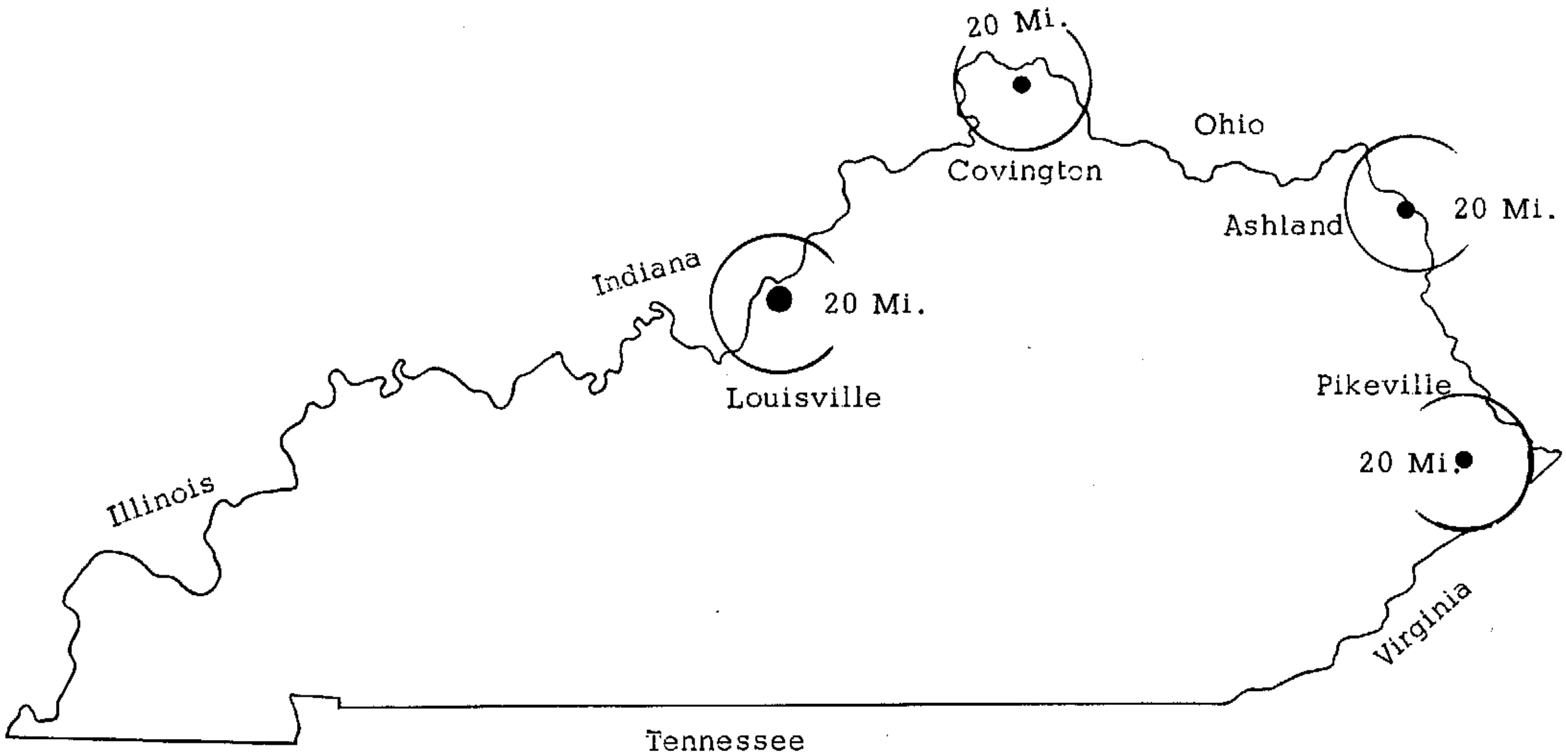

Figure 34. Location of Kentucky Urban Areas
Suggested for Future Studies

FINAL COMMENTS

The preceding was concerned with the quality of a resource that is steadily diminishing or deteriorating in the face of an increasing demand for its use. To further complicate the problem the forces creating the demand are also those that are tending to destroy the resource. A solution to this problem was beyond the scope of the present study. It may be, however, that if there is a solution, it lies in the return to a preoccupation with quality rather than quantity in the planning of American cities and in American life in general. If this comes to pass, then the ideas developed during this research, may find fruitful application.

APPENDIX A

KEY TO MAPPING SYMBOLS, WATER QUALITY STANDARDS AND SAMPLE QUESTIONNAIRES

I. KEY TO MAPPING SYMBOLS - PARENT MATERIAL AND SOILS

Source: 30, Appendix B and 25, pp. 127-128

ORIGIN AND TYPE OF PARENT FORMATION:

A. Residual Soils (designated by rock type)

a) Sedimentary - S

(1) Limestone - Sl

(2) Sandstone - Ss

(3) Shale - Sh

[Similar sets of symbols may be used for Igneous (Ig) and Metamorphic (MM) rocks]

B. Non-Residual Soils (designated by unit land form)

a) Fluvial - F

(1) Floodplain - FP

a. Bar type - FPB

b. Bar meander - FPM

c. Covered - FPC

d. Complex - FPV

e. Recent - FPR

f. Old - FPO (no definite terrace levels)

g. Sloughs - FPS

h. Point bar scrolls - FPB

i. Abandoned channel - FPA

(2) Terrace - FT

(3) Delta - FD

(4) Deltaic Plain - FDP

b) Colluvial - C

(1) Cone - CC

(2) Talus, scree, etc. - CT

DEGREE OF CONTRAST WITHIN SOIL PROFILE:

If profile is contrasty, a capital "C" is added after the origin, landform, rock type designation.

TEXTURAL NATURE OF SOIL PROFILE:

(Unified Soil Classification System)

Source: 55, pp. 67-70

A. Coarse-grained Soils:

a) GW and SW groups comprise well-graded gravelly soils and sandy soils with little or no non-plastic fines.

b) GP and SP groups are poorly graded gravels and sands with little or no non-plastic fines. These materials may be classified as uniform gravels, uniform sand, or gap-graded materials.

c) GM and SM groups comprise silty gravels and silty sands with fines having no plasticity. Both well-graded and poorly graded materials are included in these two groups. Normally, these soils have little to no dry strength, but occasionally the fines or binder material will contain a natural cementing agent which will increase dry strength.

d) GC and SC groups comprise gravelly or sandy soils with fines that are more clay-like and which range in plasticity from low to high. Both well and poorly graded materials are included in these groups.

B. Fine-grained Soils:

a) ML and MH groups are soils classified as sandy silts, clayey silts, or inorgantic silts with relatively low plasticity. Loess-type soils, rock flours, micaceous and diatomaceous soils are also included. Some types of kaolin clays and illite clays also fall within these groups.

b) CH and CL groups are primarily inorganic clays. The

CH groups, medium and high plasticity clays, include the fat clays, gumbo clays, bentonite, and certain volcanic clays. The low plasticity clays are classified CL and are usually lean clays, sandy clays, or silt clays. The glacial clays of the northern United States cover a wide band in these two groups.

c) OL and OH groups are soils characterized by the presence of organic matter. Organic silts and clays are classified in these two groups, and they have a plasticity range corresponding to the ML and MH group.

DRAINAGE CONDITIONS:

e - excellent;	10 ft. to water table
g - good;	6 to 10 ft. to water table
i - imperfect;	3 to 6 ft. to water table
p - poor;	1 to 3 ft. to water table
v - very poor;	0 to 1 ft. to water table

SLOPE: (See also page 20 of this study.)

f - flat slopes; 0 to 2 percent

m - medium slopes; 2 to 5 percent but may have some flatter slopes and short steep slopes.

mst - 5 to 10 percent

st - steep; most slopes greater than 10 percent but may include flatter slopes.

vst - 10 to 20 percent

C - > 20 percent (cliffs)

SPECIAL SYMBOLS:

X - existence of important exceptions regarding any or all of the three primary identification elements; parent material, texture or drainage.

R - detailed, accurate mapping not feasible due to many variations in soil makeup.

a, b, c, etc. - subdivisions of areas of like parent material, texture and drainage to indicate differences in landform or other important characteristics. (not often needed).

/ - diagonal bar - used to separate two symbols where accurate delineation of boundaries is not feasible.

_ - horizontal bar - code symbols above and below bar to show where bedrock is near surface or where one material overlies another to such a shallow depth that ordinary construction excavation would be likely to encounter the lower layer.

---- broken line; boundary not clearly defined - transition zone between different materials.

II. KEY TO MAPPING SYMBOLS* - VEGETATION

Source: 31, pp. 2, 3

FOREST LANDS:

Forested land is classified by a system which describes the forest by species, height and density. Height indicates tree size while density determines light conditions under the stand and the likelihood of brushy conditions under it.

Species and species groups are designated by letters as follows:

P - Species of pine constitute at least 80% of the stand.

HK - Hemlock constitutes at least 80% of the stand.

C - Red cedar constitutes at least 80% of the stand.

H - Species of hardwood constituting at least 80% of the stand.

PH - A mixture of pine and hardwood with neither the pine nor the hardwood making up 80% of the stand.

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* Used by permission of the author.

HH - A mixture of hemlock and hardwood with neither the hemlock nor the hardwood making up 80% of the stand.

CH - A mixture of cedar with hardwoods none making up 80% of the stand.

Five height classes are designated as follows:

1 - 1 ft. to 20 ft.

2 - 21 ft. to 40 ft.

3 - 41 ft. to 60 ft.

4 - 61 ft. to 80 ft.

5 - 81 ft. to 100 ft.

Three density classes are indicated by letters.

A - good density, 81 to 100% crown closure

B - poor density, 51 to 80% crown closure

C - open forest, 30 to 50% crown closure

The map symbol is formed by listing the three appropriate symbols for species, height class and density in sequence.

ABANDONED FIELDS:

AF - Is an abandoned field which is reverting to wild land. Woody vegetation is abundant but the crown cover is less than 30%. If the crown cover were greater than 30%, the land would be classified as forest. This land may be grazed by domestic animals and it is highly productive of wildlife.

III KEY TO MAPPING SYMBOLS - LAND USE AND LAND USE CAPABILITY

LAND USE:

Source: 31, pp. 1-7*

A. Agricultural or Open Lands

Agricultural land is classified by the uses and misuses to which the farmer has put it.

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* Used by permission of the author.

T - is tilled or tillable crop land which is or has recently been intensively farmed. This type consists of nearly all open, continuous fields without interruption by stone walls, hedgerows, trees or other wild vegetation. The boundaries are sharply defined and well kept up because the land is valuable.

P - is permanent pasture or wild hayland which often is not suitable for tillage due to steepness of slope, poor drainage, stoniness, or lack of fertility. This land is usually without sharply defined boundaries and often has occasional scattered shade trees for the grazing animals. The evidence of livestock or livestock uses is often present.

O - is a productive fruit orchard.

AO - is an abandoned orchard, a type heavily used by wildlife.

N - is land supporting nurseries. This type would include greenhouses and land adjacent to them as well as lands supporting horticultural specialities, ornamentals and shrubs.

H - is river bank or gullied areas immediately adjacent to the bank which are covered with miscellaneous herbaceous vegetation. Such gullied areas are unsuited for agriculture, and usually become forested in the long run.

R - is a rocky area which may support scattered herbaceous vegetation.

B. Urban and Industrial

Land classified as urban is an area which encompasses a large number of people living and working in closely ordered structures and in a confined land space. Its limits are usually at the border of the block street pattern or just beyond it.

UI - is industrial land containing facilities for the manufacture and assembly of raw or partially processed materials such as machinery, chemicals, electronics, appliances, etc. Warehouses and transportation facilities for bulk products and an open or interrupted street pattern characterize this type. Few people live here.

UIW - is land supporting industries located on the stream and using stream water in large volumes.

UC - is commercial land predominantly used for distribution, transportation, or merchandizing goods and services. Stores, hotels, offices, and smaller warehouses are usually set close to streets having a close pattern. Trees are rare, except at large suburban shopping centers which are surrounded by large parking areas. Most of the people not living in residential areas live here.

UT - is transportation land (other than the traveled way) used for air, water or land transportation facilities. Airports, docks, rail yards, and terminal freight and storage facilities are characteristics of this land use. Transportation facilities which are part of an industrial complex are included as part of the industry.

UR - is residential land used for homes and apartments which are spaced closely, arranged in orderly curved or rectangular patterns and set back from the street. Isolated large structures such as schools and churches are part of the landscape. Most of the people live here.

USR - is sparse residential land with three or more domestic dwellings which are not dense enough to classify the land as residential. This type includes homes and related structures such as garages, barns and sheds in a more scattered pattern than on residential land. The vegetation here would be trees, gardens, lawns and dirt yards associated with the dwellings.

USV - Vacation cottages.

UE - estates larger than 10 acres in size.

UO - open undeveloped land in the midst of urban areas.

\+ - cemeteries.

C. Extractive Industries and Dumps

SG - Sand or Gravel - this land is currently used for the extraction of samd or gravel.

RM - Limestone rock mine.

RQ - Open limestone quarry.

OM - Other mining - this land is used for the extraction of material other than sand, gravel or hardrock.

SB - Spoil bank - this is land from which sand, gravel or other soil materials have been extracted or is land on which surplus soil material has been dumped.

D - Dump - this land is used for dumping waste and refuse materials.

DA - Automobile dumps - automobile graveyards or active automobile junk yards.

FB - Filter bed - this land is used for treating liquids containing organic or chemical matter.

D. Outdoor Recreation

RR - horseback riding school or training area.

RCG- campground, public.

RCGP - private, organized campground.

RG - golf courses.

RD - driving ranges.

RT - race tracks.

RS - swimming pools.

RC - tennis courts.

RP - picnic area, public.

RA - athletic fields and stadiums.

RPG - playground. A conglomeration of many types of play ground facilities.

E. Change Symbol

Add "Ch" at end of land use symbol if significant change has occurred in area during past five to ten years.

F. Pollution Sources

The classification of actual or potential sources of water pollution as identified on the ground or by airphoto interpretation is as follows:

PS - is soil pollution which originates at points where the stream bank or adjacent hillside is eroding at a rate which causes excessive stream turbidity or siltation.

PC - is chemical pollution introduced by industrial or agricultural operations.

PO - is pollution by organic waste materials from paper industries, slaughter houses, rendering plants, etc.

POS - is pollution by organic waste material in the form of domestic sewage.

<u>LAND USE CAPABILITY (RURAL):</u>

Source: <u>71</u>

A. Land Use Capability - Main Classification Scheme

Land Class Symbol	Land Capability and Use Precautions	Primary Uses	Secondary Uses
	Group I. (land suitable for cultivation)		
I	Excellent land, flat, well drained. Suited to agriculture with no special precautions other than good farming practice.	Agriculture	Recreation Wildlife Pasture

Land Class Symbol	Land Capability and Use Precautions	Primary Uses	Secondary Uses
II	Good land with minor limitations such as slight slope, sandy soils, or poor drainage. Suited to agriculture with precautions such as contour farming, strip cropping, drainage, etc.	Agriculture Pasture	Recreation Wildlife
III	Moderately good land with important limitations caused by soil, slope, or drainage. Requires long rotation with soil-building crops, contouring, or terracing, strip cropping or drainage, etc.	Agriculture Pasture Watershed	Recreation, Wildlife, Urban-Industrial
IV	Fair land with severe limitations caused by soil, slope, or drainage. Suited only to occasional or limited cultivation.	Pasture Tree crops Agriculture Urban-Industrial	Recreation, Wildlife, Watershed
	Group 2. (land not suitable for cultivation)		
V	Land suited to forestry or grazing without special precautions other than normal good management.	Forestry Range Watershed	Recreation, Wildlife
VI	Suited to forestry or grazing with minor limitation caused by danger from erosion, shallow soils, etc. Requires careful management.	Forestry Range Watershed Urban-Industrial	Recreation, Wildlife

Land Class Symbol	Land Capability and Use Precautions	Primary Uses	Secondary Uses
VII	Suited to grazing or forestry with major limitations caused by slope, low rainfall, soil, etc. Use must be limited and extreme care taken.	Watershed Recreation Wildlife Forestry Range Urban-Industrial	
VIII	Unsuited to grazing or forestry because of absence of soil, steep slopes, extreme dryness or wetness.	Recreation Wildlife Watershed Urban-Industrial	

B. Land Use Capability - Subclasses*

1. Subclass (e) erosion is made up of soils where the susceptibility to erosion is the dominant problem or hazard in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.
2. Subclass (w) excess water is made up of soils where excess water is the dominant hazard or limitation in their use. Poor soil drainage, wetness, high water table, and overflow are the criteria for determining which soils belong to this subclass.
3. Subclass (s) soil limitations within the rooting zone includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult

* See Table 7, p. 80 of this study.

to correct, and salinity or sodium.

4. Subclass (c) climatic limitation is made up of soils where the climate (temperature or lack of moisture) is the only hazard or limitation in their use.

C. Land Use Capability Units*

"A capability unit contains soils that are nearly alike in plant growth and management needs."

The units are:

1 - erosion hazard
2 - wetness problems
3 - slowly permeable subsoil
4 - coarse texture, low water holding capacity
5 - fine texture, tillage problems
6 - salinity or alkali
7 - cobbly, rocky or stony
8 - root zone limitation, bedrock or hardpan
9 - low fertility, acidity or toxic properties
10 - very coarse textured substratum

LAND USE CAPABILITY (URBAN):

Source: 25, pp. 119-127

Land Use***	Rating	Soil Classification- Unified System	Drainage Class	Average Slope	Depth to Bedrock
Residential	Optimum	GW, GP SW, SP	good to excellent	0-5%	7 + ft.
	Satisfac- tory	GM, GC, ML SM, SC, CL	-	5-10%**	-

*See Table 7, p. 80 of this study.

**Limiting factor-reduces rating regardless of the other three factors.

***Commercial and transportation land uses are dependent on the density location of residential and industrial development. For this reason, the land use ratings given for either residential or industrial are generally applicable to these land use categories.

Land Use**	Rating	Soil Classification- Unified System	Drainage Class	Average Slope	Depth to Bedrock
	Marginal	MH, CH, OL OH	fair	10-20%	3 - 7 ft.
	Unsatis-factory	Muck and Peat*	poor to* very poor	>20%*	0 - 3 ft.*
Industrial	Optimum	GW, GP SW, SP	good to excellent	0- 2%	> 7 ft.
	Satisfac-tory	GM, GC, SM SC, ML, CL	-	2- 5%*	3 - 7 ft.
	Marginal	MH, CH OL, OH	fair, poor or very poor	5-10%	0 - 3 ft.
	Unsatis-factory	Muck and Peat*	area subject to periodic flooding	>10%*	-

*Limiting factor - reduces rating regardless of the other three factors.

**Commercial and transportation land uses are dependent on the density and location of residential and industrial development. For this reason, the land use ratings given for either residential or industrial are also generally applicable to these land use categories.

IV. KEY TO MAPPING SYMBOLS - TRANSPORTATION (ROADS)

The symbols used are based on the Basic Geometric Design Standards of the Kentucky Department of Highways. The Standards recognize four classes of high-type roads and three subdivisions (A, B, and C) of "class eight", the rural secondary or farm-to-market road. Alphabetical prefixes are added to the numerical symbols in this report to distinguish Interstate Highways (I); Federal Aid Primaries (FAP) and Federal Aid Secondaries (FAS).

Private farm roads and well defined foot or bridle trails are designated by the letter symbols, FT and T, respectively. The following table outlines the significant geometrics of each class of road and indicates the approximate traffic volume capacity of each by the Average Daily Traffic (ADT).

Class	ADT (Veh. per day)	Design Speed (MPH)	Pavement Width (Ft.)	Roadbed Width (Ft.)	Maximum Degree of Curvature	Maximum** Grade
1	>5000	50-70	24 (May be 4 lane)	44 (min.)	8.5°-4°	4-5%
2	1500-7000	50-70	24	44	8.5°-4°	4-5%
3	400-750	40-70	22-24	34-36	13.5°-4°	4-6%
4	<400	30-60	20-22	28-30	25°-5.5°	4-7%
8A	100-250	*	18	24	36°	12%
8B	50-100	*	16	20	56°	14%
8C	<50	*	14	18	56°	16%
FT	Single lane, gravel or dirt surfaced farm service road					
T	Foot or bridle trail; some sections may be passable by four-wheel drive vehicle.					

* Design speed controlled by the horizontal and vertical alinements.

** Varies with type of terrain; maximum grades shown are for rolling terrain.

NEW YORK STATE CLASSES AND STANDARDS FOR FRESH SURFACE WATERS

Source: 15, p. 15

Class and Best Use (1)	Dissolved Oxygen in Milligrams per Liter (2)	Coliform Bacteria Median, Per 100 Milliliter[a] (3)	pH (4)	Standards of Quality	
				Toxic Wastes, Deleterious Substances, Colored Wastes, Heated Liquids and Taste and Odor Producing Substances (5)	Floating Solids Settleable Solids Oil, and Sludge Deposits (6)
AA-Source of unfiltered Public Water Supply and any other usage	5.0 minimum (trout) 4.0 minimum (nontrout)	Not to exceed 50	6.5 to 8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or make the waters unsafe or unsuitable	None attributable to sewage, industrial wastes or other wastes

[a]Waste effluents discharging into public water supply and recreation waters must be effectively disinfected.

NEW YORK STATE CLASSES AND STANDARDS FOR FRESH SURFACE WATERS
(Continued)

(1)	(2)	(3)	(4)	(5)	(6)
A-Source of filtered Public Water Supply and any other usage	5.0 minimum (trout) 4.0 minimum (nontrout)	Not to exceed 5,000	6.5 to 8.5	None in sufficient amounts or at such temperature as to be injurious to fish life or make the waters unsafe or unsuitable[b]	None which are readily visible and attributable to sewage, industrial wastes or other wastes
B-Bathing and any other usages except as a source of Public Water Supply	5.0 minimum (trout) 4.0 minimum (nontrout)	Not to exceed 2,400	6.5 to 8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or make the waters unsafe or unsuitable	None which are readily visible and attributable to sewage, industrial wastes or other wastes
C-Fishing and any other usages except	5.0 minimum (trout)	Not appli-	6.5 to	None in sufficient amounts or at such	None which are readily visible and

[b] Phenolic compounds cannot exceed .005 milligrams per liter; no odor producing substances causing threshold odor number to exceed 8.

NEW YORK STATE CLASSES AND STANDARDS FOR FRESH SURFACE WATERS
(Continued)

(1)	(2)	(3)	(4)	(5)	(6)
Public Water Supply	4.0 minimum (nontrout)	cable	8.5	temperatures as to be injurious to fish life or impair the waters for any other best usage	attributable to sewage, industrial wastes or other wastes
D-Natural drainage Agriculture, and Industrial Water Supply	3.0 minimum	Not appli-cable	6.0 to 9.5	None in sufficient amounts or at such temperatures as to prevent fish survi-val or impair the waters for agri-tural purposes or any other best usage	None which are readily visible and attributable to sewage, industrial wastes or other wastes

USER QUESTIONNAIRE

1. How many miles from home did you travel even if you came by indirect route?

   No. of Miles __________ Direct Route __________

2. What town and county are you from?

   Town __________________ County ________________

3. What do you do for a living?

   ______ a. Skilled Labor ______ f. Retired
   ______ b. Unskilled Labor ______ g. Student
   ______ c. Professional ______ h. Housewife
   ______ d. Office (White Collar) ______ i. Unemployed
   ______ e. Farmer ______ j. Other

4. What is your total family income before taxes?

   ______ a. Under $3,000 ______ d. 7,000 - 9,999
   ______ b. 3,000 - 4,999 ______ e. Over 10,000
   ______ c. 5,000 - 6,999

5. What type of group is this?

   ______ a. Individual ______ c. Boy Scouts
   ______ b. Family ______ d. Other

6. Age Group

Age Group		Males	Females
______	a. Under 12	______	________
______	b. 13 - 19	______	________
______	c. 20 - 44	______	________
______	d. 45 - 64	______	________
______	e. 65 and Over	______	________

USER QUESTIONNAIRE

(Continued)

7. Which of the below activities are they doing?

_____ a. Fishing
_____ b. Picnicking
_____ c. Camping
_____ d. Hiking
_____ e. Sightseeing
_____ f. Loafing
_____ g. Horse Trails
_____ h. Other

8. Where did you park your car?

____

Creek: _______________________

Location: _______________________

Date: _______________________

Time: _______________________

Weather: _______________________

Temp.: _______________________

BOY SCOUT QUESTIONNAIRE

1. Does your troop ever go to any of the four below creeks during the year? YES______ NO______ If so, check which one or ones.

    ______ a. Boone Creek ______ c. Clear Creek

    ______ b. Jessamine Creek ______ d Hickman Creek

    If not, list places your troop does visit.______________________

    ____

2. How many times during the year do you go?____________________

3. For what purpose do you go?

    ______ a. Camping ______ c. Other

    ______ b. Hiking

4. Approximately how many go?

    ______ a. 0 - 5 ______ d. 15 - 20

    ______ b. 5 - 10 ______ e. 20 - 25

    ______ c. 10 - 15 ______ f. Over 25

5. How long do you generally stay and approximately where along the creek or creeks do you stay? ______________________

    ____

    ____

    ____

6. What is your opinion on the suitability of these creek areas for scouting activities? ______________________

    ____

    ____

    What would make them more suitable?____________________

    ____

BOY SCOUT QUESTIONNAIRE

(Continued)

7. Was permission obtained for use of the area?

   YES _____ NO _____ If so, from whom? ____________________

8. You are encouraged to express other comments or ideas not expressed by answering the above questions on the back on this questionnaire.

NAME ____

ADDRESS ____

____

OWNER QUESTIONNAIRE

Name ______________________________

Address ____________________________

____

1. Are you interested in preserving the natural state and beauty of the Creek? Yes _____ No _____

2. Would you be interested in having your land used for public recreation? Yes _____ No _____ If not, explain why ____________

____

____

3. If so, in what manner do you think this should be accomplished?

   _____ (a) Develop it yourself and charge people for using it.

   _____ (b) Sell it to a government or state agency and let them develop it.

   _____ (c) You keep the land and let the government or state agency develop and administer it.

   _____ (d) Sell or give an easement to proper agency.

4. If you think none of the above are appropriate, explain how you think it should be? ______________________________

____

____

5. How many acres of land do you own? __________

6. Approximately how much of this borders the creek? ____________

7. Please list the crops which you grow and the approximate acreage of each.

Crops	Acreage
______________	______________
______________	______________
______________	______________
______________	______________

OWNER QUESTIONNAIRE

(Continued)

8. Do you feel that such a project would benefit yourself?

Yes _______ No _______

Why or why not? ____

____

The community? Yes _______ No _______ Why or why not? _____

____

PRIVATE FACILITIES QUESTIONNAIRE

Owner: ______________________________

Creek: ______________________________

1. How much money do you have invested? __________________

2. Has the venture been profitable? YES_____ NO _____

   If so, how much is the gross yearly income? ______________

   Net profit? ______________

3. What facilities are provided? ______________________________

   ____

   How much land area is involved in the operation? _____________

4. What type of people use this facility? ______________________

   Are they mostly local (within 5 miles)? YES_____ NO _____

5. If you had room to expand the facility, would you do so?

   YES _____ NO _____

6. What would be the major complication regarding such an expansion?

   ____

7. How long has the facility been in operation? ________________

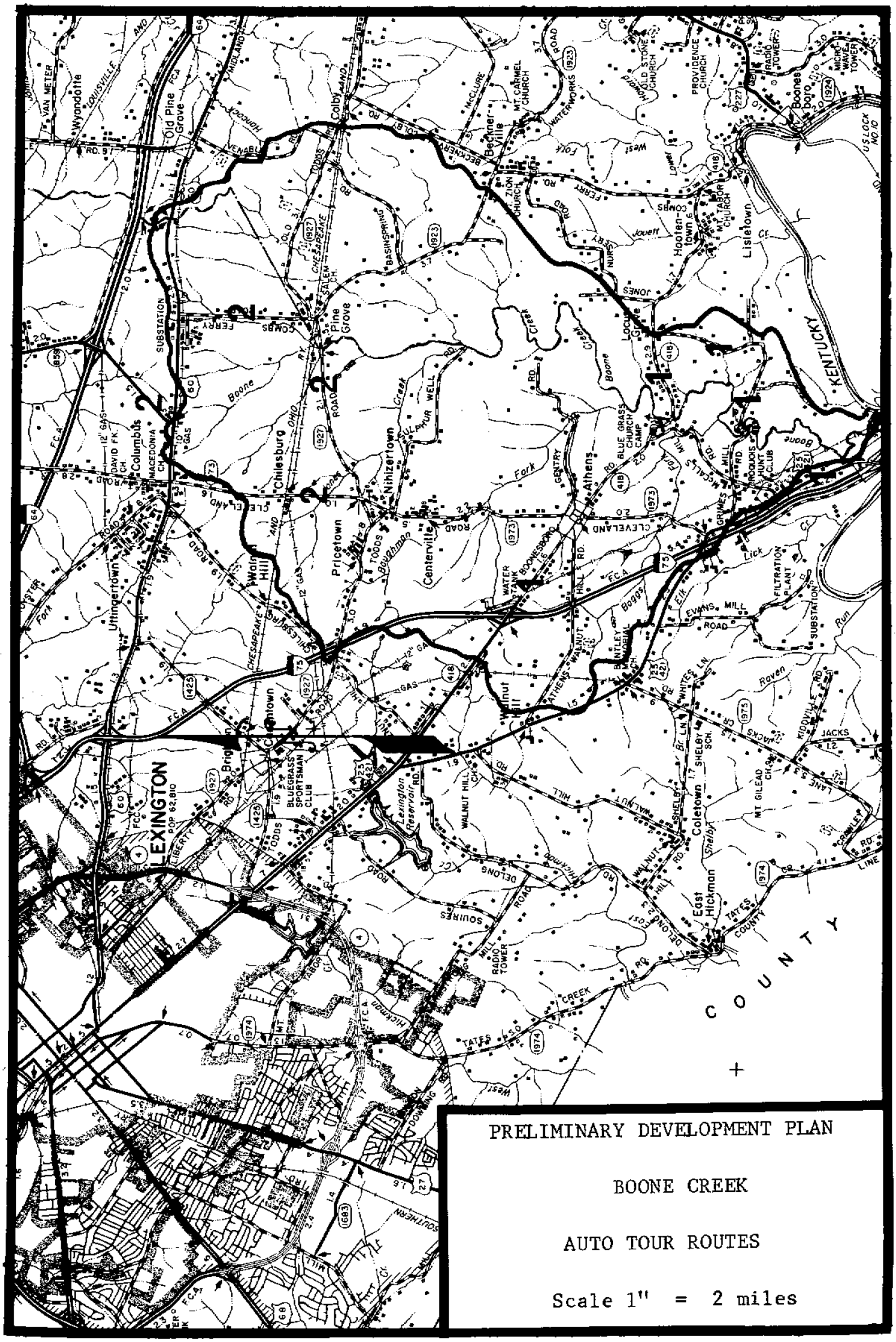
8. Have indirect benefits resulted from the facility (for example increased sale of food, drink, etc.)? YES _____ NO _____

   If so, what would you estimate the value of this increase to be? ______________

APPENDIX B

MAPS TO ACCOMPANY THE CASE STUDIES OF BOONE AND JESSAMINE CREEKS:

Slope Maps
Geological Maps
Soils Maps
Stream Order and Vegetation Maps
Resource, Transportation, Land Use and
    Land Use Capability Maps
Preliminary Development Plans

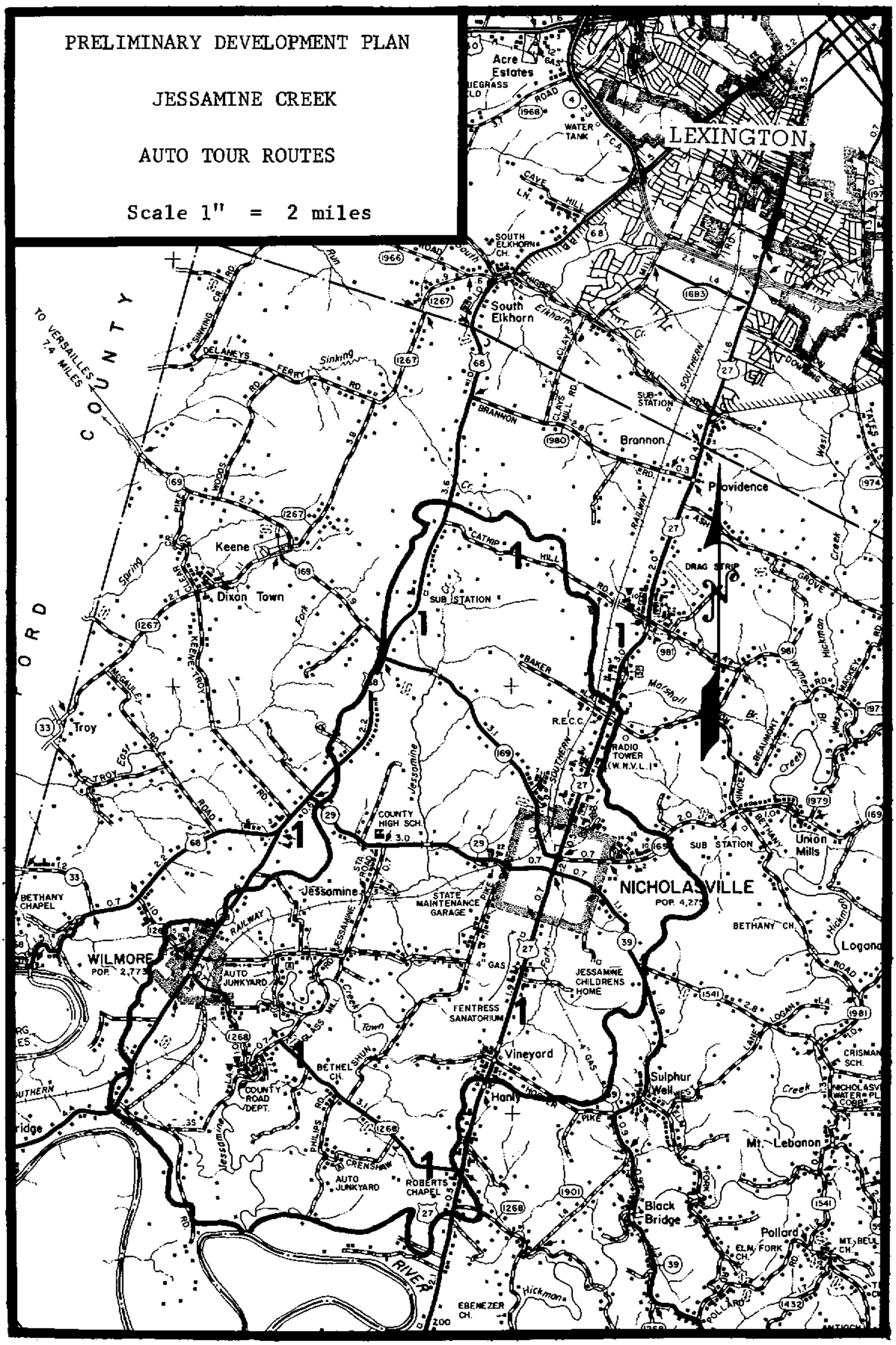


PRELIMINARY DEVELOPMENT PLAN

BOONE CREEK

AUTO TOUR ROUTES

Scale 1" = 2 miles

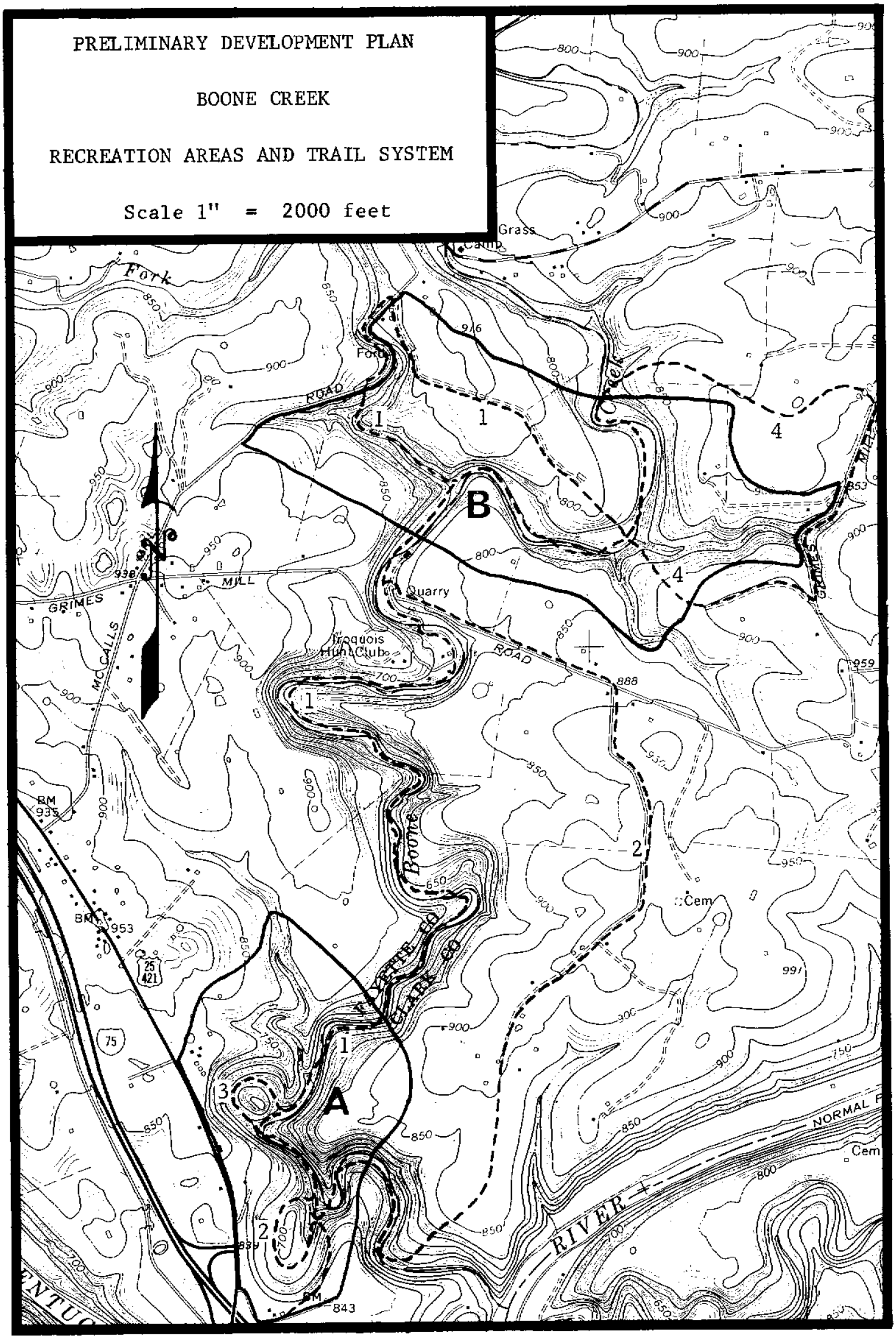

PRELIMINARY DEVELOPMENT PLAN
JESSAMINE CREEK
AUTO TOUR ROUTES
Scale 1" = 2 miles
LEXINGTON
Acre Estates
South Elkhorn
Brannon
Providence
Keene
Dixon Town
Troy
TO VERSAILLES 7.4 MILES
COUNTY
FORD
Jessamine
WILMORE
POP. 2,773
NICHOLASVILLE
POP. 4,275
Union Mills
COUNTY HIGH SCH.
STATE MAINTENANCE GARAGE
AUTO JUNKYARD
COUNTY ROAD DEPT.
FENTRESS SANATORIUM
JESSAMINE CHILDRENS HOME
Vineyard
Sulphur Well
Mt. Lebanon
Black Bridge
Pollard
BETHANY CH.
BETHANY CHAPEL
BETHEL SHUN CH.
ROBERTS CHAPEL
EBENEZER CH.
RADIO TOWER (W.N.V.L.)
R.E.C.C.
DRAG STRIP
SUB STATION
RIVER

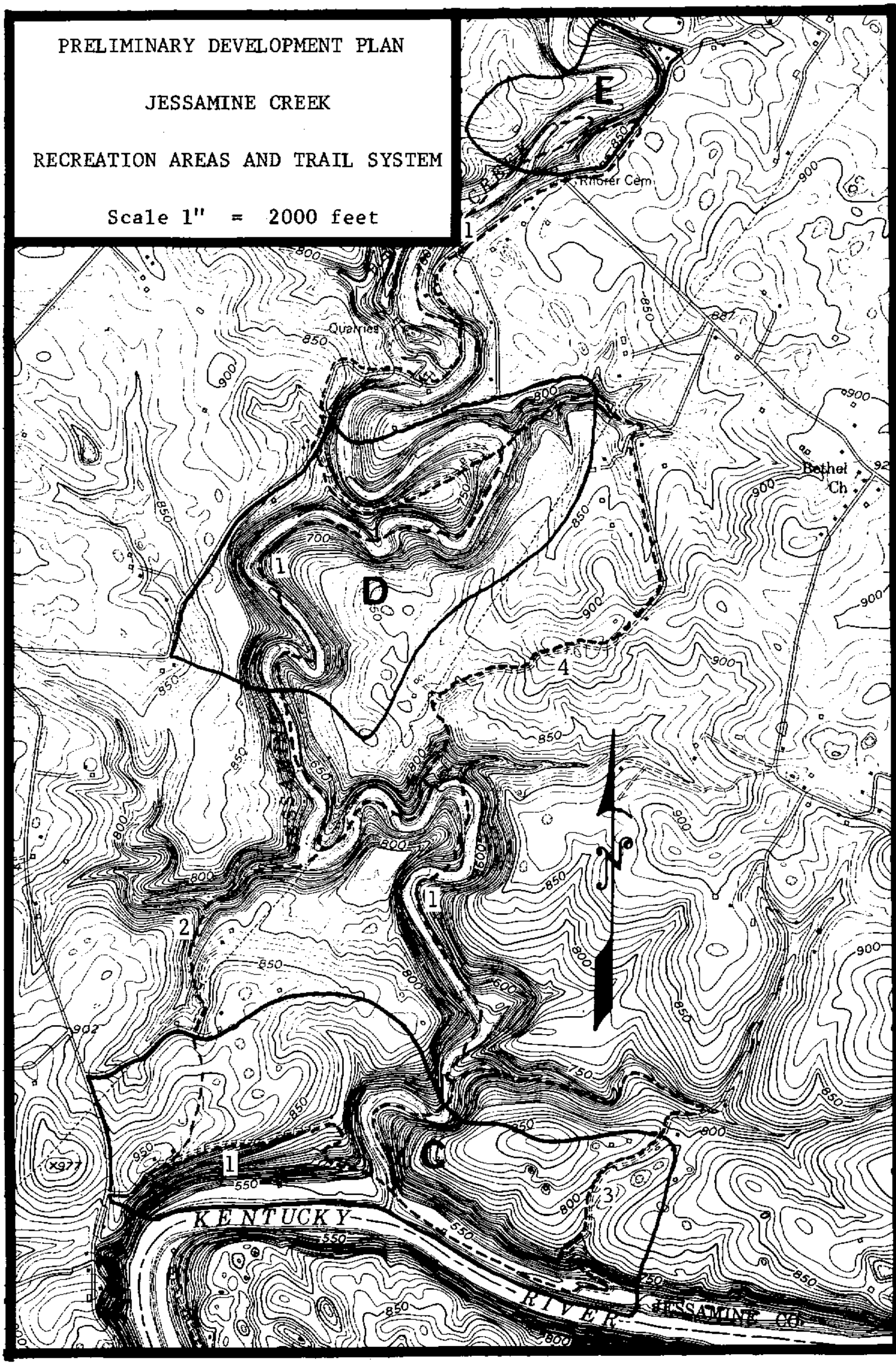
PRELIMINARY DEVELOPMENT PLAN

BOONE CREEK

RECREATION AREAS AND TRAIL SYSTEM

Scale 1" = 2000 feet




PRELIMINARY DEVELOPMENT PLAN
JESSAMINE CREEK
RECREATION AREAS AND TRAIL SYSTEM
Scale 1" = 2000 feet
E
D
C
1
2
3
4
Quarries
Bethel Ch
KENTUCKY
RIVER
JESSAMINE CO.

APPENDIX C

COMPUTATION OF KEY ELEMENT RATINGS AND SCORES FOR RECREATIONAL ACTIVITIES AND AREAS

I. <u>Primitive Camping</u>

A. Ratings

Key Elements	Value or Measure of Value	Rating B.[1]	Rating J.[2]	Rating Weights	Product B.	Product J.
1. Climate	1 (p. 56,57)*	3	3	1 (p.57)**	3	3
	2	9	9	3	27	27
	3	8	8	4	32	32
	4	7	7	2	14	14
			Sum		76	76
			Rounded Rating		8	8
2. Scenery	1 (p.58)	6	8	1 (p.59)	6	8
	2	1	1	3	3	3
	3	3	2	3	9	6
	4c	8	7	3	24	21
			Sum		42	38
			Rounded Rating		4	4
3. Natural Environment	1 (p.60)	1	1	3 (p.61)	3	3
	2	0	0	3	0	0
	3	3	2	2	6	4
	4	6	7	1	6	7
	5	5	6	1	5	6
			Sum		20	20
			Rounded Rating		2	2
4. Water Quality	2 (p.62,63)	8	6	2 (p.63)	16	12
	4	7	7	4	28	28
	5	6	6	4	24	24
			Sum		68	64
			Rounded Rating		7	6

* Definitions of the values or measures of value can be found on these pages.

** Values of the rating weights can be found on these pages.

[1] B-Ratings and Scores for the Boone Creek Watershed

[2] J-Ratings and Scores for the Jessamine Creek Watershed

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
5. Water Quantity	1 (p.64)	8	10	3 (p.64)	24	30
	2	1	1	4	4	4
	3	10	10	3	30	30
				Sum	58	64
				Rounded Rating	6	6
6. Age (p.66)				Rounded Rating	8	8
7. Occupation (p.66,67)				Rounded Rating	8	8
8. Disvalues (p.68)				Rounded Rating	-2	-3

B. Score (primitive camping) Based on Table 2

Key Elements	Rounded Ratings B	Rounded Ratings J	Element Multipliers	Product B	Product J
1. Climate	8	8	3	24	24
2. Scenery	4	4	2	8	8
3. Natural Environment	2	2	2	4	4
4. Water Quality	7	6	2	14	12
5. Water Quantity	6	6	1	6	6
6. Age	8	8	1	8	8
7. Occupation	8	8	1	8	8
8. Disvalues	-2	-3	3	-6	-9
	Sum		12	66	61
	Total Possible Score			120	120
	Percentage Score			55%	51%

II. Transient Camping

A. Ratings

Key Elements	Value or Measure of Value	Rating B	Rating J	Rating Weights	Product B	Product J
1. Climate	1	6	6	1	6	6
	2	9	9	3	27	27
	3	9	9	4	36	36
	4	7	7	2	14	14
			Sum		93	93
			Rounded Rating		9	9
2. Scenery	2	1	1	6	6	6
	4a	6	6	4	24	24
			Sum		30	30
			Rounded Rating		3	3
3. Soils	1a (p.61,62)	7	8	3 (p.62)	21	24
	2	6	7	3	18	21
	3	7	7	3	21	21
	4	7	7	1	7	7
			Sum		67	73
			Rounded Rating		7	7
4. Water Quality	1	10	10	1	10	10
	2	8	6	2	16	12
	3	8	8	1	8	8
	4	7	7	3	21	21
	5	6	6	3	18	18
			Sum		73	69
			Rounded Rating		7	7
5. Water Quantity	1	8	10	3	24	30
	2	1	1	6	6	6
	3	10	10	1	10	10
			Sum		40	45
			Rounded Rating		4	5

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
6. Tourist Routes (p. 67,68)				Rounded Rating	9	6
7. Disvalues				Rounded Rating	-3	-4

B. Score (transient camping) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	9	9	1	9	9
2. Scenery	3	3	1	3	3
3. Soils	7	7	3	21	21
4. Water Quality	7	7	1	7	7
5. Water Quantity	4	5	1	4	5
6. Tourist Routes	9	6	5	45	30
7. Disvalues	-3	-4	1	-3	-4
	Sum		12	86	71
	Total Possible Score			120	120
	Percentage Score			72%	59%

III Group Camping

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	3	3	2	6	6
	2	8	8	2	16	16
	3	10	10	4	40	40
	4	7	7	2	14	14
				Sum	76	76
				Rounded Rating	8	8

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
2. Scenery	2	1	1	4	4	4
	3	3	2	2	6	4
	4b	7	7	4	28	28
			Sum		38	36
			Rounded Rating		4	4
3. Soils	1a	7	8	2	14	16
	2	5	6	3	15	18
	3	6	7	3	18	21
	4	6	6	2	12	12
			Sum		59	67
			Rounded Rating		6	7
4. Water Quality	1	10	10	1	10	10
	2	8	6	3	24	18
	3	8	8	1	8	8
	4	7	7	3	21	21
	5	6	6	2	12	12
			Sum		75	69
			Rounded Rating		8	7
5. Water Quantity	1	8	10	3	24	30
	2	1	1	5	5	5
	3	10	10	2	20	20
			Sum		49	55
			Rounded Rating		5	6
6. Age			Rounded Rating		7	7
7. Local Access (p.67)			Rounded Rating		10	8
8. Disvalues			Rounded Rating		-2	-3

B. Score (group camping) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	2	16	16
2. Scenery	4	4	1	4	4

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
3. Soils	6	7	4	24	28
4. Water Quality	8	7	2	16	14
5. Water Quantity	5	6	1	5	6
6. Age	7	7	1	7	7
7. Local Access	10	8	1	10	8
8. Disvalues	-2	-3	2	-4	-6
	Sum		12	78	77
	Total Possible Score			120	120
	Percentage Score			65%	64%

IV Pan and Rough Fishing

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	6	6	3	18	18
	2	9	9	2	18	18
	3	9	9	2	18	18
	4	7	7	3	21	21
			Sum		75	75
			Rounded Rating		8	8
2. Water Quality	1	10	10	3	30	30
	3	8	8	2	16	16
	4	7	7	3	21	21
	5	6	6	2	12	12
			Sum		79	79
			Rounded Rating		8	8
3. Water Quantity	3	10	10	10	100	100
			Sum		100	100
			Rounded Rating		10	10

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
4. Fish Populations	1 (p. 65)	4	4	5 (p. 65)	20	20
	3	8	7	2	16	14
	4	9	10	3	27	30
			Sum		63	64
			Rounded Rating		6	6
5. Occupation			Rounded Rating		3	3

B. Score (pan and rough fishing) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	1	8	8
2. Water Quality	8	8	2	16	16
3. Water Quantity	10	10	3	30	30
4. Fish Populations	6	6	4	24	24
5. Occupation	3	3	1	3	3
	Sum		11	81	81
	Total Possible Score			110	110
	Percentage Score			74%	74%

V. Game Fishing

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	6	6	3	18	18
	2	9	9	2	18	18
	3	9	9	2	18	18
	4	7	7	3	21	21
			Sum		75	75
			Rounded Rating		8	8

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
2. Water Quality	1	10	10	4	40	40
	3	8	8	1	8	8
	4	7	7	3	21	21
	5	6	6	2	12	12
				Sum	81	81
				Rounded Rating	8	8
3. Water Quantity	1	8	10	3	24	30
	2	1	1	1	1	1
	3	10	10	6	60	60
				Sum	85	91
				Rounded Rating	9	9
4. Fish Populations	2	2	1	4	8	4
	3	8	7	4	32	28
	4	9	10	2	18	20
				Sum	58	52
				Rounded Rating	6	5
5. Occupation				Rounded Rating	7	7
6. Income level (p.67)				Rounded Rating	5	5
7. Tourist Routes				Rounded Rating	9	6

B. Score (game fishing) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	1	8	8
2. Water Quality	8	8	3	24	24
3. Water Quantity	9	9	3	27	27
4. Fish Populations	6	5	3	18	15
5. Occupation	7	7	1	7	7
6. Income level	5	5	1	5	5

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
7. Tourist Routes	9	6	1	9	6
Sum			13	98	92
Total Possible Score				130	130
Percentage Score				75%	71%

VI Picnicking

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	3	3	2	6	6
	2	9	9	3	27	27
	3	10	10	4	40	40
	4	7	7	1	7	1
			Sum		80	80
			Rounded Rating		8	8
2. Scenery	1	6	8	2	12	16
	2	1	1	3	3	3
	3	3	2	2	6	4
	4b	7	7	2	14	14
	5	8	8	1	8	8
			Sum		43	45
			Rounded Rating		4	5
3. Soils	16	9	9	3	27	27
	2	6	7	4	24	28
	3	7	7	2	14	14
	4	7	7	1	7	7
			Sum		72	76
			Rounded Rating		7	8
4. Water Quality	1	8	10	4	32	40
	2	1	1	4	4	4

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	3	10	10	2	20	20
			Sum		56	64
			Rounded Rating		6	6
5. Income level			Rounded Rating		5	5
6. Local Roads			Rounded Rating		8	6
7. Tourist Routes			Rounded Rating		9	7
8. Disvalues			Rounded Rating		-2	-4

B. Scores (picnicking) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	1	8	8
2. Scenery	4	5	1	4	5
3. Soils	7	8	2	14	16
4. Water Quality	6	6	1	6	6
5. Income level	5	5	1	5	5
6. Local Roads	8	6	1	8	6
7. Tourist Routes	9	7	1	9	7
8. Disvalues	-2	-4	2	-4	-8
	Sum		8	50	45
	Total Possible Score			80	80
	Percentage Score			63%	56%

VII Hiking Trails

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	5	5	1	5	5

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	2	9	9	2	18	18
	3	10	10	4	40	40
	4	7	7	3	21	21
			Sum		84	84
			Rounded Rating		8	8
2. Scenery	1	6	8	1	6	8
	2	1	1	3	3	3
	3	3	2	3	9	6
	4b	7	7	2	14	14
	5	8	8	1	8	8
			Sum		40	39
			Rounded Rating		4	4
3. Natural Environment	1	1	1	3	3	3
	2	0	0	2	2	0
	3	3	2	3	9	6
	4	7	7	1	7	7
	5	6	6	1	6	6
			Sum		25	22
			Rounded Rating		3	2
4. Age			Rounded Rating		8	8
5. Occupation			Rounded Rating		8	8
6. Disvalues			Rounded Rating		-2	-3

B. Scores (hiking trails) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	3	24	24
2. Scenery	4	4	2	8	8
3. Natural Environment	3	2	2	6	4
4. Age	8	8	1	8	8
5. Occupation	8	8	1	8	8

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
6. Disvalues	-2	-3	3	-6	-9
	Sum		9	48	43
	Total Possible Score			90	90
	Percentage Score			54%	48%

VIII Horseback Riding Trails

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	5	5	2	10	10
	2	9	9	3	27	27
	3	10	10	4	40	40
	4	7	7	1	7	7
			Sum		84	84
			Rounded Rating		8	8
2. Scenery	2	1	1	3	3	3
	4b	7	7	3	21	21
	5	8	8	4	32	32
			Sum		56	56
			Rounded Rating		6	6
3. Natural Environment	1	1	1	5	5	5
	2	0	0	5	0	0
			Sum		5	5
			Rounded Rating		1	1
4. Soils	1b	9	9	6	54	54
	4	7	7	4	28	28
			Sum		82	82
			Rounded Rating		8	8
5. Age			Rounded Rating		8	8

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
6. Occupation				Rounded Rating	8	8
7. Income level				Rounded Rating	6	6
8. Disvalues				Rounded Rating	-2	-3

B. Score (horseback riding trails) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	2	16	16
2. Scenery	6	6	1	6	6
3. Natural Environment	1	1	1	1	1
4. Soils	8	8	1	8	8
5. Age	8	8	1	8	8
6. Occupation	8	8	1	8	8
7. Income level	6	6	2	12	12
8. Disvalues	-2	-3	1	-2	-3
	Sum		9	57	56
	Total Possible Score			90	90
	Percentage Score			63%	62%

IX Bicycling Trails

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	5	5	1	5	5
	2	9	9	3	27	27
	3	10	10	5	50	50
	4	7	7	1	7	7
				Sum	89	89
				Rounded Rating	9	9

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
2. Scenery	2	1	1	3	3	3
	4b	7	7	3	21	21
	5	8	8	4	32	32
			Sum		56	56
			Rounded Rating		6	6
3. Natural Environment	1	1	1	5	5	5
	2	0	0	5	0	0
			Sum		5	5
			Rounded Rating		1	1
4. Soils	1a	7	8	6	42	48
	4	7	7	4	28	28
			Sum		70	76
			Rounded Rating		7	8
5. Age			Rounded Rating		8	8
6. Occupation			Rounded Rating		8	8
7. Income level			Rounded Rating		5	5
8. Local Roads			Rounded Rating		7	8
9. Disvalues			Rounded Rating		-2	-3

B. Score (bicycling trails) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	9	9	2	18	18
2. Scenery	6	6	1	6	6
3. Natural Environment	1	1	1	1	1
4. Soils	7	8	2	14	16
5. Age	8	8	1	8	8
6. Occupation	8	8	1	8	8
7. Income level	5	5	1	5	5

Key Elements	Rounded Ratings B.	J.	Element Multipliers	Product B.	J.
8. Local Roads	7	8	1	7	8
9. Disvalues	-2	-3	1	-2	-3
	Sum		10	65	67
	Total Possible Score			100	100
	Percentage Score			65%	67%

X Auto Tour Routes

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	J.	Rating Weights	Product B.	J.
1. Climate	1	10	10	1	10	10
	2	9	9	4	36	36
	3	8	8	4	32	32
	4	7	7	1	7	7
			Sum		85	85
			Rounded Rating		9	9
2. Scenery	1	6	8	2	12	16
	2	1	1	2	2	2
	3	3	2	2	6	4
	5	8	8	4	32	32
			Sum		52	54
			Rounded Rating		5	5
3. Natural Environment	1	1	1	3	3	3
	2	0	0	2	0	0
	3	3	2	3	9	6
	4	6	7	2	12	14
			Sum		24	23
			Rounded Rating		2	2
4. Historical Values	1 (p.61)	7	7	3 (p. 61)	21	21
	2	7	3	3	21	9

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	3	8	3	4	32	12
			Sum		74	42
			Rounded Rating		7	4
5. Soils	4	7	7	10	70	70
			Sum		70	70
			Rounded Rating		7	7
6. Local Access			Rounded Rating		6	7
7. Tourist Routes					9	6
8. Disvalues					-3	-4

B. Score (auto tour routes) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	9	9	1	9	9
2. Scenery	5	5	2	10	10
3. Natural Environment	2	2	1	2	2
4. Historical Values	7	4	2	14	8
5. Soils	7	7	2	14	14
6. Local Access	6	7	4	24	28
7. Tourist Routes	9	6	1	9	6
8. Disvalues	-3	-4	2	-6	-8
	Sum		13	76	69
	Total Possible Score			130	130
	Percentage Score			59%	53%

XI Sightseeing

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	10	10	2	20	20
	2	9	9	3	27	27
	3	8	8	4	32	32
	4	7	7	1	7	7
			Sum		86	86
			Rounded Rating		9	9
2. Scenery	1	6	8	3	18	24
	2	1	1	2	2	2
	3	3	2	1	3	2
	4b	7	7	1	7	7
	5	8	8	3	24	24
			Sum		54	59
			Rounded Rating		5	6
3. Natural Environment	4	6	7	5	30	35
	6	0	10	5	0	50
			Sum		30	85
			Rounded Rating		3	9
4. Historical Values	1	7	7	2	14	14
	2	7	3	3	21	9
	3	8	3	5	40	15
			Sum		75	38
			Rounded Rating		8	4
5. Local Roads			Rounded Rating		7	8
6. Tourist Routes			Rounded Rating		7	5
7. Disvalues			Rounded Rating		-3	-5

B. Score (sightseeing) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	9	9	2	18	18
2. Scenery	5	6	2	10	12

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
3. Natural Environment	3	9	1	3	9
4. Historical Values	8	4	3	24	12
5. Local Roads	7	8	3	21	24
6. Tourist Routes	7	5	1	7	5
7. Disvalues	-3	-5	3	-9	-15
	Sum		12	74	65
	Total Possible Score			120	120
	Percentage Score			62%	54%

XII Nature Walks

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	5	5	1	5	5
	2	9	9	2	18	18
	3	10	10	4	40	40
	4	7	7	3	21	21
			Sum		84	84
			Rounded Rating		8	8
2. Scenery	1	6	8	1	6	8
	2	1	1	4	4	4
	3	3	2	3	9	6
	4b	7	7	2	14	14
			Sum		33	32
			Rounded Rating		3	3
3. Natural Environment	1	1	1	1	1	1
	2	0	0	1	0	0
	3	3	2	2	6	4
	4	6	7	2	12	14
	5	5	6	2	10	12

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	6	0	10	2	0	20
				Sum	31	51
				Rounded Rating	3	5
4. Occupation				Rounded Rating	8	8
5. Local Roads				Rounded Rating	8	9
6. Disvalues				Rounded Rating	-6	-5

B. Score (nature walks) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	1	8	8
2. Scenery	3	3	1	3	3
3. Natural Environment	3	5	3	9	15
4. Occupation	8	8	1	8	8
5. Local Roads	8	9	1	8	9
6. Disvalues	-6	-5	2	-12	-10
	Sum		7	24	33
	Total Possible Score			70	70
	Percentage Score			34%	47%

XIII Walking for Pleasure

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Climate	1	5	5	1	5	5
	2	9	9	2	18	18
	3	10	10	3	30	30
	4	7	7	4	28	28
				Sum	81	81
				Rounded Rating	8	8

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
2. Scenery	2	1	1	4	4	4
	4b	7	7	3	21	21
	5	8	8	3	24	24
			Sum		49	49
			Rounded Rating		5	5
3. Natural Environment	1	1	1	4	4	4
	2	0	0	4	0	0
	3	3	2	2	6	4
			Sum		10	8
			Rounded Rating		1	1
4. Occupation			Rounded Rating		8	8
5. Disvalues			Rounded Rating		-2	-2

B. Score (walking for pleasure) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Climate	8	8	1	8	8
2. Scenery	5	5	1	5	5
3. Natural Environment	1	1	1	1	1
4. Occupation	8	8	1	8	8
5. Disvalues	-2	-2	1	-2	-2
	Sum		4	20	20
	Total Possible Score			40	40
	Percentage Score			50%	50%

XIV Natural Areas

A. Rating

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Scenery	2	1	1	4	4	4

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	3	3	2	4	12	8
	4c	8	7	2	16	14
			Sum		32	26
			Rounded Rating		3	3
2. Natural Environment	1	1	1	2	2	2
	2	0	0	2	0	0
	3	3	2	2	6	4
	4	6	7	2	12	14
	5	5	6	1	5	6
	6	0	10	1	0	10
			Sum		25	36
			Rounded Rating		3	4
3. Water Quality	1	10	10	3	30	30
	3	8	8	2	16	16
	4	7	7	3	21	21
	5	6	6	2	12	12
			Sum		79	79
			Rounded Rating		8	8
4. Fish Populations	1	4	4	2	8	8
	2	2	1	2	4	2
	3	8	7	3	24	21
	4	9	10	3	27	30
			Sum		63	61
			Rounded Rating		6	6
5. Local Roads			Rounded Rating		9	7
6. Tourist Routes			Rounded Rating		6	5
7. Disvalues			Rounded Rating		-3	-4

B. Score (natural areas) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Scenery	3	3	2	6	6

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
2. Natural Environment	3	4	5	15	20
3. Water Quality	8	8	3	24	24
4. Fish Populations	6	6	3	18	18
5. Local Roads	9	7	1	9	7
6. Tourist Routes	6	5	1	6	5
7. Disvalues	-3	-4	4	-12	-16
	Sum		15	66	64
	Total Possible Score			150	150
	Percentage Score			44%	43%

XV Scenic Areas

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Scenery	1	6	8	2	12	16
	2	1	1	2	2	2

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
	3	3	2	2	6	4
	4c	8	7	2	16	14
	5	8	8	2	16	16
			Sum		52	52
			Rounded Rating		5	5
2. Natural Environment	1	1	1	4	4	4
	3	3	2	4	12	8
	4	6	7	2	12	14
			Sum		28	26
			Rounded Rating		3	3
3. Local Roads			Rounded Rating		9	8
4. Tourist Routes			Rounded Rating		7	6
5. Disvalues			Rounded Rating		-2	-2

B. Score (scenic areas) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Scenery	5	5	5	25	25
2. Natural Environment	3	3	2	6	6
3. Local Roads	9	8	1	9	8
4. Tourist Routes	7	6	1	7	6

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
5. Disvalues	-2	-2	3	-6	-6
	Sum		9	41	39
	Total Possible Score			90	90
	Percentage Score			46%	44%

XVI Historic Areas

A. Ratings

Key Elements	Value or Measure of Value	Rating B.	Rating J.	Rating Weights	Product B.	Product J.
1. Historical Values	1	7	7	2	14	14
	2	7	3	3	21	9
	3	8	3	5	40	15
			Sum		75	38
			Rounded Rating		8	4
2. Local Roads			Rounded Rating		9	8
3. Tourist Routes			Rounded Rating		5	6
4. Disvalues			Rounded Rating		-4	-5

B. Score (historic areas) Based on Table 2

Key Elements	Rounded Ratings B.	Rounded Ratings J.	Element Multipliers	Product B.	Product J.
1. Historical Values	8	4	5	40	20
2. Local Roads	9	8	1	9	8
3. Tourist Routes	5	6	3	15	18
4. Disvalues	-4	-5	1	-4	-5
	Sum		9	60	41
	Total Possible Score			90	90
	Percentage Score			67%	46%

APPENDIX D

POPULATION, DISTANCE AND DAILY CAMPING VISITATION DATA

Origins (Ky. County or State)	Population	Otter Creek Park Air Line Distance	Otter Creek Park Camping Visitation 1965	1966	Combined	Boonesboro State Park Air Line Distance	Boonesboro State Park Camping Visitation 1965	1966	1967	Combined
1. Adair	14699	65	0	0	0	74	0	0	10	10
2. Allen	12269	77	0	0	0	124	0	0	0	0
3. Anderson	8618	59	0	0	0	34	0	95	76	171
4. Ballard	8291	168	0	0	0	255	0	0	0	0
5. Barren	28303	61	0	0	0	103	0	35	7	42
6. Bath	9114	116	0	0	0	30	0	8	128	136
7. Bell	35336	142	0	0	0	79	2	8	0	10
8. Boone	21940	97	0	0	0	77	0	198	209	407
9. Bourbon	18178	105	0	0	0	20	50	71	218	339
10. Boyd	52163	176	0	0	0	90	55	310	197	562
11. Boyle	21257	67	0	0	0	31	8	101	193	302
12. Bracken	7422	111	0	0	0	53	0	0	0	0
13. Breathitt	15490	138	0	0	0	50	0	0	4	4
14. Breckenridge	14734	24	0	0	0	113	0	5	8	13
15. Bullitt	15726	17	0	21	21	74	0	36	5	41
16. Butler	9586	57	0	0	0	132	0	0	0	0
17. Caldwell	13073	109	0	0	0	192	5	7	0	12
18. Calloway	20972	145	0	0	0	224	0	8	5	13
19. Campbell	86803	107	10	10	20	69	63	165	257	485
20. Carlisle	5608	167	0	0	0	253	0	0	0	0
21. Carrol	7978	65	0	0	0	69	0	3	39	42
22. Carter	20817	156	0	0	0	73	0	0	0	0
23. Casey	14327	68	0	0	0	51	0	0	0	0
24. Christian	56904	102	0	0	0	179	0	0	10	10
25. Clark	21075	95	0	0	0	8	130	955	1470	2555
26. Clay	20748	127	0	0	0	55	0	7	35	42
27. Clinton	8886	93	0	0	0	91	0	0	0	0

Origins (Ky. County or State)	Population	Otter Creek Park				Boonesboro State Park				
		Air Line Distance	Camping Visitation 1965	1966	Combined	Air Line Distance	Camping Visitation 1965	1966	1967	Combined
28. Crittenden	8648	112	0	0	0	199	0	0	0	0
29. Cumberland	7835	81	0	0	0	92	0	0	0	0
30. Daviess	70588	56	0	0	0	146	12	12	48	72
31. Edmonson	8085	50	0	0	0	113	0	0	0	0
32. Elliott	6330	149	0	0	0	59	0	0	0	0
33. Estill	12466	106	0	0	0	20	8	0	51	59
34. Fayette	131906	79	0	11	11	15	575	3025	4673	8273
35. Fleming	10890	121	0	0	0	43	0	10	3	13
36. Floyd	41642	168	0	0	0	78	0	6	0	6
37. Franklin	29421	62	0	0	0	37	39	127	151	317
38. Fulton	11256	184	0	0	0	269	0	0	0	0
39. Gallatin	3867	79	0	0	0	66	0	0	0	0
40. Garrard	9747	77	0	0	0	24	0	0	0	0
41. Grant	9489	87	0	0	0	50	0	6	19	25
42. Graves	30021	154	0	0	0	237	17	45	9	71
43. Grayson	15834	32	0	0	0	106	0	0	0	0
44. Green	11249	51	0	0	0	75	0	0	0	0
45. Greenup	29238	167	0	0	0	85	0	34	37	71
46. Hancock	5330	36	0	0	0	127	0	0	0	0
47. Hardin	67789	14	113	97	210	83	5	24	138	167
48. Harlan	51107	156	0	0	0	83	0	0	0	0
49. Harrison	13704	93	0	0	0	32	0	56	78	134
50. Hart	14119	44	0	0	0	92	0	0	0	0
51. Henderson	33519	79	0	0	0	170	0	5	11	16
52. Henry	10987	54	0	0	0	58	0	22	16	38
53. Hickman	6747	173	0	0	0	256	0	0	0	0

Origins (Ky. County or State)	Population	Otter Creek Park				Boonesboro State Park				
		Air Line Distance	Camping Visitation 1965	1966	Combined	Air Line Distance	Camping Visitation 1965	1966	1967	Combined
54. Hopkins	38458	84	0	0	0	158	0	18	2	20
55. Jackson	10677	109	0	0	0	33	36	0	0	36
56. Jefferson	610947	22	344	846	1190	77	134	942	1295	2371
57. Jessamine	13625	75	0	0	0	17	15	88	110	213
58. Johnson	19748	167	0	8	8	74	12	26	4	42
59. Kenton	120700	100	0	10	10	69	24	280	606	910
60. Knott	17362	149	0	0	0	75	0	0	0	0
61. Knox	25258	130	0	0	0	69	0	0	0	0
62. Larue	10346	28	0	0	0	78	0	5	5	10
63. Laurel	24901	113	0	0	0	50	20	103	47	170
64. Lawrence	12134	174	0	0	0	85	0	0	0	0
65. Lee	7420	121	0	0	0	59	0	0	0	0
66. Leslie	10941	146	0	0	0	66	0	0	0	0
67. Letcher	30102	173	0	0	0	89	0	5	155	160
68. Lewis	13115	144	0	0	0	66	3	0	0	3
69. Lincoln	16503	75	0	0	0	55	0	31	10	41
70. Livingston	7029	132	0	0	0	217	0	0	0	0
71. Logan	20896	84	0	0	0	151	0	0	0	0
72. Lyon	5924	111	0	0	0	203	0	0	0	0
73. McCracken	57306	143	0	0	0	228	0	31	63	94
74. McCreary	12463	112	0	0	0	76	0	0	0	0
75. McLean	9355	68	0	0	0	154	0	0	0	0
76. Madison	33482	90	0	0	0	14	234	529	1015	1778
77. Magoffin	11156	152	0	0	0	62	0	6	0	6
78. Marion	16887	47	0	4	4	55	0	4	0	4
79. Marshall	16736	137	0	0	0	220	0	5	16	21
80. Martin	10201	177	0	0	0	87	0	6	0	6

Origins (Ky. County or State)	Population	Otter Creek Park				Boonesboro State Park				
		Air Line Distance	Camping Visitation 1965	1966	Combined	Air Line Distance	Camping Visitation 1965	1966	1967	Combined
81. Mason	18454	124	0	0	0	55	0	8	16	24
82. Meade	18938	10	0	15	15	97	0	5	0	5
83. Menifee	4276	123	0	0	0	33	0	0	0	0
84. Mercer	14596	62	0	0	0	31	7	4	17	28
85. Metcalfe	8367	65	0	0	0	91	0	0	0	0
86. Monroe	11799	82	0	0	0	86	0	0	0	0
87. Montgomery	13461	107	4	0	4	20	16	236	395	647
88. Morgan	11056	141	0	0	0	51	0	0	0	0
89. Muhlenberg	27791	76	0	0	0	155	0	0	0	0
90. Nelson	22168	30	0	5	5	61	0	0	49	49
91. Nicholas	6677	105	0	0	0	30	0	8	0	8
92. Ohio	17725	54	0	0	0	138	0	3	2	5
93. Oldham	13388	45	0	0	0	62	0	5	0	5
94. Owen	8237	72	0	0	0	50	0	4	25	29
95. Owsley	5369	114	0	0	0	41	0	0	0	0
96. Pendleton	9968	99	0	0	0	50	0	0	32	32
97. Perry	34961	149	0	0	0	69	0	0	0	0
98. Pike	68264	183	0	0	0	94	2	19	0	21
99. Powell	6674	111	0	0	0	21	0	19	10	29
100. Pulaski	34403	91	0	0	0	55	0	0	0	0
101. Robertson	2443	109	0	0	0	43	0	0	0	0
102. Rockcastle	12334	95	0	0	0	35	0	36	5	41
103. Rowan	12808	134	0	0	0	46	0	6	28	34
104. Russell	11076	79	0	0	0	72	0	0	0	0
105. Scott	15376	77	0	0	0	25	13	58	286	357
106. Shelby	18493	46	0	0	0	52	0	24	27	51
107. Simpson	11548	83	0	0	0	141	0	3	0	3

Origins (Ky. County or State)	Population	Otter Creek Park				Boonesboro State Park				
		Air Line	Camping Visitation			Air Line	Camping Visitation			
		Distance	1965	1966	Combined	Distance	1965	1966	1967	Combined
108. Spencer	5680	36	0	0	0	56	0	0	0	0
109. Taylor	16285	52	0	0	0	66	0	2	44	46
110. Todd	11364	93	0	0	0	164	0	0	0	0
111. Trigg	8870	116	0	0	0	194	0	0	0	0
112. Trimble	5102	55	0	0	0	70	0	0	3	3
113. Union	14537	97	0	0	0	186	0	24	0	24
114. Warren	45491	65	0	0	0	126	0	0	6	6
115. Washington	11168	45	0	0	0	50	0	0	6	6
116. Wayne	14700	94	0	0	0	75	0	0	0	0
117. Webster	14244	89	0	0	0	172	0	0	0	0
118. Whitley	25815	124	0	0	0	75	0	9	34	43
119. Wolfe	6534	128	0	0	0	38	0	0	2	2
120. Woodford	11913	67	0	0	0	25	12	158	120	290
121. Alabama	3266740	315	5	23	28	343	134	10	98	242
122. Arizona	1302161	1495	35	6	41	1533	0	4	193	197
123. Arkansas	1786222	416	0	12	12	463	0	12	42	54
124. California	15717204	1922	17	31	48	1955	38	141	165	344
125. Colorado	1753947	1030	0	7	7	1083	0	10	43	53
126. Connecticut	2535354	760	5	0	5	702	12	69	122	203
127. Delaware	446292	575	0	0	0	513	5	11	47	63
128. D. of C.	763956	495	27	0	27	415	0	10	16	26
129. Florida	4951560	765	86	131	217	675	110	514	818	1442
130. Georgia	3943116	383	2	20	22	350	49	116	284	449
131. Idaho	667191	1467	0	0	0	1465	0	9	4	13
132. Illinois	10081158	278	238	282	520	366	156	988	1548	2692
133. Indiana	4662498	127	169	313	482	180	393	1405	2697	4495

Origins (Ky. County or State)	Population	Otter Creek Park Air Line Distance	Otter Creek Park Camping Visitation 1965	1966	Combined	Boonesboro State Park Air Line Distance	Boonesboro State Park Camping Visitation 1965	1966	1967	Combined
134. Iowa	2757537	480	37	112	149	554	7	237	407	651
135. Kansas	2178611	629	9	10	19	699	3	26	52	81
136. Louisiana	3257022	602	8	12	20	636	27	42	152	221
137. Maine	969265	1014	0	0	0	963	0	10	18	28
138. Maryland	3100689	520	5	16	21	436	4	154	124	282
139. Mass.	5148578	816	0	34	34	748	8	70	151	229
140. Michigan	7823194	406	178	384	562	426	514	3018	3915	7447
141. Minnesota	2413864	684	19	33	52	730	30	77	529	636
142. Miss.	2178141	462	0	18	18	497	0	8	23	31
143. Missouri	4319813	394	23	46	69	474	31	166	201	398
144. Montana	674767	1450	0	4	4	1530	0	16	4	20
145. Nebraska	1411330	673	0	10	10	753	5	16	24	45
146. Nevada	285278	1816	0	0	0	1853	0	0	7	7
147. N.H.	921606	850	0	12	12	785	0	14	14	28
148. N. J.	6066782	628	33	40	73	559	14	361	340	715
149. N.M.	951023	1155	0	5	5	1220	0	0	6	6
150. New York	16782304	696	135	92	227	624	254	477	832	1563
151. N.C.	4556155	355	26	56	82	291	41	108	275	424
152. N.D.	632446	854	0	11	11	1030	0	5	0	5
153. Ohio	9706397	216	261	581	842	205	1201	6192	8829	16222
154. Oklahoma	2328284	664	12	7	19	735	0	38	53	91
155. Oregon	1768687	1894	0	0	0	1915	4	20	49	73
156. Penn.	11319366	380	101	71	172	455	265	593	767	1625
157. R.I.	859488	820	0	9	9	764	5	16	5	26
158. S.C.	2382594	395	0	20	20	324	22	42	86	150
159. S.D.	680514	964	4	6	10	923	4	23	31	58

Origins (Ky. County or State)	Population	Otter Creek Park				Boonesboro State Park				
		Air Line	Camping Visitation			Air Line	Camping Visitation			
		Distance	1965	1966	Combined	Distance	1965	1966	1967	Combined
160. Tenn.	3567089	133	5	30	35	239	30	99	243	372
161. Texas	9579677	945	32	35	67	1005	15	83	276	374
162. Utah	890627	1397	0	0	0	1445	0	11	53	64
163. Vermont	389881	833	0	96	96	783	0	3	0	3
164. Virginia	3966949	492	36	145	181	395	45	264	343	652
165. Wash.	2853214	1893	8	2	10	1915	4	14	76	94
166. W.Va.	1860421	310	5	4	9	270	48	248	408	704
167. Wisc.	3951777	505	103	108	211	580	60	322	409	791
168. Wyoming	330066	1130	0	3	3	1183	0	0	0	0

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