DESIGN METHODOLOGY FOR PUBLIC USE AREAS ON WATER RESOURCE PROJECTS

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INTRODUCTION

A. General

Outdoor recreation is currently assuming an important position among our country's concerns with the quality of our environment and social life. Consequently, we are witnessing rapid change in outdoor recreation programs and policies. A traditional viewpoint that held outdoor recreation as a byproduct of conservation policies is being superseded by a philosophy that holds recreation to be a primary public purpose and would preserve and develop such resources for recreational use.

The growing importance and relevance of outdoor recreation has not yet been reflected to an equal degree in the research and systematic analysis upon which planners must rely upon for guidance. Recent research has been directed toward obtaining a better understanding of the social and psychological aspects of outdoor recreation. Additional research has been undertaken concerning resources, with the natural conditions that govern their change, and with the management policies that contribute to their conservation and preservation.

Water resource projects are becoming an important part of our civilization. In addition, our civilization has more time and funds to devote to recreation than any civilization in the past. This means

the development of the recreational potential of the water resource projects is more important now than in the past. This must be accomplished by employing design methods that fully develop the resources of the project while conserving the natural beauty of the area. Furthermore, no single discipline can pretend to solve substantial problems without collaborative assistance from those in allied fields.

While it may seem reasonable that a team relationship should exist, it is missing in too many cases. To some extent, lack of collaboration is due to the professional isolationism brought about by the speciality phenomenon. A team should be comprised of a recreation planner acting as the team leader, a civil engineer, and a soils and materials engineer. In addition, other members that should be involved part time would be a hydraulic engineer, an electrical engineer, a mechanical engineer, a construction engineer, and an operational or management representative.

The information and procedures presented in this thesis are drawn from the experiences of the author who has been employed as a civil engineer and recreation planner by the Tulsa District of the U.S. Corps of Engineers.

B. Objectives

The primary objective of this thesis is to present the orderly procedures that would enable a recreational resource planner to research, design, develop, and evaluate water oriented recreation areas. Furthermore, this thesis presents the criteria for selection, design,

and placement for recreational facilities within a selected water oriented public use area.

This thesis should be used to aid the planner or park designer; however, a planner should always rely upon his basic talents and ingenuity to develop the resources of a proposed project.

C. Justification of This Research

With the increased interest in recreation and with the predicted decrease in the work week which would give people more leisure time, more and better designed recreation areas are essential.

This thesis sets forth a design methodology that permits the evaluation of existing or proposed recreational areas, and sets forth a methodology for selection, planning, and design of future areas.

The results of this research will provide the recreational resource planner a tool with which he can (1) analyze the potential of an undeveloped area, (2) determine the suitability of that area to support various types of recreational activities, (3) and determine the types of recreational activities that should be provided for this area.

D. Organization of This Thesis

During the development of this methodology, the design was broken into three phases. The first is a "survey" or an assembling of facts and data which might have consequence for the design's outcome. The second is "analysis" or the making of value judgments about the effects of one fact upon another. The third may be called "design" or the weaving of the results of analysis into a comprehensive form to provide an organized solution to the problem. However, before the

survey phase, the recreation planner must know what factors affect the design of the public use areas. Additionally, before the plan's development phase, the planner must know the facility criteria and the number of facilities required to develop the water resource project. Therefore, this information is incorporated into this thesis.

CHAPTER II

EXISTING LITERATURE

A. Literature Survey

Most of the early literature was published by the U.S. Government through grant research projects. These pamphlets usually contain regulations and guidelines covering the design and management of recreational areas and national parks. These publications were usually broad in scope and directed toward the national parks. While these are beneficial, they do not provide a procedure for analyzing and developing a selected area. However, a review of some of the significant publications have been included in this thesis.

In 1938, Albert H. Good authored a three volume guide for designing national parks entitled Park and Recreation Structures. This publication detailed buildings, bridges, parkings, and signs. Some of the plans presented in this publication are timeless and could be utilized in parks now being designed. However, since most of these plans call for a great deal of manual labor, they are often passed over for plans that require less labor to construct.

In the early 1950's, the National Conference on State Parks and the National Recreation and Park Association in cooperation with the National Park Service and through the U.S. Government Printing Office initiated a continuing publication entitled Park Practice Design. This

publication has been periodically supplemented to prevent this publication from becoming outdated. The guides presented are meant to aid the recreation planner and not to take away the initiative of the planner.

In 1962 a 27-volume report entitled Public Outdoor Recreation Areas--Acreage, Use, Potential was made to the Outdoor Recreation Resource Review Commission. This report surveys our country's outdoor recreation resources, measures the existing and likely demands upon them over the following 40 years, and recommends action to insure their availability to all existing and future generations of Americans. However, this report did not cover the development of water resource projects adequately enough to aid a water resource project recreation planner.

From 1965 through 1972 several outdoor recreation research programs produced information on many aspects of recreational development. Many of these are listed in the Bibliography. The publication that has stimulated the greatest change in the theory of park design was a pamphlet entitled Park Road Standards published by the National Park Service in 1968. The theory presented in this pamphlet has been incorporated into this thesis.

A recent publication Anatomy of a Park by Albert J. Rutledge presents a procedure for analyzing, designing, and evaluating parks. This book was written for landscape architects and does contain a great deal of selling of landscape architects. The principles set forth in this book are outlined below.

1. Everything must have a purpose. (This principle relates the park to the ecology and all development within it.)

2. Design must be for people. (Balance of impersonal and personal needs are covered in this principle.)

3. Both function and aesthetics must be satisfied. (Balance of dollar and human values are covered in this principle.)

4. Establish a substantial experience. (Effects of facilities upon the predominate features of the area are a part of this principle.)

5. Establish an appropriate experience. (This principle stated that the park should be suited to personality of place, user, and function and suited to scale.)

6. Satisfy technical requirements. (This principle covers size, quantities, orientation, and operating needs.)

7. Meet needs for lowest possible cost. (Balance of needs and budget, use of existing site resources, provision of appropriate structural materials and plant materials, and attention to details are included in this principle.)

8. Provide for supervision ease. (This principle covers safety, circulation, and balance of use freedom and control.)

This book then proceeds to establish a design procedure that is very helpful to the recreation resource planner and to the landscape architect. The first step is to obtain an adequate survey. This includes a complete inventory of on-site and off-site factors. The second step is to analyze the program relationship and to develop diagrams and site plans.

The third step of the design process would be called the synthesis. This includes the establishment of the design concept and then refining the plan to develop this concept. From this a final plan is developed for submittal or review.

This book also presents a method of evaluating a plan. A critique of this method is to understand what the designer has done, consider the designer's goals, and evaluate goal realization.

B. Demand and Supply Studies

The State Comprehensive Outdoor Recreation Plan (SCORP) publications are the best source of information for demand and supply of recreation facilities in a project area. This contains demand and supply data which has been prepared by and periodically updated by each state. These studies were carefully designed to help all levels of government determine where (or if) recreation facilities are needed. A study of "SCORP" publications covering the project "Area of Influence" (usually a 50-mile radius of the project shoreline) will help the recreation planner determine what types of recreation activities are desired and needed at the project. By knowing this and the criteria for these facilities, the planner could establish as one of his goals a plan that would satisfy this need.

CHAPTER III

DESIGN CONSIDERATIONS

A. Factors Affecting the Design of Public Use Areas

In the initial evaluation of an area, the planner must spend enough time within the area walking and studying the features of the area to become familiar with all elements. To aid in this, the planner should prestudy the best available maps. These maps will be useful when the planner goes to the field to evaluate potential areas. The planner should keep all his notes upon these maps to help him when the areas are being re-evaluated in the office. In some organizations, one person makes the initial field trip and selects the areas to be developed and then the job of developing the selected areas is turned over to a second planner. This practice severely handicaps the second planner and should be avoided. The planner must make his own evaluation of an area before an adequate design can be prepared.

The factors that must be considered to thoroughly evaluate the potential of an area with the minimum disturbance of the ecology of the area are: (1) accessibility, (2) topography, (3) size, (4) vegetation, (5) soils, (6) pool fluctuations, (7) climate, (8) water depth and circulation, (9) air flow, (10) availability of

ground water, and (11) adjacent land uses. All or a combination of these factors contribute in the design of an area.

These factors and their relationship to water oriented recreation areas are discussed in the following paragraphs.

1. Accessibility

Perhaps the major consideration in evaluating access to the area is the quality and number of major access roads from the nearby population centers to the recreation area. Furthermore, an area must be accessible from a city, county, state or federal highway before federal funds can be expended to develop this area. It is possible to construct an access road to an isolated area; however, the cost of constructing such roads limits this means of access. In evaluating this factor, county, state, and federal highway agencies should be contacted to obtain information related to future improvements of existing roads or construction of new roads in the general area that would influence the flow of traffic to the potential recreation area. Furthermore, observations and examination of recreation use at reservoirs with differing access features indicate that the ability to disperse about a reservoir adjacent to the water is an important consideration in attendance levels.

2. Topography

This single factor is one of the easiest factors to evaluate. If the area is too flat, a lake fluctuation would either flood the facilities near the shoreline or recede the waterline and create an unsightly muddy area between the facilities and the lake. If the area

is too steep, facilities cannot be physically sited upon the terrain or the cut and fill requirements to site roads and other facilities would destroy the area. The minimum slope is a function of the lake fluctuation and the maximum slope is a function of the soil characteristics. Natural barriers such as ravines and creeks are important when the terrain is being evaluated. These features serve as buffers between different uses and as a means of controlling access.

The roughness of a recreation site can make a considerable difference in the number of facilities that can be developed in a fixed area. For example, strongly undulating terrain may mean that campground roads cannot be located the normal distance apart so fewer lots are obtained on each acre. Parts of an area may be too steep for camp or picnic sites and these areas should be indicated on the maps and considered when evaluating the size requirements of the area.

3. Size

Outdoor Recreation Space Standards was published by the Department of the Interior in 1970. This publication provided a guide to the minimum area required to support the desired facilities. However, these standards should not be applied to most water resource projects recreation areas. The space required to support recreational facilities is a function of the terrain, vegetative cover, and soil characteristics.

A recreation area could be as small as a 5-acre tract which could accommodate a boat ramp and a few picnic tables, or as large an area as a single access road can serve.

The limits of potential areas should be flexible at this stage and should be established to provide space for all desirable initial facilities and space for expansion of these facilities to provide for future visitation increases.

4. Vegetation

The relationship of the soil to vegetation is significant. The evaluation of the existing vegetation can give the planner information about the soil, groundwater table, and geology of the area. The planner should be aware that only certain species of trees and grasses grow in a specific soil or under certain groundwater conditions. By knowing a few trees and grasses, a planner can make some quick judgments about the area. Willows, sycamore, and certain other trees require subirrigation and could indicate to the planner that groundwater for a water supply system may be available. Water grass and sand burrs are two grasses whose name tells the planner something about the soil in that area, and, in the case of the water grass, they also warn a planner that subgrade conditions in the area may not be suitable for recreation development without draining the area.

The type, species, and density of growth has a tremendous effect on carrying capacity of an area. A study of vegetative survival in recreational areas indicated that under natural conditions, the smaller plants generally appear to be able to withstand recreation uses better than the larger plants. Those with narrower, more leathery leaves and the common grasses were more tolerant to development than those with larger or more succulent leaf structures.

It is well known that good ground cover cannot be produced in deep shade; therefore, planners often thin out trees in an effort to grow grass under them. Thus, the carrying capacity of land with a fairly light tree cover is generally higher than land that is densely covered with trees whether the ground cover be natural grasses and shrubs or a well-maintained turf.

In areas where the vegetative cover will deteriorate with constant use, a single access road should be provided and the area should be closed or barricaded to all use, except on holiday weekends, for one out of every three years to allow the vegetative cover to re-establish itself.

5. Soils

For most activities, the ground is the base on which the activity takes place and its quality has a direct effect on the recreational experience. This factor can be partially evaluated from a study of the topography and the vegetation factors as discussed in the previous paragraphs. The geology and soils of a recreation area can often be the most important factors in determining its ability to support recreation. It should be carefully noted that areas with rock outcroppings often indicate shallow soils. Shallow soils cannot support heavy traffic and these areas often become bleak, poorly shaded, and devoid of screening vegetation.

The ability to produce grasses, shrubbery and trees is not the only attribute of the area's geology and soils that affects developability. Another important parameter is drainage. For most activities, good surface drainage is essential. For example, picnic areas on

poorly-drained soils do not dry out speedily after a rain and, consequently, may provide fewer recreation opportunities during the season.

Soils can also be a factor in the siting of improvements. Consideration must be given to whether the soil is deep enough for pit toilets, or if it is suitable for foundations or for septic tank and tile field sewage systems.

6. Pool Fluctuations

Although some recreation researchers are claiming that pool fluctuations have very little effect upon the visitation at a project, this factor has a great bearing in the design of a recreation area. It would be very difficult to evaluate an area without taking a topography map and marking the 10-year drawdown contour, the conservation pool contour, the two-year frequency contour, the five-year frequency contour, and the 50-year frequency contour. This enables the planner to evaluate the effects of pool fluctuation upon the potential of the area. Furthermore, it would indicate to the planner the different siting zones that enter into the design of an area.

7. Climate

Since it is not likely that the climate will vary from area to area, this factor will not enter directly into the selection processes. However, the normal climate of the area will determine if the planner will be designing an area for summer activities or for summer and winter activities. The increased interest in snowmobiles has created

special problems in the areas that have snow on the ground for long periods of time.

8. Water Depth and Circulation

Shallow water and drop-offs at or near the shoreline can be a benefit or a liability. A swimming area and beach should have a 3 to 5 percent slope with good water circulation to prevent the water from stagnating or becoming turbid. Steep banks and deep water are beneficial at concession sites, especially at lakes that fluctuate severely.

Adequate water depth is always an important factor when evaluating an area for a boat ramp site. This facility requires adequate water depth and protection from wind-wave action. If a boat ramp is necessary to develop an area and a suitable site is not available, an alternate area may be preferable.

9. Air Flow

This factor is often overlooked. The planner must be certain that adequate air flow through the area is available, especially in the warmer climates. Invariably, some of the scenic sites on the project are in areas that cannot receive adequate air circulation. Camping should never be planned in these areas.

10. Availability of Groundwater

Where rural water districts or local water systems are not available and where the cost of filtering lake water cannot be economically justified, a water well would be required to furnish potable

water to the area. If the availability of groundwater is questionable, the area should be researched or tested before the area is chosen and developed as a recreation area. Many public use areas have been under construction before an attempt was made to develop a well within the area only to find that potable groundwater was not available. This delays completion of the recreation area and adds unexpected expense to the cost of developing the area. This factor can determine the preference between two areas when other factors are equal.

11. Adjacent Land Uses

This can be a deciding factor for some areas. For example, a recreation planner would never place an area downwind from a cattle feed lot, refinery, or similar industry. Additionally, if the access road goes through or by objectionable or unsightly areas, this would create an unfavorable impression upon the recreationist before he reaches the recreation area. Each planner must use his own judgment in evaluating this factor.

B. Survey Requirements

Surveys can be classified or divided into three stages. These stages could be called site reconnaissance, topography surveys, and alignment surveys.

The site reconnaissance or first stage is an evaluation of all project areas considering the factors previously discussed. After all the factors have been evaluated, the areas best suited for recreational development must be selected for additional surveys.

The second stage consists of obtaining accurate topography surveys. The requirements for this survey may vary in scale and in contour intervals; however, most of the other factors remain the same. Two-foot contour intervals at a scale of 1-inch equals 200 feet is preferred. All trees, fences, buildings, roads, ditches, ponds, etc. must be indicated on the topography map. Ideally, a controlled aerial mosiac should be obtained if the topography is obtained by aerial photography and a Kelsh Plotter. Aerial topography has proved to be a satisfactory method of obtaining information at this stage.

All reference points and bench marks used in making the topography survey should be marked on the ground with a permanent marker and referenced. The State Plane Grid System should be established and shown on the topography sheets. In addition, the bench marks and topography control points should be shown on the contour map by reference number and elevation. Property lines should be established and monumented.

Before the third stage or alignment survey can begin, an analysis of the topography survey must be made and the area designed. Chapter IV presents the methodology of designing these areas.

The third stage or alignment survey can be developed one of two ways. The first method would be to layout definite road alignments upon the topography sheets and have these computed alignments staked and referenced using the ties and data provided. The second, and preferable, method is to indicate a starting point for the survey and have approximate alignments flagged. The planner could then take a team of design engineers over the flagged alignment to assure that the

best possible alignments are staked. The approved alignments would then be staked and referenced.

By either method, the same information about the survey alignment is needed. The centerline survey should provide a marked stake at each station, a hub and marked stake at each PC and PT, and an iron pin and marked stake with a minimum of two references at each PI. Temporary and permanent bench marks must be established through the area.

From this, additional information must be obtained. This includes profiling of the alignments, making field book sketches of all drains and taking spot elevations on 50-foot centers for 100 feet each side of the centerline of the roadway along the flow line of the drain, and tying this survey into known points or into the State Plane Coordinates. From the coordinates, the PI's can be accurately plotted on the topography maps and accurate contract plans developed.

C. Analysis of Survey Information

When the topography maps are received, the planner uses this information to reanalyze the areas. The analyzing process is divided into two steps. The first step is a review of the Factors Affecting Design of Public Use Areas with special emphasis upon the effects of pool fluctuation. The second step is to take the Facility Criteria for Water Resource Projects and evaluate the area for its potential.

The first step is a review of all factors used to evaluate the area initially. Many areas prove undevelopable at this point. If the area floods more frequently than the original contours indicated or if water is too shallow presenting an unsightly or unsafe condition, then an alternate area should be selected for development.

The second step of the analysis process is to evaluate the area for its recreational potential. Experience is the best teacher for this evaluation; however, an unexperienced planner can keep the criteria for the various facilities at hand and evaluate an area adequately. To evaluate the recreational potential of an area, the accurate topography maps and controlled aerial mosiacs, if available, should be taken to the field and the areas suitable for development should be marked for future reference. The areas with camping potential should be marked "camping." The areas suitable for picnicking should be so marked. If an area could be used for three or four purposes, they all should be indicated.

CHAPTER IV

DESIGN PROCEDURES

A. Facility Criteria

This section presents the design criteria and the facility load criteria necessary to design and develop a recreation area on a water resource project. This includes elevation limitations on structures and other basis for selecting facilities and the techniques required to develop an area.

Although these criteria were compiled to facilitate water oriented recreation areas, the facility load factors apply to any public use area. The criteria have been divided into sixteen segments to simplify discussion and referencing.

1. Siting

Generally, the character of each site and its natural features should be appraised and the most scenic parts of the area should remain undeveloped for enjoyment of all of the visitors. Only the most adaptable terrain and soils should be used for siting of facilities, and excessive cuts and fills should be avoided. In addition, undeveloped space should be left as a buffer between different types of uses and as a means of controlling access. Where possible, this undeveloped space should be a natural physical feature such as a

ravine, or a creek. If the size, lack of vegetative cover, or terrain prevents providing an undeveloped space between alternate uses, two areas should be developed and designed as one unit. One area would serve the camping needs and the other area would serve the day use activities.

Structure sites should be selected after consideration of the above factors and pertinent elevations. Sites should be classified as: being above the 50-year flood frequency pool, above the 5-year flood frequency pool but below the 50-year level, or above the 2-year flood frequency pool and below the 5-year level. The design criteria for the various structures indicate in which zone a structure should be located. An illustration of the siting criteria is shown in Figure 1.

2. Water System

The criteria for selecting a water supply system for a public use area are shown in Table I.

In areas where local or rural water districts have developed, every effort should be made to connect and use this source of potable water. If the water district is not capable of supplying peak demand, special storage tanks may be necessary to make up for the shortage.

The second alternative is to construct a packaged water treatment plant. This facility can serve a larger public use area or two or more small areas. If the areas around the lake are close together, it may be economically feasible to develop a water filter plant to serve all the recreation areas. This source is often the only alternative.

The pressurized waterwell is used where the groundwater resources are adequate. Some sources of groundwater are preferable over the

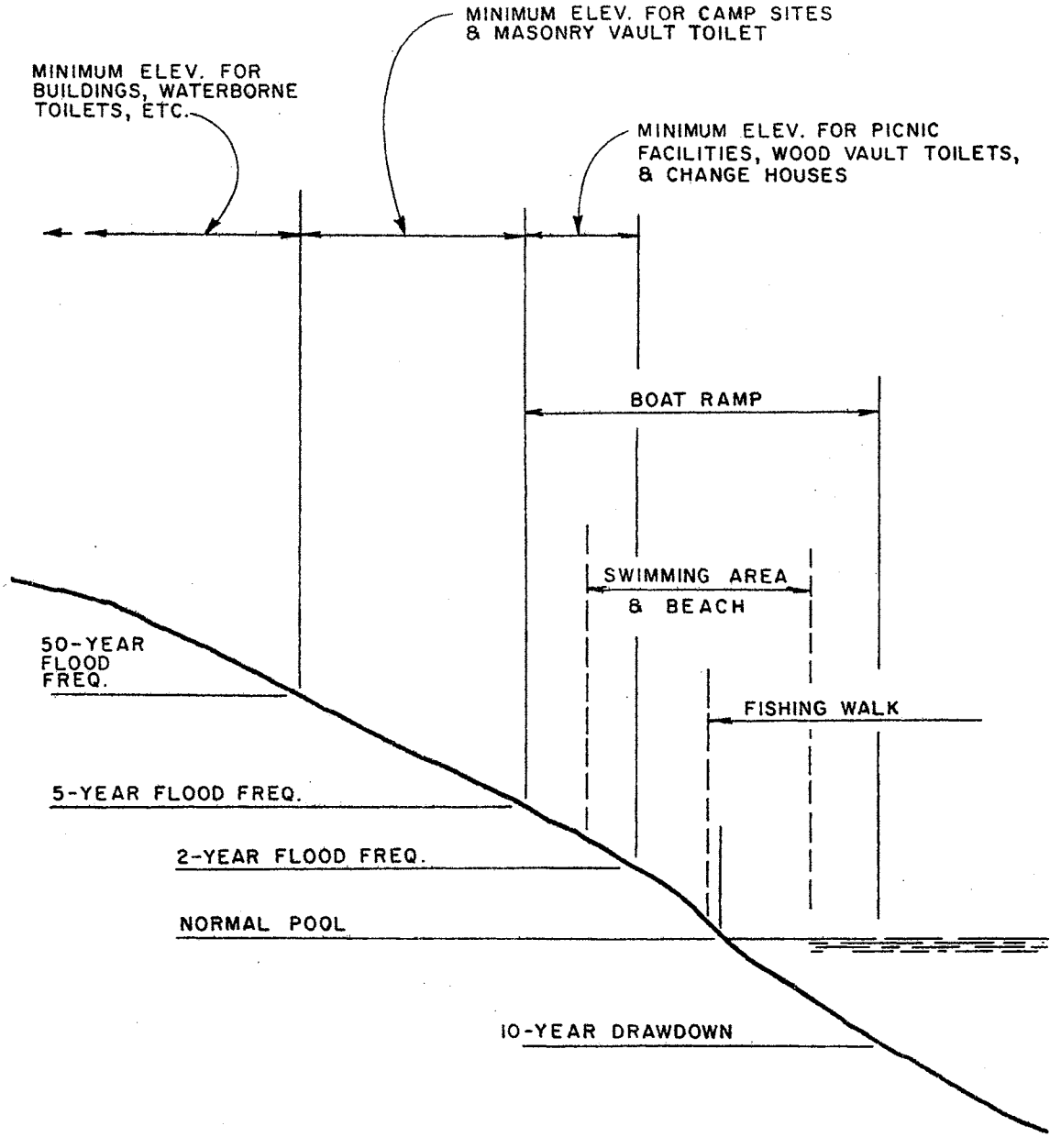

Figure 1. Siting Diagram

TABLE I

WATER SUPPLY SOURCES

No.	Source	Application
1	Connect to an existing treated water system.	Desirable for all areas.
2	Treated lake water	Desirable for large areas where No. 1 does not exist.
3	Pressurized waterwell	Desirable for smaller areas where No. 2 is too large and No. 1 does not exist.
4	Hand pump well	For small areas where pressurized water is not required.

treated lake water. In areas where aquifers exist, this means of water supply should be researched before a lake filter plant is designed. The demand in a public use area should be established by one of two methods and checked by the other. The first method sizes the system based upon the facilities provided. Table II lists the demand rates used at water oriented recreation areas.

TABLE II

WATER REQUIRED FOR FACILITIES WITHIN A RECREATION AREA

Facility	Demand GPH*
Hydrant--Picnic Area	250
Hydrant--Camping Area	400
Waterborne Toilet	148
With Shower Add	178
With Washhouse Add	150
Changehouse With Shower (Each)	150

*The demand period for Table II varies as follows:
Heavy Use - 12 hours per day
Light Use - 8 Hours per day
Showers and Washhouses - 6 hours per day

The second method uses an estimated total number of visitors in an area and sizes the system on a gallons per person basis. In picnic area, a design load of 10 gallons per person is used. When using this method to compute demand, the planner must remember that casual visitors will utilize waterborne facilities and must be considered in the design calculations.

3. Sewage Collection and Treatment Systems

The two types of toilets used in recreational areas require different treatment. Sewage from the vault toilets should be either processed through a local treatment system or in a project oxidation pond. A service contract should be issued to clean these vault toilets on a regular basis. Usually these vaults require cleaning four times a year.

The waterborn facility will require a tile field or oxidation pond. The oxidation pond should be screened from the developed area and fenced. In most cases, waste will have to be pumped to this facility. Oxidation ponds are desirable for toilets, showers, and washhouses. Oxidation ponds should be designed for total retention unless sufficient data is available and the total volume of waste warrants designing and operating a packaged treatment plant. The U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi, is currently conducting a research program entitled, "Design of Water and Sewer Systems and Treatment Methods for Public Use Areas" to develop waste loading data from various types of facilities within recreation areas.

Public Law 92-500 increased the requirements for wastewater treatment. It is nearly certain that the present practice of discharging waste from vault toilets into a local treatment system will not be acceptable because this sudden massive demand would overload the treatment facility and pollute the receiving stream. Until the Waterways Experiment Station completes the reference research program and develops better ways of treating waste from vault toilets in this region, the method of diluting the vault waste and treating it in a

total retention oxidation pond is the desirable sollution to this problem.

Total retention ponds must be leakproof and the pond must be constructed above the effects of flooding. It is also desirable to keep these oxidation ponds a minimum of 1,000 feet from the developed areas.

The disposal of solid waste is a growing operational problem. This waste should either be disposed of by contracting through an off-project sanitary collector or by providing a land fill on project lands. An isolated, centerally located area should be selected and a survey of the soils and groundwater should be undertaken to determine if this area is suitable for a sanitary land fill. This should be coordinated with responsible local health officials.

4. Roads

The design and location of park roads must be in accordance with the philosophy that how a person views the park can be as significant as what he sees. These parks should be places to which people go for a special kind of experience. A park road is not one that merely conforms to standards of technical roadbuilding excellence. Preserving the integrity of the landscape, respecting ecological processes, insuring a fully rewarding visitor experience--these are the elements which dictate the means of visitor access and the development of design standards. To accomplish this, a design must be flexible.

Park roads are built over terrain and under climatic conditions which approach the infinite in variety. Each road problem must be influenced by the specific local conditions of climate and topography,

as well as ecological and interpretative factors. This prohibits the establishment of arbitrary standards. Four classifications for park roads are listed in Table III.

TABLE III

PARK ROAD CLASSIFICATIONS

Use	Lanes (10' Wide)	Max Design Speed (MPH)	Total Roadway Width (ft)
1. Access	2	45	28
2. Circulation			
(1) Two-Way Camp and Picnic	2	25	26
(2) One-Way Camp	1	15	14**
(3) One-Way Picnic	1	15	12
3. Service and Maintenance			
(1) Water Well	1	--	14
(2) Trailer Sanitary Station	1	--	14
(3) Toilets	1	--	10
4. Pullouts, Pullthroughs and Paralleled Parking			
(1) Camp Pullouts	1	--	14
(2) Picnic Pullouts	1	--	12
(3) Trailer Pullthroughs	1	--	14
(4) Parallel Parking			
(A) Camp	1	--	12
(B) Picnic	1	--	11

**Roadway widths having curves with radius less than 143 feet should be widened 3' 6".

Typical roadway selections should be included in the plans; however, these selections should only be used as a basis for computation of roadway quantities. The roads must be designed to follow ridges where practicable to avoid heavy cuts and fills and drainage ditches. Selective cutting should be used to produce variation and indentation

in the tree line. With a natural setting as the goal, a minimum disturbance to the natural setting should be a primary consideration at any project.

The design of the ditches and slopes should blend with the related tree and vegetative cover to provide a natural setting. Slopes should be rounded, warped at the ends for transition, and properly seeded, fertilized, and mulched for early recovery and erosion control.

The design of all structures should be aesthetically pleasing as well as functional and easily maintained. Drainage structures for access roads are normally sized to discharge the 10-year frequency runoff. Low water drains (dips) should be used on roads with lower design speeds with small runoff quantities unless a defined ditch has formed and a culvert would serve the design purpose better. For ease of maintenance, pipe culverts should be cut on the slope of the fill.

On access roads and two-way circulation roads, grades of 7 percent are normally a desired maximum, but grades up to 10 percent should be considered to avoid excessive cuts and fills or to reach desirable areas. On one-way roads where vertical sight distance is not a problem, grades of up to 15 percent can be used for a short distance (usually less than 1,000 ft) and an undulating gradeline used to reduce cuts and fills to a minimum and to provide better base roads from which camping and picnicking facilities can be constructed. Most roadway surfaces should be paved.

The horizontal alignments of the roads are based upon the design speed. The maximum design speed for the different classifications of roads is shown in Table III. Generally, access roads are designed for

speed limits from 25 to 45 MPH and one-way circulation roads and other special purpose roads are designed for 5 to 15 MPH.

5. Parking Areas

The materials used in construction and maintenance of the roads are equally applicable to the parking areas adjoining these areas. The treatment of the subbase of the parking area is the same as the adjoining roadway. The depth of a car parking space should be 20 feet and the depth of a car and trailer parking space should be 40 feet (35 feet minimum). The width of a parking space should be 10 feet and each parking space should be marked with painted lines to help control traffic. Curbing should be used to control traffic flow in looping parking areas. The minimum aisle width is usually 20 feet.

The minimum number of parking spaces for a boat ramp is ten. For ramps having 40 expected launchings per normal weekend day, 25 car and trailer spaces per ramp lane is desirable. The number of parking spaces for a picnic area is normally determined by the number of picnic tables. A ratio of three parking spaces for two tables is desirable. If a parking area is being sized for an activity other than picnicking or camping, one car parking space should be provided for each three people expected to be involved in the activity at one time.

6. Launching Ramps

The design criteria established in this thesis are a combination of standards and experience. These criteria are presented in Table IV.

TABLE IV

BOAT RAMP CRITERIA

Item	Limitations
Width	12 to 14 feet per lane
Slope	12 percent minimum, 15 percent maximum, 13 to 14 percent desirable.
Upper Limit	5-year flood frequency elevation or on navigation lakes 3 feet above normal operating pool with appropriate allowances for backwater effects.
Lower Limit	4 feet below the 10-year drawdown or on navigation lakes, 4 feet (minimum) below the normal operating pool.
Surfacing	Scored or patterned concrete.
Maneuvering Areas	1 minimum 75-foot diameter vehicular turnaround per ramp.

The number of lanes proposed to serve a project should be a function of the number of boat launchings on a normal weekend day. This is determined by ascertaining what percent of the recreationists will boat or fish from boats and from this total number, apply a 3.2 person per vehicle average. This reduces to the expected number of boat launchings per normal weekend day. The number of lanes that should be proposed is based upon assumption that one lane is needed for each 40 boat launchings per normal weekend day. If the expected visitation will increase at the project under consideration, the ultimate visitation should be used to determine the number of lanes since adding lanes after the lake has formed is very expensive.

Experience has shown that the criteria presented in Table IV should be adjusted for the region and resource being served. The planner should consider widening the single boat lane to 16 feet wide if the lane is constructed on a fill or is over 200 feet long or over 100 feet to the waterline at normal pool. Additionally, the planner should be aware the construction of a 28-foot wide ramp does not necessarily provide the same number of boat launchings as two 14-foot ramps. Observations made at existing double lane ramps indicate that unless the double lane ramp is physically divided or at least double lane (painted) marked, users will launch their boat from the center of the ramp which reduces the ramp to an effective one lane ramp. In some cases, it may be more desirable to design and construct two separate single lanes than to provide one double lane ramp.

Experience indicates that boat ramp grades steeper than 14 percent are difficult for some vehicles to maneuver; therefore, the planner should study the expected use the ramp will receive and if warranted, the desirable ramp grades may be limited to 12 to 14 percent.

At resource projects where the difference between the 5-year frequency and the 10-year drawdown creates an excessively long ramp (over 250 feet), the ramp should be split and overlapped to reduce the required backing distance. The lower section of the split ramp would extend up from 4 feet below the 10-year drawdown to 5 feet above the normal operating (conservation) pool. A parking area would be provided to serve this lower section of the boat ramp. The upper section of the boat ramp would extend up from 5 feet below the normal pool to the 5-year frequency elevation. A parking area would be provided to serve this upper section of the boat ramp. This arrangement provides an

added benefit since both sections of the ramp can be utilized at or near normal (conservation) pool. A folding sign should be provided at the entrance to both ramp segments. When the water elevation is too high or too low, the sign will direct users to the alternate segment of the ramp.

A boat ramp must be sited in an area with adequate water depth and where wind-waves will not disturb launchings. If this is not practical, a dike should be constructed parallel to the ramp for wave protection and to double as a fishing dike.

7. Docks, Dikes, and Mooring Facilities

The requirements for dikes are usually limited to those listed in the previous paragraph. In boating areas, one courtesy pier is desirable at each launching ramp having an expected 40 boat launchings per normal weekend day. However, since wind-wave action and lake level fluctuations influence feasibility for installation, the operating conditions of the site should be thoroughly considered. For this reason, courtesy piers are often omitted from the initial development. The planner must always try to provide at least one such facility at a project to accommodate the physically handicapped.

In concession areas, all floating boat piers, covered boat slips and marine service stations will be constructed in accordance with the regulations of the leasing agency and the policing authority. The concession limits should include over 600 feet of shoreline, a sizeable area above the effects of flooding, a toilet, and a parking area. Potable water should be made available from the public use area water supply system.

8. Picnic Unit

A typical family picnic unit includes a parking space, a table, and a pedestal fireplace. Trash receptacles are also included but placed to permit two family picnic units to use one facility. An additional parking space should be available in the event two families picnic at one table. Basically, there are two types of family picnic areas. One type requires parking of all vehicles in one large parking area and the users to walk to a table. The other type is an area where each picnic table has a parking space near to the table. This pattern of development looks and functions similar to a camping area. This type of facility is used in combination picnicking-camping areas. Methodology for computing the number of picnic tables for a predicted visitation is included as a part of Paragraph B in this chapter.

A typical group picnic unit includes a group shelter that has three picnic tables, three pedestal fireplaces, and a trash receptacle. This facility should be located in a scenic area preferably overlooking the lake. It is desirable to have one of these group picnic units for each 225 picnickers per normal summer weekend day.

9. Camping Unit

Camping areas should be classified as either an area with adequate tree cover or an area without native tree cover. The criteria for these areas differ considerably.

In areas with native trees, each facility should be carefully located in an effort to minimize destruction of the existing ecology. Major tent and trailer camping areas should be comprised of a minimum

of 50 spaces for ease of maintenance and to justify providing waterborne sanitary facilities. The number of sites should not exceed five per acre and a minimum of 50 percent of the spaces should be interchangeable to accommodate either tent or trailer camping equipment. The preferable distance between camp spaces is 75 feet center to center; however, this distance should be adjusted to fit terrain and cause the minimum amount of disturbance.

A camping unit should contain an area for one car or one car and trailer parking space, one picnic table, a pedestal fireplace, and a trash receptacle. The table should be located so that the table is on the passenger side of a car and the fireplace should be located downwind from the table. Access to the site should be on a 14-foot wide gravel stub or pullthrough. The last 30 feet of the gravel stub should be graded level or near level to serve as a base for tents and to permit the refrigerator equipment in trailers and campers to work correctly. An average stub should be 60 feet long and should make a 45 to 60 degree angle with the circulation road. A car and trailer stub must be laid out to require backing into the space. This permits vehicles with trailers to unhook and leave the trailer at camp site. When pullthroughs are provided, the total length of the spur should be 120 feet to 150 feet. The center 40-foot section of this 14-foot wide gravel road should be level. As with all camp sites, the table should be on the passenger side of the pullthrough.

In areas bare of natural shade for campers, each individual site must have a shelter over the concrete table. In areas where the heaviest use is predicted and where existing vegetation will deteriorate under this use, a concrete slab 15 by 20 feet which contains the

concrete table and base should be constructed approximately 10 feet away from a parallel parking space. If there is a strong predominate wind during the recreation season, the corner of the slab exposed to the predominate wind should be provided with a wind break and privacy fence. This should be constructed from two 8-foot sections of wood fence 6-foot high placed to form an "L" shaped corner. The parking space for this facility should be constructed parallel to the access road or loop road and this parking space must be level to serve the campers and trailer users. Tent campers should be able to set their tents on the level concrete slab adjacent to the table. A concrete walk should be constructed between the pedestal fireplace and the camp slab. The preferable distance between camp spaces should be 100 feet center to center. In addition to the facilities already described for this type of camping area, all the other facilities normally provided for a camping area must be provided.

10. Swimming Beaches

Terrain characteristics, topography, soil composition and stability, availability of sand, suspension of soils in water, cross currents to wash away undesirable materials, impounded water quality and temperature, wind and wave action, and pool drawdown will form the basis for evaluating development feasibilities. Beaches should be planned in coves only at sites where adequate water circulation is obtainable.

Trees must be removed completely and stump holes filled in underwater areas and in shore-side sand areas designated for beach development. The beach should be graded to a unifrom slope and in

grassed areas adjacent to the sand beach, the trees should be left standing where practicable.

The swimming area should be outlined with buoys, international orange in color, with a cable passing through each buoy and with the cable supported with flotation material in accordance with Red Cross recommendations. Additional warning buoys are required 100 feet (minimum) to 300 feet (desirable) outside the designated area.

Benches and designated swimming areas should be sized based upon surveys which indicate that 55 percent of the public use area visitors will use this facility. A turnover factor of three is used in this load calculation. The beach (sand and turf) area is sized assuming that 50 percent of the users will sun bath while 30 percent of the users will swim. The remaining 10 percent are elsewhere. Under ideal conditions, 50 square feet per person of sand or turf is desirable for sun bathing and 30 square feet per person of swimming area inside a buoyed safety zone.

The maximum grade on a graded beach should be 4 to 5 percent. The parking area should be separated from the beach and swimming area by a vegetation buffer if possible. At projects where sand is unavailable or where wind-wave action will destroy a beach, a slab of soil cement or concrete should be provided in the swimming area. This special protection should be extended far enough up the shoreline to protect against wave runup when the pool is at or near normal level.

Change houses and toilets should be provided at or near the beach facility. The change houses should be sited above the two-year flood frequency elevation and the requirements for the toilets are discussed in a following paragraph.

11. Shelters, Toilets, and Other Buildings

The design criteria for various shelters, toilets, and other project building should be in keeping with the design concept for the project and in keeping with good architectural practices. Normally, a project will require group picnic shelters, individual picnic shelters, waterborne toilets, masonry vault toilets, and wood vault toilets. Special consideration should be given to designing some of the toilets and other shelters so that physically handicapped recreationists can utilize these facilities.

Table V lists the facility load criteria that should be used in selecting toilets.

Shelters, other than individual picnic table covers, should be sited above the effects of flooding if practical.

Waterborne toilets are desirable in all areas; however, the cost of providing this facility severely limits its use. These facilities should be sited above the 50-year flood frequency elevation and a minimum of a 5-car parking area should be provided.

The masonry vault toilet is a masonry structure that usually has the same floor plan as a waterborne toilet. Most of these structures are designed so that they can be converted to waterborne structures in the future. The wood vault toilet is a single unit with a wooden superstructure designed to permit removal during periods of flooding. Wood vault toilets should only be used when a masonry vault or waterborne toilet cannot be physically or economically justified. The distance from the farthest picnic or camp site to a toilet is an additional consideration a planner must give to siting toilets.

TABLE V

DESIGN CRITERIA FOR TOILETS

Facility	Design Criteria
Waterborne Toilets	In picnic areas with over 50,000 expected annual visitation, provide one waterborne toilet for each 2,500 normal summer weekend day visitors. In camping areas, provide one waterborne toilet and one washhouse for each 50 camp spaces. This facility should be within 300 feet of the farthest camp site or within 600 feet of the farthest picnic site. This structure must be located above the 50-year flood frequency elevation.
Washhouse	In camping areas, provide one to serve a minimum of 50 spaces and a maximum of 100 developed sites. This facility should be within 600 feet of the farthest camp site. This structure should be designed to accommodate the handicapped. This structure should be located above the 50-year flood frequency elevation.
Masonry Vault Toilet	This combined unit toilet should be used in areas where the level of use does not warrant a better facility. Provide one such vault-type toilet for each 2,500 normal summer weekend day visitors or provide this facility to serve a 600-foot radius in picnic areas or provide this facility in a swimming area where a waterborne facility cannot be justified. Provide this facility to serve a 300-foot radius in a camping area or one for each 5 to 10 camping spaces. This structure should be sited and constructed above the 5-year flood frequency elevation.
Wood Vault Toilets	This single vault-type toilet should be used only in areas where the level of use does not warrant a better facility. Provide two such units (men-women) for each 1,500 normal summer weekend day visitors or provide this facility to serve a 600-foot radius in picnic areas or a 300-foot radius in camping areas or one set for each 5 to 10 camping spaces. This structure should be sited above the 2-year flood frequency elevation.

TABLE V (continued)

Facility	Design Criteria
Change Houses	These single, roofless structures are constructed as a set with a common exterior shower. One set of change houses should serve up to 600 swimmers on a normal summer weekend. These structures should be sited above the 2-year flood level and it is desirable to site these above the 5-year flood frequency elevation.

A picnicker should not be required to walk more than 600 feet to a toilet. A camper should not be required to walk more than 300 feet to a toilet and a shower should be available within a reasonable distance. A limiting factor when siting vault toilets is that the nearest picnic site or camp site should be no closer than 125 feet from the vault toilet. For waterborne toilets, this distance can be reduced to 75 feet.

12. Playground Facilities for Children and Facilities for the Elderly

Playground equipment should be relatively vandalproof and have a life expectancy of over 25 years. The playground should be divided into two segments. In addition to the normal facilities provided, a small area should be designed for toddlers. The playground equipment chosen should blend into the setting of the park. Playground equipment should be provided in areas with over 100,000 expected annual visitation.

Recreational facilities to serve recreational activities such as shuffle boards, horseshoe pits, and shoreline fishing walks should be provided in major public use areas to serve the elderly. The planner must decide under what conditions these facilities should be provided.

13. Electrical Distribution and Security Lighting

Electrical facilities should be placed underground wherever practical and especially within recreation areas, except where to do so would cause excessive damage to the ecology of the area. The planner should place these underground electrical lines parallel to the access and circulation roads. If an electrical line must be cut

through an undeveloped area, then an effort should be made to utilize the cleared alignment as a trial to minimize the impact to the area. Primary metering of electrical power is usually desirable and most electrical companies will sign an agreement to maintain the electrical system for their cost.

Security lighting should be provided at all boat ramps, toilets, beaches, change houses, and other areas where security is needed.

14. Trails and Foot Bridges

Typical hiking trails, foot paths, and natural trails should be designed in accordance with Trail Planning and Layout by Byron L. Ashbaugh. Typical details of foot bridges are given in the Park Practice Design publication.

Foot bridges or small culverts should be provided across creeks and deep ditches where nature trails or paths cross these obstacles.

15. Site Improvement and Landscaping

Site improvement includes the removal of noxious growth, poison ivy, nettles, etc. which could harm the users. Undergrowth adjacent to facilities can harbor ticks, insects, and reptiles and should be thinned or removed. Unmanaged ponds should be drained and filled to help control mosquitoes.

Grading within a public use area should be held to a minimum so that as much natural cover as possible will remain undisturbed; however, sufficient grading should be accomplished to properly drain surface water away from facilities. Dead trees or dead limbs which

might fall during a storm and injure users should be cut and removed from the site.

Facilities should be placed to take advantage of existing trees and shrubs when such placement is possible. If trees and shrubs have to be added for shade or aesthetic effect, a careful selection of indigenous or well adapted plant materials should be used. Ultimate size and spread of plants will be the guide for their placement near facilities. Plants should be used that require a minimum of pruning, trimming or spraying. Combinations of evergreen and deciduous plants and plants of pleasing texture compatibility should be grouped to compliment picnic units, toilet buildings, parking areas, etc. If natural features such as weathered rock outcrops, flowing springs, or wide vistas exist, the landscape plan should be constructed to feature them.

16. Signs

All traffic control signs should be selected and placed as directed in the Manual on Uniform Traffic Control Devices for Streets and Highways. Area designation and information signs should be designed to bring out the design concept of the project. These are usually made by routing the information into wooded signs. Signs should not be provided when a recreationist can see a facility.

Interpretive devices at most water resource projects would be limited to nature trail markers. These should be constructed to be as vandalproof as practical. In most instances, a special braille plate should be attached to the lower right hand corner of these devices. Normally, additional interpretive devices will be added to expand the

recreational experience of the visitor after a project transposes to a lake ecology.

Navigation buoys will be placed near the beach, boat ramps, concession areas, and near the outlet structure to restrict boats from some areas or to control boat speed limits or activity of a boat within a designated area.

B. Method of Computing Number of Facilities Required from Visitation Estimates

Procedures and formulative data required to determine the annual visitation for any project should be taken from Technical Report No. 2, Plan Formulation and Evaluation Studies--Recreation: Estimating Initial Reservoir Recreation Use, Sacramento District, dated October, 1969. The method that should be used to estimate the number of facilities to support a predicted annual visitation is presented in this section. Future visitation is based upon planner's judgment guided by the fact that only certain land and water areas on the project are available for recreation. The planner must determine the degree of crowding that recreationists will tolerate before seeking alternate areas for recreation or alternate types of recreation.

The facilities required to support this visitation can be computed from surveys made at similar water resource projects. In Oklahoma, these surveys have indicated that about 17 percent of the annual visitors attend during the peak month of use and that the visitation on weekends during this period is about 65 percent of the 17 percent total. These surveys also indicated that the average percentage of visitors who use the picnic tables is about 23 percent, that there is

an average of 3.2 persons per table use, and that a turnover rate of 1.5 should be used each day per table. The surveys indicate that about 10 percent of the vehicles at a project have boats and trailers. The criteria presented in this thesis for a boat ramp indicated each ramp lane should accommodate 40 boat launchings per normal weekend day.

The planner should note that 10 percent of the total of 23 percent are campers and that the turnover factor of 1.5 should not be used for the campers.

An example, noted below, illustrates the recommended procedure for computing the numbers of facilities from an estimated initial and ultimate visitations. For this example, an estimated initial annual visitation of 500,000 and an estimated ultimate annual visitation of 700,000 (or an increase of 200,000 visitors in the future) and the above noted participation rates will be used.

Visitation on a normal weekend day:

Initial: $500{,}000 \times 0.17 \times 0.65 \times 1/8 = 6{,}910$

Future: $200{,}000 \times 0.17 \times 0.65 \times 1/8 = 2{,}760$

Number of Tables:

Initial Picnic: (23% - 10% = 13%)

$$\frac{6{,}910 \times 0.13}{3.2 \times 1.5} = 187$$

Initial Camp: (10%)

$$\frac{6{,}910 \times 0.10}{3.2} = 216$$

Total Initial Tables = 403

Future Picnic: (13%)

$$\frac{2{,}760 \times 0.13}{3.2 \times 1.5} = 75$$

Future Camp: (10%)

$$\frac{2{,}760 \times 0.10}{3.2} = 86$$

Total Future Tables = 161

Number of Boat Ramp Lanes:

Initial:

$$\frac{6{,}910 \times 0.10}{3.2 \times 40} = 5.4 \text{ Use } 6$$

Future:

$$\frac{2{,}760 \times 0.10}{3.2 \times 40} = 2.2 \text{ Use } 2$$

Total Number of Ramp Lanes = 8*

*A planner should always provide for the total number of boat ramp lanes in the initial construction.

C. Developing Facility Plans

The ability a planner needs to design recreation areas is similar to that required to solve any kind of land-use problem, the primary difference between public use area design and that of a subdivision is the inputs which are analyzed to arrive at a solution.

Design ability develops from experience. It takes a great amount of time and patience spent in simply doing, testing, discovering, and developing talents. Much of the trial, error, and frustration that this entails is due to the fact that no one has yet invented a design cookbook containing procedures which guarantee results if followed. However, what many planners and designers follow to have some success

is a process which helps them sort out the facts, premises, and combinations that lead to solutions.

Every action begins with the identification of objectives or what is to be accomplished. The concept or objective could vary from one of only providing for foot traffic to the project resources to one that provides for full development of all resources. A concept in a section of our country void of trees might be to provide grassland parks. Before a development theme is determined, the planner or designer should study the area to assure himself that this concept will provide the best plan of development of all project lands.

By the time the planner or designer is ready to develop the plans, he has made two evaluations of the area. The first evaluation was made using the original topographic maps. The notes made on such an evaluation are shown on Figure 2. The second evaluation was made after accurate topographic maps were obtained in this area. This re-evaluation also includes finding sites for boat ramps, concession areas, and swimming areas. The notes made during this evaluation are shown in Figure 3.

The planner should now take the accurate topographic maps which he used to keep field notes upon, and overlay this with vellum and make rough sketches with various road alignments and recreational activities.

The first facility that should be located is the boat ramp. The swimming area and the concession area are the facilities that should be located next. (If more than one ramp site, swimming area, or concession area is developable, then all the sights should be indicated so that alternates may be considered). Areas and points that are especially adaptable for camping or picnicking should be noted on the sketch by

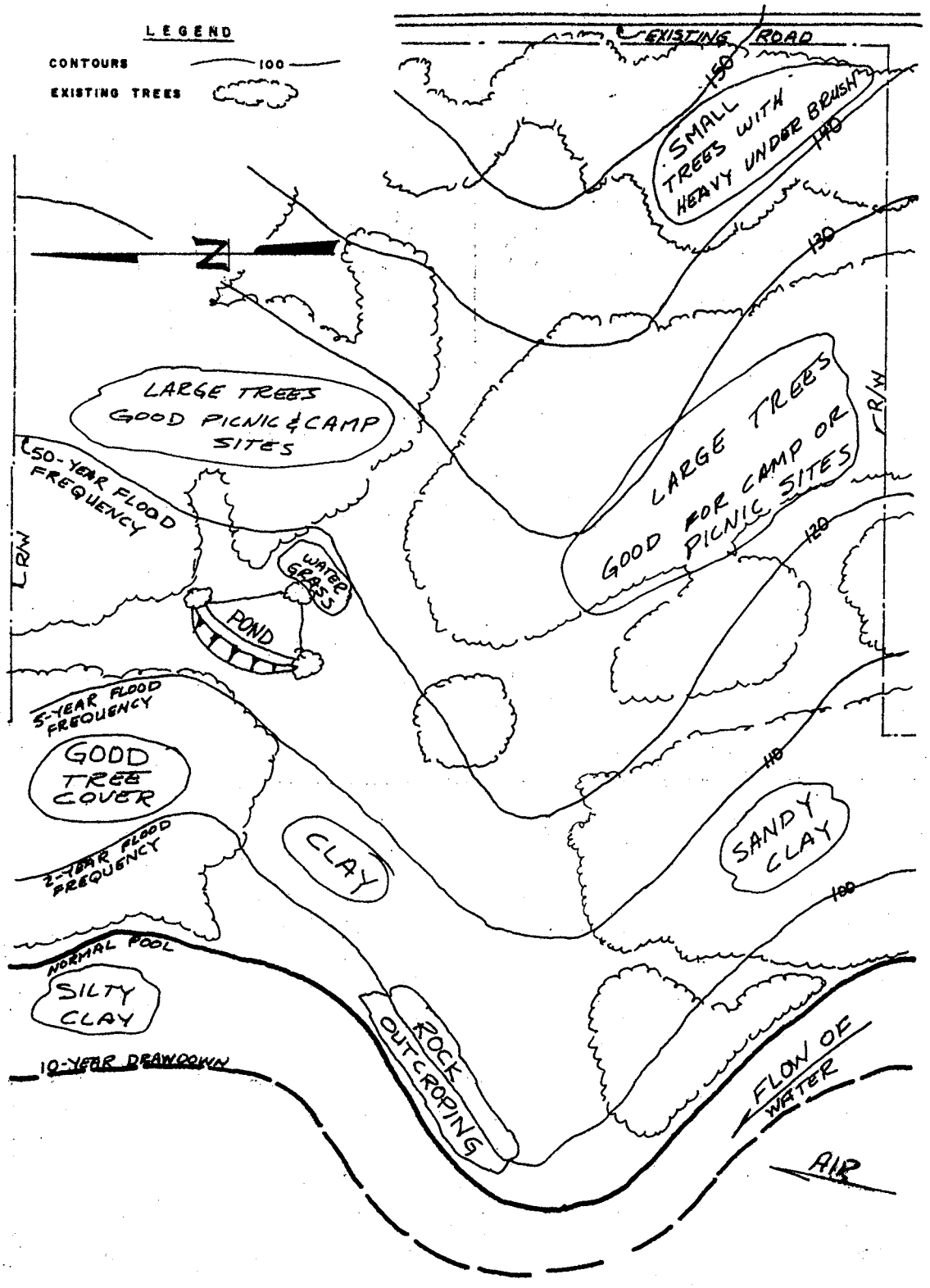

Figure 2. Notes Made During Initial Site Evaluation

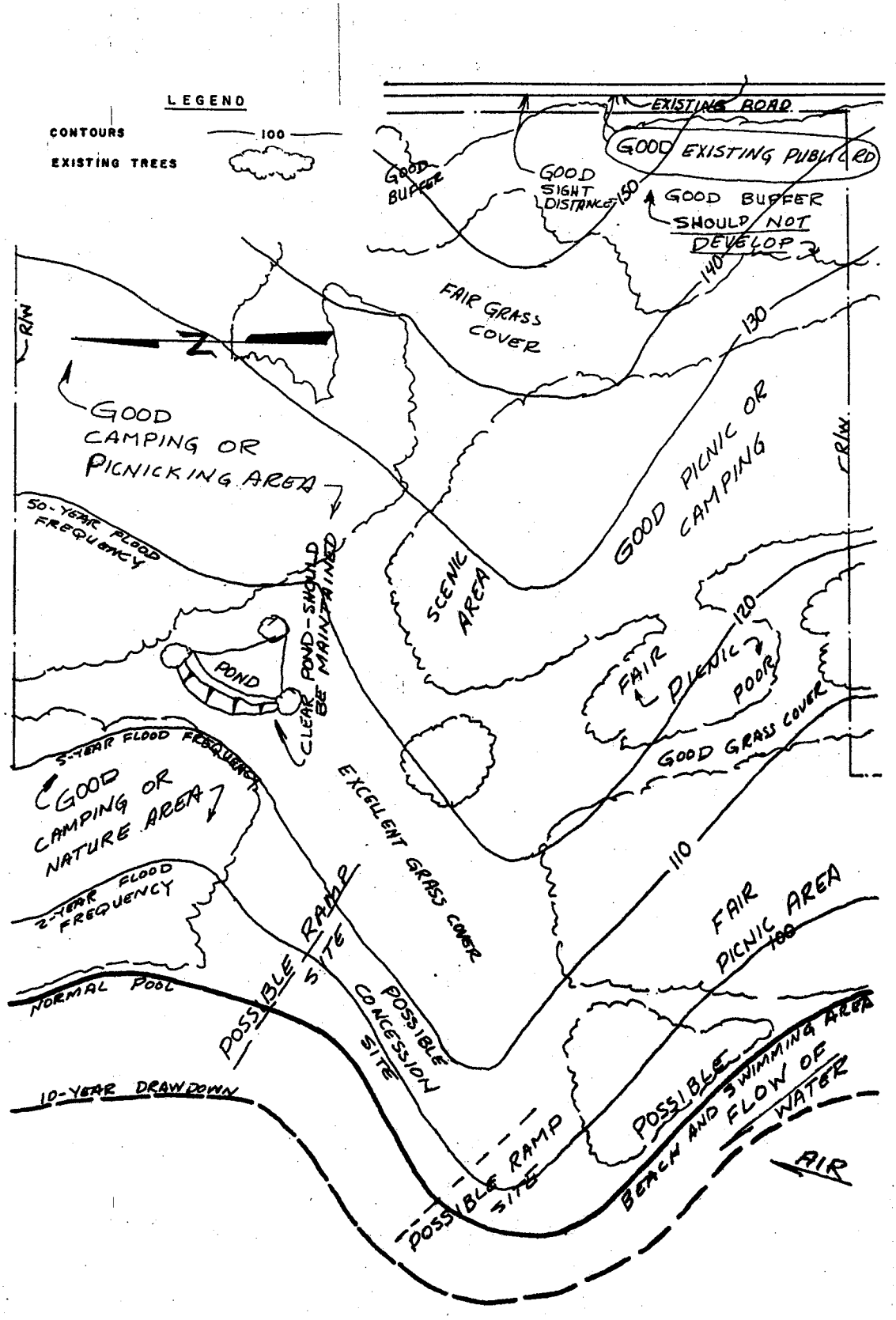

Figure 3. Notes From Second Field Evaluation

circling the area and writing in the possible uses. Unless the entrance to the area is fixed, the planner will have to study the possible entrances and select the one that provides the best sight distance.

With the entrance and sites established, a road system can be sketched. Generally, road alignments should follow ridges. Alternate plans should be sketched and compared to obtain the most economical and feasible layouts. Each sketch should be analyzed to see if the goals set can be reached by the layout being considered.

Road alignments are the basis from which all facilities are referenced. The procedures in developing road alignments are the same for public use areas as for developing a housing addition or a mobile home park. However, the planner must provide the buffer zones between the different recreation activities.

The planner should consider the needs of the recreationist associated with each activity and develop a plan that provides these needs to the extent possible. A partial list of the recreational activities and the related facilities is shown in Table VI.

After a scheme of development has been selected that satisfies all the design goals, the planner or designer should prepare a rough plan which establishes road alignments and facility locations. Each area should be planned to the optimum capacity of the area. Figure 4 illustrates this procedure.

After all areas have been developed to this state, the number of facilities provided in each area should be tabulated. This tabulation should be compared with the number of facilities required from visitation estimates. The number of camping sites and picnic sites

TABLE VI

ACTIVITIES AND RELATED FACILITIES

Activity	Desirable Facilities
Nature Areas	Parking Toilet Drinking water Trails
Picnicking	Parking Toilets Drinking water Playground equipment Playing fields Concession Trails Swimming Boat ramp
Camping	Toilet with showers Drinking water Concession Trails Swimming Boat ramp
Swimming	Change house Toilet Parking Drinking water
Marina	Toilet Drinking water Parking Boat repairs and rentals Boat ramp
Boat ramp	Parking Toilet Courtesy dock
Fishing Areas	Fishing walk Parking Toilet Drinking water Dike or pier

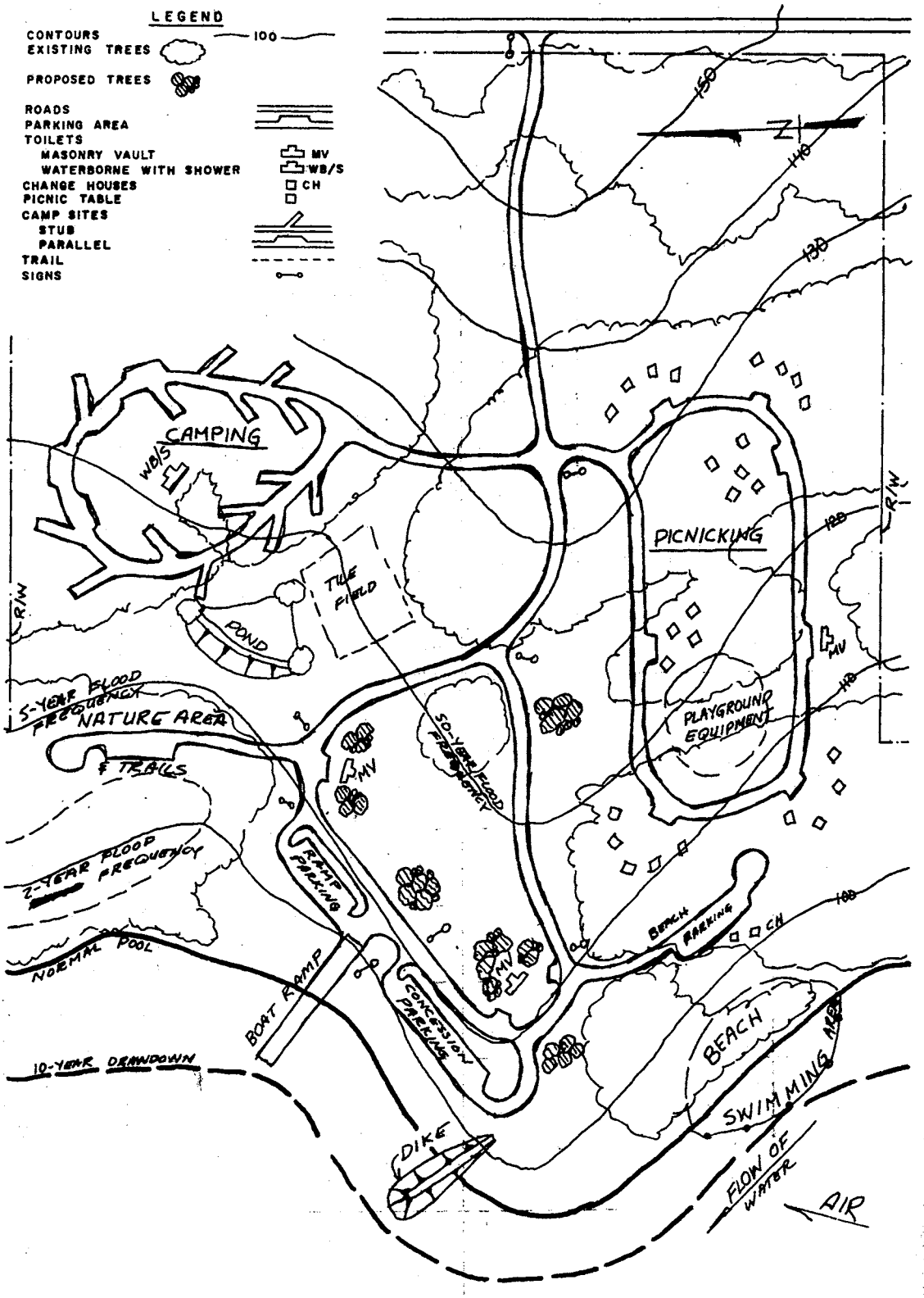

Figure 4. Sketch of Full Development

as well as supporting facilities may require increasing or decreasing. With experience, a planner will be able to make these numbers come close to each other.

The best areas should be developed initially with the less desirable areas left for future development permitting these areas to improve with time and proper management. When determining what facilities to leave for future development, a planner should leave complete loops undeveloped.

After these decisions have been made, a final more detailed plan should be prepared. Figure 5 illustrates what should be shown for this step. This plan should be taken to the field with a survey crew and the road alignments surveyed, and the road alignments and facility sites that are unsuitable should be revised. From this final survey, the formal plan can be developed for submittal to the developing agency for their review.

D. Evaluation of Plans

Before a plan can be adequately evaluated, the reviewer should understand the goals and design concept for the project. The evaluator should study the areas chosen for development and consider the factors affecting the design of public use areas. These factors include evaluation of accessibility, topography, size, vegetation, soils, pool fluctuations, climate, water depth and circulation, air flow, availability of groundwater, and adjacent land uses. This should give the evaluator the basis for forming his own evaluation of each area.

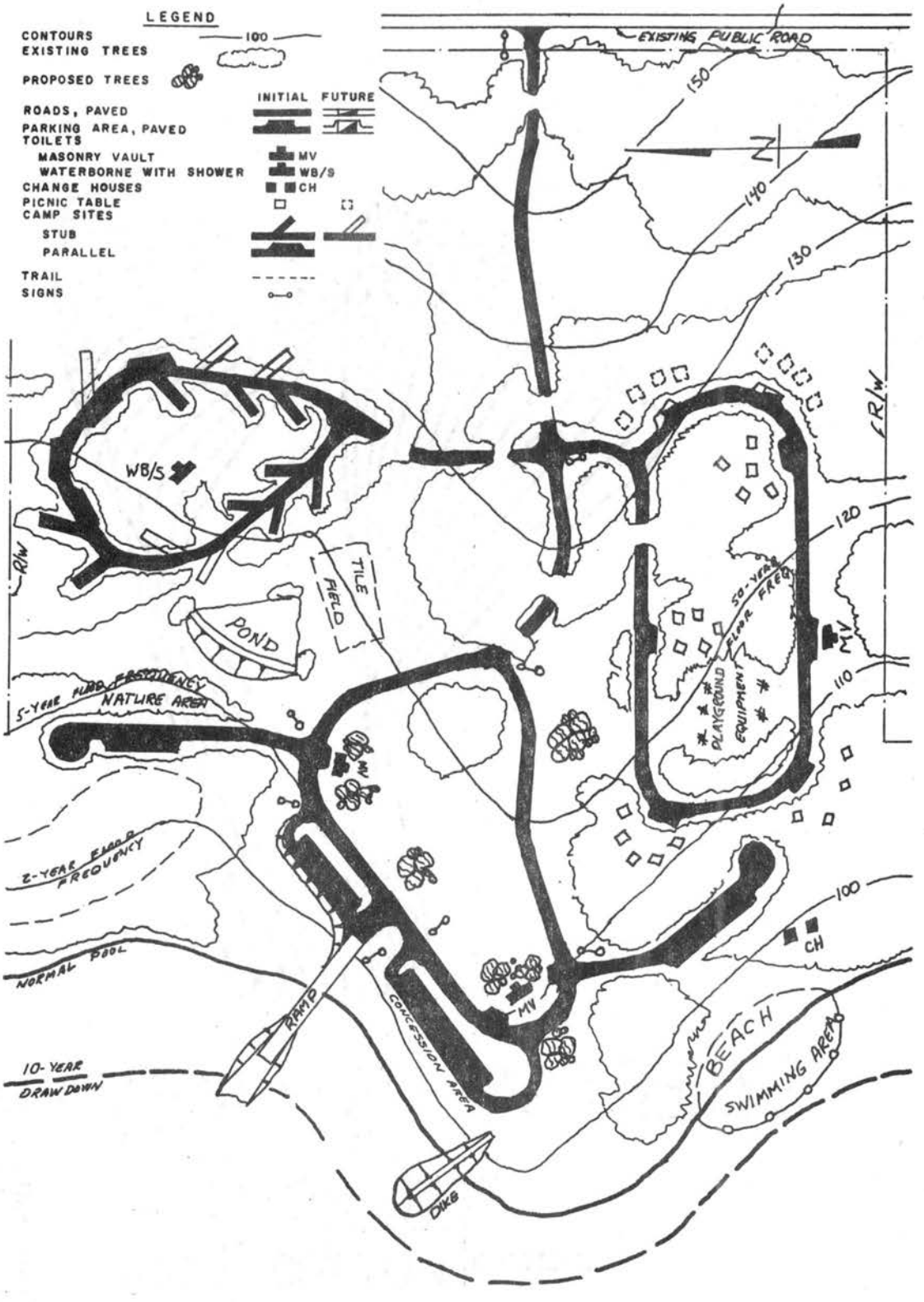

Figure 5. Revised Plan

The evaluator should know the design requirements for each facility proposed. Each facility should be checked to insure that the facility is sited correctly.

The evaluation of the design portion of the plans is a value judgment; however, the evaluator should follow through the procedures of designing these areas and he should compare his sketches to the plan proposed. If the designer has overlooked a factor, then this should be brought to his attention for correction.

CHAPTER V

CONCLUSION

It is essential that a planner or park designer understand the factors that affect the selection and design of recreation areas on a water resource project. If these factors are not evaluated, the areas selected for development may not provide the basis from which an adequate recreation area can be developed.

A planner must be able to determine what survey information will enable him to reanalyze an area for its potential and obtain this information in prospective public use areas.

Before the planner progresses to the next step of the analysis and design process, criteria for design and placement of recreational facilities must be reviewed and the planner should determine the numbers of these facilities that are required to facilitate the expected annual visitation.

The process through which a planner goes to develop a scheme for an area or for the project is usually based upon the imagination of the planner. The planner must know if a concept or set of goals established for an area or a project can be accomplished reasonably with the resources and existing ecology.

The development of sketches, preliminary plans, and final plans should reflect all the factors considered and should reflect the thinking and judgment of the planner.

CHAPTER VI

SUGGESTIONS FOR FUTURE WORK

Based on the results of this investigation, the following suggestions are made for future research in the area of selection of public use areas and placement of facilities within these areas.

1. A study on the use of different roadway surfacing within an area and how the different surfacings affect the attendance levels within an area.

2. A study on the methods used to design and construct roads within public use areas.

3. A study to determine if development of public use areas should be limited to one or two large recreation areas or to smaller areas dispersed over the project lands.

4. A study to determine if recreational areas should be designed to accommodate the recreationist with off-road vehicles and the recreationist with horses who needs a place to ride.

5. A study to determine the needs of the recreationist who would like to hike into nature areas for one or more days.

6. A study to determine if the needs of the group campers can be satisfied by selecting an area and constructing group camp facilities and by making these areas available on a short-term first-come first-served basis.

A SELECTED BIBLIOGRAPHY

Ashbaugh, Byron L., and Raymond J. Kordish. Trail Planning and Layout. New York: National Audubon Society, 1967.

Frieswky, Seebolt H. Mobile and Portable Recreation Facilities in Parks and Recreation. National Recreation and Park Association. Washington: Government Printing Office, 1966.

Good, Albert H. Park and Recreation Structures. National Park Service. Washington: Government Printing Office, 1938.

National Park Service. Park Practice Design. Washington: Government Printing Office, Continuing Publication.

National Recreation and Park Association. National Park Recreation and Open Space Standards. Washington: Government Printing Office, 1971.

Phillips, George R., Frank J. Gibbs, and Wilbur R. Matton. Forest Trees of Oklahoma. Forestry Division, State Board of Agriculture and Forest Service, U.S. Department of Agriculture. Washington: Government Printing Office, 1959.

Rutledge, Albert J. Anatomy of Park. New York: McGraw-Hill, 1971.

U.S. Department of the Interior, National Park Service. Park Road Standards. Washington: Government Printing Office, 1968.

U.S. Department of the Interior. Outdoor Recreation Space Standards. Washington: Government Printing Office, 1970.

U.S. Department of Transportation and U.S. Department of the Interior. Bicycling for Recreation and Commuting. Washington: Government Printing Office, 1972.

Vollmer Associates. Parking for Recreation. National Recreation and Park Association. Washington: Government Printing Office, 1965.

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