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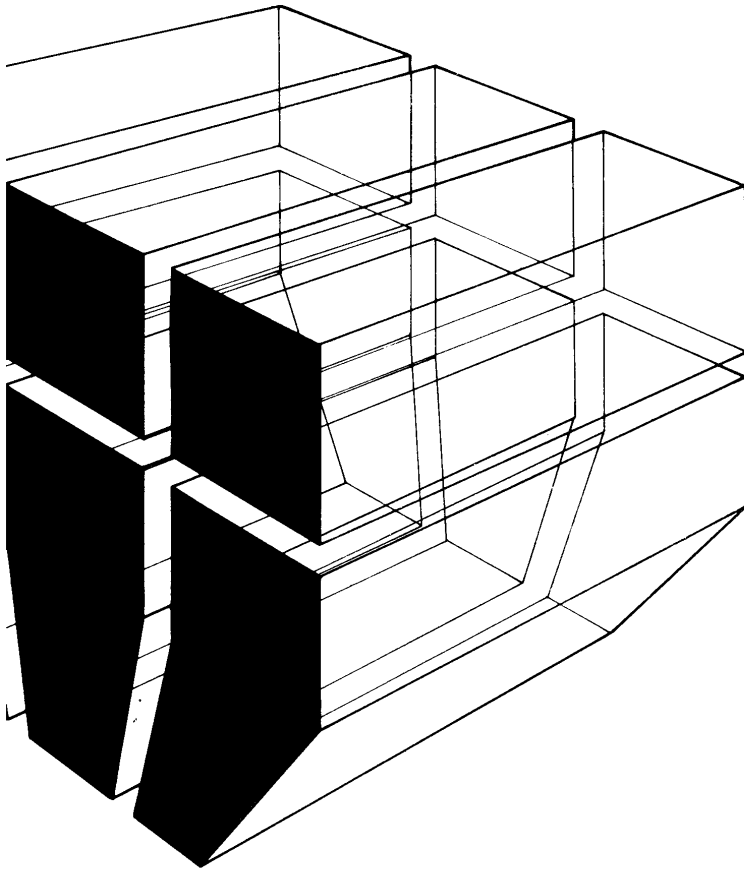
TECHNICAL REPORT N-121  
November 1981

ESTABLISHING PRIORITIES FOR ACQUIRING  
NATURAL RESOURCES DATA PARAMETERS

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by  
W. D. Severinghaus  
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CERL-TR-N-121	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ESTABLISHING PRIORITIES FOR ACQUIRING NATURAL RESOURCES DATA PARAMETERS		5. TYPE OF REPORT & PERIOD COVERED FINAL
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. D. Severinghaus R. G. Goette1 L. L. Radke		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ARMY CONSTRUCTION ENGINEERING RESEARCH LABORATORY P.O. BOX 4005, CHAMPAIGN, IL 61820		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 4A762720A896-B-024
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE November 1981
		13. NUMBER OF PAGES 192
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Copies are obtainable from the National Technical Information Service Springfield, VA 22151		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) natural resources army installations		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report explains procedures allowing personnel who manage natural resources at Army installations to gather and disseminate environmental data efficiently. The report defines data parameters required for natural resources management in the areas of (1) fish and wildlife; (2) forestry; (3) agricultural outleasings; (4) outdoor recreation; (5) training; and (6) buildings and grounds. Techniques are described for ranking parameters on the basis of the duration of usefulness of a piece of information, the need to have the information, and the availability of the information.		

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These procedures will indicate to the natural resources manager: (1) the data that he/she needs to collect; (2) the importance others attach to this information; (3) the order in which the information should be acquired.

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## FOREWORD

This research was performed by the Environmental Division (EN), U.S. Army Construction Engineering Research Laboratory (CERL) for the Directorate of Military Construction, Office of the Chief of Engineers (OCE), under Project 4A762720A896, "Environmental Quality for Construction and Operation of Military Facilities"; Task B, "Source Reduction Control and Treatment"; Work Unit 024, "Guidelines for Natural Resources Management and Land Use Compatibilities." The OCE Technical Monitor was Mr. Donald Bandel, DAEN-MPO-B.

The work which led to the development of this document was the result of interdisciplinary cooperation between CERL personnel and a team of scientists assembled for this study: Dr. H. E. Balbach, CERL; Mr. R. S. Baran, CERL; Mr. J. J. Fittipaldi, CERL; Ms. W. J. Garrison, Environmental Associates, Champaign, IL; Mr. W. D. Goran, Environmental Associates, Champaign, IL; Mr. H. J. Grau, Oklahoma Biological Survey, Norman, OK; Mr. J. M. Higgins and Mr. C. Janacek, Mason and Hanger, Silas Mason Co., Inc., Cornhusker Army Ammunition Plant, Grand Island, NB; Dr. E. B. Jelks, Illinois State University, Normal, IL; Dr. G. D. Schnell, Oklahoma Biological Survey, Norman, OK; Dr. T. R. Yocum and Dr. R. A. Young, University of Illinois, Champaign, IL.

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# ESTABLISHING PRIORITIES FOR ACQUIRING NATURAL RESOURCES DATA PARAMETERS

## I INTRODUCTION

### Background

The need to use fully the natural resources on U.S. Army installations is becoming more crucial. Training to maintain military readiness and advanced weapons systems, and nonmilitary use of lands accompanied by a reduction in new land acquisition provide increasing pressure to manage resources effectively.

Presently, several offices on an Army installation manage natural resources. The U.S. Army Construction Engineering Research Laboratory (CERL) is conducting research on several aspects of natural resources management, and has helped Army installations comply with AR 200-1 by developing extensive management programs, models, and systems (for reports on CERL's previous work, see pertinent references, pp 17-36).<sup>1</sup> The Office of the Chief of Engineers (OCE) asked CERL to pursue research on coordinating and making more efficient the efforts of the various installation offices responsible for natural resources.

This report provides the natural resources managers on Army installations a single listing of the data parameters needed to properly administer the areas of buildings and grounds, fish and wildlife, training, forestry, outdoor recreation, and agricultural outleasings. This listing is so detailed that installation and ecosystem specificity are major concerns. The parameters are ranked to indicate the order in which they should be acquired.

### Objective

The objective of this study was to develop a procedure allowing efficient gathering and dissemination of environmental data for managing natural resources.

### Approach

Much of the information in this report was obtained from professionals who are actually responsible for maintaining and managing successful programs in their respective areas of expertise -- e.g., buildings and grounds, training, forestry. CERL asked each of these individuals to develop a list of data parameters for natural resources. CERL then synthesized this information and returned a master list to each professional, who ranked all parameters to help establish the importance of the various types of environmental data. The parameters were ranked on three points: (1) duration of usefulness -- how long, in relative terms, is one piece of information useful before it has to

<sup>1</sup> Environmental Protection and Enhancement, Army Regulation (AR) 200-1 (Department of the Army [DA], 20 January 1978).



be acquired again; (2) need -- how essential is this piece of information to a successful management program; and (3) availability -- under normal conditions has this information already been collected, is it available in the literature, can it be purchased, or will it take a new effort to acquire? CERL then compiled this information and established rankings based on the importance of acquiring each parameter.

### Scope

The specific areas of building and grounds, forestry, fish and wildlife, training, agricultural outleasings, and outdoor recreation are covered. Archeological and cultural resource management falls within the scope of this report since it interfaces in some way with all of the discussed area. It is not included in this report since it is not a renewable resource and requires separate handling.

### Mode of Technology Transfer

It is anticipated that after field testing, the procedures outlined in this report will be used to prepare Department of the Army handbooks on state-of-the-art methodologies for environmental data collection.

### Users of the Report

This report will assist those installation employees in the Division of Planning and Training, the Facility Engineer and associated personnel, and the personnel responsible for outdoor recreation in G-3. The report will help coordinate the work of the various installation natural resources managers and is directed to all personnel under these programs.

## 2 USER PROCEDURES

This report deals with the areas of natural resources management that are represented by forestry, fish and wildlife, buildings and grounds, training, outdoor recreation, and agricultural outleases. The areas are loosely defined as follows:

(1) Agricultural Outleases -- Activities related to the leasing of Army controlled lands for the purposes of grazing or cropping. Includes background information needed to develop an outleasing program as well as develop the lease itself.

(2) Buildings and Ground -- Activities and information required to properly manage those parts of an installation that are moderately to heavily developed. This would include most of the cantonment area as well as transportation routes and other manicured or developed non-cantonment areas.

(3) Fish and Wildlife -- Activities and information required to manage sport fishing and hunting programs. This would include stream, river, lake, and pool management, stocking programs, wildlife food plots, quota determination, and harvest censoring.

(4) Forestry -- Activities and information required to operate a forest management program that allows optimum use and utilization of forest resources. This would include information on land ownership, forest, soil, and climatic information, as well as contract, protection, and silvicultural information.

(5) Outdoor Recreation -- Activities and information for the successful planning and management of outdoor recreation to ensure harmony with the physical environment, satisfy the leisure needs of the users, and justify the investment in providing recreational facilities and opportunities. This includes cantonment and non-cantonment based recreation as well as military personnel, civilian personnel, and the public.

(6) Training -- Activities and information related to those aspects of training that deal directly with the field training mission. Aspects of the training mission that do not affect land use were not considered.

It should be remembered that any system of ranking or prioritization that assigns finite numbers to qualitative values may produce bias. This system is only meant as general guidance, and within this system the manager making the final decision on data acquisition should take other unquantifiable factors into consideration. For example, forestry programs at deserty Fort Bliss, scrubby Fort Hood, and heavily timbered Fort Benning should have a varying effect on the end result of prioritization.

## The Appendices

In Appendix A, the parameters are divided into 15 groups (e.g., soil parameters, climatic parameters) and defined. The definitions will help show managers in one area -- e.g., training or forestry management -- how other areas may be able to use information about a given parameter. The definitions synthesize responses of the personnel asked to list and define all parameters required to manage the specific natural resource in their area of expertise. Accompanying most of these definitions is a brief explanation of the purpose and use of the information. Appendix A was meant to be thorough but will not necessarily include all parameters; it is reasonable to expect that some items have been excluded due to the enormous variation within the United States and its available natural resources. The user of this report should examine Appendix A closely, add any excluded parameter that is critical, and delete any which is not relevant.

The rankings of the data parameters (Appendix B) will allow the user to gauge the most important items. The natural resources professionals participating in this study ranked each parameter on three points, as indicated in Table 1.

1. Duration of usefulness: The relative length of time one piece of information is available. Data that must be continuously gathered received a low ranking value of 1 (e.g., water quality measurements that must be done weekly or daily). Data acquired annually, such as the population of deer for fish and wildlife management, received an intermediate value of 3, while information that is acquired only once, such as topographic maps, received a value of 5.

2. Need: A measure of the relative importance of a particular piece of information to the operation of a successful natural resources management program in each specific area. The ranking was again based on a sliding scale of 1 to 5, with 1 representing a parameter which would be nice to know but not critical to that specific program, and 5 representing a parameter which, if not known, would severely affect the success of the management program.

3. Availability: A measure of the likelihood that a piece of information will be readily available. The ranking for this category was based on the professional's opinion about the general availability of various data on U.S. Army installations. On the sliding scale, a 1 indicated that the information definitely would not be available and would have to be obtained through basic research, a 3 meant that the information should be available and in most cases would only have to be located, and 5 indicated that the information should be in hand.

The table for installation-specific priorities (Appendix C) will probably be the most useful section of this report. Most installations already have very capable professionals managing the various natural resources programs. These professionals should be able to rank the list of parameters, thus giving this tool added strength by making it more specific to their installation. Once each group of parameters is ranked, priorities within groups can be established and a coordinated effort begun to obtain the most pertinent information. A secondary product of this procedure will be the ranked section on availability. If a person from one office ranks the parameter a 5 (indicating

Table 1  
Rating Table

Duration

1. Data that must be continuously monitored on at least a weekly basis to be effective.
2. Data requiring acquisition more than once a year to be effective.
3. Data requiring annual acquisition to be effective.
4. Data requiring acquisition once every few years to be effective.
5. Data which once acquired would never have to be gathered again.

Need

1. Information not pertinent to management but would be informative at a general level.
2. Information which could reduce the total effectiveness of a management program but not noticeably.
3. Information which would reduce the total effectiveness of a management program but only minimally.
4. Information which would not terminate a management program but would significantly reduce its effectiveness.
5. Information which the lack of would terminate or render totally ineffective a management program.

Availability

- Information definitely would not be available and would have to be obtained through basic research.
2. Information would be partially available and would require some additional research.
  3. Information should be available and in most cases would only have to be located.
  4. Information should be available and its location is known.
  5. Information is in hand.

he/she actually has the information), all areas ranking it less than five will know where to find the information easily.

### Establishing Priorities

A general procedure for setting priorities is presented in this section. The professionals participating in the listing, defining, and ranking phase of this study were asked to rank each parameter according to their opinion of the average situation on U.S. Army installations. This approach has obvious drawbacks because the natural resources covered by this report are quite diverse. Establishing priorities so generally will be most useful for installations without a complete, experienced staff to handle all aspects of natural resources management. In such cases, this report will be valuable for: (1) documenting the major overlap between information required to manage all natural resources; (2) familiarizing the user with terminology, its meaning, and its use in areas of natural resource management that are not part of his/her areas of expertise; (3) providing a coordinated approach to reduce and eliminate repetitive and unnecessary data acquisition; and (4) establishing for an installation the order in which natural resources data should be collected.

To use this report efficiently, personnel first should examine Appendix A. From this list, parameters that appear to be relevant to the installation should be chosen. (Obviously the user of this report must be familiar with an installation and its resources.) Some parameters or areas of management may not be needed. For example, tank/infantry training is not conducted at ammunition plants, and forestry will not be appropriate on an installation such as the White Sands Missile Range. If there is a question about whether a particular parameter should be of concern, the discussion in Appendix A should provide enough information to solve the problem.

When the user has a list of parameters of major concern, he/she pulls from the tables in Appendix B all those parameters and their rankings. The user then goes through this list and removes all parameters in his/her possession. For example, most managers will have topographic maps, aerial photographs, and soil surveys on hand. Next, the user makes a list of the remaining parameters ranked 5 in the availability column, and organizes these by the natural resource area that ought to have the information. It will be necessary to obtain this information, or at least verify its existence and its source, before progressing much further. On the final list will be parameters that the user does not have or does not know where to find.

The next step is to organize this final list of data parameters based on the rankings presented in Appendix B. The user then should be able to hire contractors to collect information for all remaining items under each of the 15 parameter groups.

For ease in explanation, we will assume that the first several steps eliminated none of the data parameters and that all pieces of information must now be acquired. The listing is thus the same as that in Appendix B.

The mean ranking for each group of data parameters should be determined. The results for Appendix B are listed in Table 2, and the groups are ranked

Table 2  
Example of Parameter Ranking

Parameter Groups	Statistical Comparisons*					
	N	$\bar{X}$	SD	t	df	P>
1. Terrestrial Natural Abiotic	15	63.73	16.97	0.88	60	0.2
2. Soil	47	62.72	10.81	0.04	65	0.9
3. Aquatic Natural Abiotic	20	64.45	16.28	0.46	45	0.5
4. Climatic	27	60.78	10.74	0.26	58	0.5
5. Terrestrial Man-Influenced Abiotic	33	58.30	9.81	0.65	57	0.5
6. Aquatic Man-Influenced Abiotic	26	57.19	12.19	0.41	120	0.5
7. Existing Structural Facilities	96	53.97	11.23	0.06	129	0.9
8. Terrestrial Plants	36	57.11	9.31	0.71	93	0.4
9. Terrestrial Man-Influenced Biotic	59	56.46	8.47	1.37	66	0.1
10. Terrestrial General Biotic	9	53.33	7.23	0.08	34	0.9
11. Terrestrial Animal	27	47.70	9.86	1.15	61	0.2
12. People/Population	36	49.19	15.28	0.94	48	0.2
13. Military	14	45.21	6.38	0.73	22	0.4
14. Surrounding Area	10	42.90	9.28	1.98	27	0.5
15. Aquatic Biotic	19	35.26	6.19			

\*N = sample size,  $\bar{X}$  = mean, SD = standard deviation, t = t-value for t-test of means, df = degrees of final freedom, P> = probability greater than.

according to their importance. That is, given the general information in Appendix B, it is most important to obtain Terrestrial Natural Abiotic data, then Soil, Aquatic Natural Abiotic, Climatic, etc. The average rankings were tested using a t-test of means to verify that the mean rankings were not significantly different (i.e., did not represent different entities); the ranking values can be used for comparison.

Within each of the parameter groupings, another ranking system exists (Table 3). Once it has been decided to acquire information on a specific grouping, such as climate, these internal rankings can be used to determine the priority within each group and can help especially if funding levels are not sufficient to obtain all the information.

Table 3  
Rankings for Climatic Parameters

<u>Ranking</u>	<u>Parameter</u>
82	Precipitation (Distribution)
79	Precipitation (Type)
76	Sunlight Duration
76	Length of Growing Season
74	Precipitation (Amount)
73	Winds
72	Frost Free Period
72	Storms
70	Snowfall (Monthly)
70	Air Temperature
65	Snow Accumulation
64	Snowfall (Number of Days)
63	Humidity (Seasonal Patterns)
60	Mean Number Days Cloud Cover/Month
59	Wind Chill Factor
59	Thunderstorm Patterns (Frequency)
58	Effect of Temperature Extremes on Equipment
57	Effect of Storms on Equipment and Transportation
57	Solar Radiation
56	Evaporation and Transpiration
55	Humidity (Daily Patterns)
55	Effect of Temperature Extremes on Transportation
53	Per Month Freeze-Thaw Transitions
50	Degree Days Heating
48	Degree Days Cooling
48	Visibility Conditions
40	Altitude of Clouds

### 3 ESTABLISHING INSTALLATION-SPECIFIC PRIORITIES

Most installations will have staff members with the expertise to deal with each of the six natural resources areas specifically covered in this report: buildings and grounds, fish and wildlife, forestry, agricultural outleashes, training, and outdoor recreation. If the expertise is available to cover all of these areas or only part of them, the data parameters can be ranked so that they deal with problems that are specific to the installation, as well as with those that are generally found. To use a more specific approach in establishing priorities for data acquisition, the following approach should be used.

1. The responsibility for each area of natural resources management is to be assigned to a person with the expertise to properly handle that area. Also, some areas listed may not concern the installation and should not be considered. Each participant is given a list of the data parameters and their definitions (Appendix A). Participants list parameters pertaining to their particular area by deleting those that are irrelevant and adding any appropriate to the area. Definitions should be written so that additional parameters will be understandable to people working in other areas. The coordinator for this project collects the revised lists and definitions and organizes them by adding to or deleting from the master list in Appendix C. (A blank matrix which can be reproduced is included in Appendix C.)

2. Matrices with the installation-specific parameters are returned to the original participants, who rank each parameter on the sliding scale of 1 through 5 for duration of usefulness, need, and availability (see pp 10-11). If some areas of concern cannot be ranked for the specific installation, the information in Appendix B should be used.

3. The ranked matrices are returned to the coordinator and transcribed on one master matrix.

4. To complete the process, the guidelines explained in Establishing Priorities should be followed.



#### 4 CONCLUSION

This report has explained procedures allowing Army installations to gather and disseminate environmental information efficiently. Specifically, the report has defined data parameters required for proper natural resources management in the areas of (1) fish and wildlife; (2) forestry; (3) agricultural outleashes; (4) outdoor recreation; (5) training; and (6) buildings and grounds. Techniques have been described for establishing priorities among parameters by ranking each on the basis of the duration of usefulness of a piece of information, the need to have the information, and the availability of the information.

## LIST OF INFORMATION SOURCES

For addresses of many of the agencies listed below, see R. Lacey, H. Balbach, J. Fittipaldi, Compendium of Administrators of Land Use and Related Programs, Technical Report N-40/ADA057226 (U.S. Army Construction Engineering Research Laboratory [CERL], July 1978).

### Agricultural Outleases

#### *Obtaining Data Parameters*

1. Climatological Data can be obtained from the Environmental Data Service, National Climatic Center, National Oceanic and Atmospheric Administration [NOAA], Asheville, North Carolina.
2. Cooperative Extension Service.
3. National Range Handbook (SCS, USDA, 1974), with looseleaf updates.
4. National Range Handbook, NRH-1 (SCS, USDA, July 13, 1976).
5. Range Plant Handbook (Forest Service, USDA, 1937).
6. Local Soil Conservation Service.
7. Soil Survey Manual, U.S. Department of Agriculture (USDA) Handbook No. 18 (Bureau of Plant Industry, Soils and Agricultural Engineering, August 1951). Several sections have been more recently updated.

#### *Implementing Proper Management Plans*

1. Proper Use and Management of Grazing Land (Arizona Inter-Agency Range Committee, 1972).
2. Environmental Protection and Enhancement, Army Regulation (AR) 200-1 (Department of the Army [DA], December 1973).
3. Granting Use of Real Estate, AR 405-80 (DA, August 1978).
4. Natural Resources, AR 420-74 (DA, 1 July 1977).
5. Bell, Hershel M., Rangeland Management for Livestock Production (University of Oklahoma Press, 1973).
6. Control of Water Pollution from Cropland, Vols I and II (Agricultural Research Service, USDA, Office of Research and Development, November 1975).
7. Forest Interpreters Primer on Range Management, TT-54 (Forest Service, USDA, October 1977).
8. Heady, Harold F., Rangeland Management (McGraw Hill Book Company, 1975).

9. Hormay, August L., Principles of Rest-Rotation Grazing and Multiple Use Land Management, TI-4 (Forest Service, USDA, September 1970).
10. Hutchins, Wells A., Water Rights in the Nineteen Western States (Natural Resource Economics Division, Economic Research Service, USDA, 1974).
11. National Handbook of Conservation Practices (SCS, USDA, May 1970).
12. Russell, E. Walter, Soil Conditions and Plant Growth (Longman, 1973).
13. Stoddart, Laurence A., Arthur D. Smith, and T. W. Box, Range Management (McGraw Hill Book Company, 1975).
14. Thorne, D. Wynne, Marlowe D. Thorne, Soil, Water and Crop Production (AVI Publishing Co., Inc., 1979).

### Buildings and Ground Management

#### *Army Regulations (ARs)*

1. Army Recreation Services, AR 28-1 (DA, January 1979).
2. Aerial Dispersal of Pesticides, AR 40-574 (DA, 26 April 1976).
3. Environmental Protection and Enhancement, AR 200-1 (DA, 20 January 1978).
4. Use of Off-Road Vehicles on Army Land, AR 210-9 (DA, 1 July 1978).
5. Master Planning for Permanent Army Installations, AR 210-20 (DA, 26 January 1976).
6. Family Housing Management, AR 210-50 (DA, 1 April 1971).
7. Post Cemeteries, AR 210-190 (DA, 21 March 1975).
8. Granting Use of Real Estate, AR 405-80 (DA, 1 February 1979).
9. Disposal of Real Estate, AR 405-90 (DA, 27 April 1977).
10. Natural Resources -- Land, Forest and Wildlife Management, AR 420-74 (DA, 1 July 1977).
11. Pest Control Services, AR 420-76 (DA, 15 July 1976).

#### *Technical Manuals (TMs)*

1. Herbicide Manual for Noncropland Weeds, TM 5-629 (DA, August 1970).
2. Grounds Maintenance and Land Management, TM 5-630 (DA, 4 December 1967).
3. Woodland Management, TM 5-631 (DA, 2 April 1963).
4. Military Entomology Operational Handbook, TM 5-632 (DA, December 1971).

*Other Sources*

1. Installation Land Management Plan.
2. Installation Forest Management Plan.
3. Installation Landscape Planting and Maintenance Plan.
4. Installation Fish and Wildlife Management Plan.
5. Installation Maintenance Plan.
6. County Soil Survey.
7. Local Soil Conservation Service.
8. County and State Extension Service

Fish and Wildlife Management

*Specific References*

- Bennett, G. W., Management of Lakes and Ponds (Van Nostrand Reinhold Co., 1970).
- Carp, E., ed., Proceedings of the International Conference on Conservation of Wetlands and Waterfowl (International Waterfowl Research Board, 1972).
- Clark, J. R., Coastal Ecosystem Management: A Technical Manual for the Conservation of Coastal Zone Resources (John Wiley--Interscience, 1977).
- Duffey, E. and A. S. Watt, eds., Scientific Management of Animal and Plant Communities for Conservation: Eleventh Symposium of the British Ecological Society (Blackwells Scientific Publications, 1970).
- Dunham, D. K. and A. W. Collopy, The Transect Method of Stream Habitat Inventory: Guidelines and Application (U.S. Forest Service Intermountain Region, 1975).
- Edmondson, W. T. and G. C. Winberg, eds., A Manual on Methods for the Assessment of Secondary Productivity in Fresh Water (Blackwells Scientific Publishers, 1971).
- Giles, R. H., ed., Wildlife Management Techniques, Third edition (Wildlife Society, 1971).
- Habitat Evaluation Procedures, Revised (U.S. Fish and Wildlife Service, 1979).
- Hynes, H. B. N., The Ecology of Running Water (Univ. Toronto Press, 1976).

- Lagler, K. F., Freshwater Fishery Biology (Wm. C. Brown Co., 1977).
- Leopold, A., Game Management (C. Scribner's Sons, 1948).
- Mammalian Predator Damage Management for Livestock Protection in the Western United States (U.S. Fish and Wildlife Service, Department of the Interior, 1979).
- Marmelstein, A. (Chairman), Classification Inventory, and Analysis of Fish and Wildlife Habitat: Proceedings of a National Symposium, January 24-27, Phoenix, Arizona (Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior, 1977), 604 pp.
- Moen, A. N., Wildlife Ecology: An Analytical Approach (W. H. Freeman and Co., 1973).
- Mosby, H. S., ed., Wildlife Investigational Techniques, Second edition (Wildlife Society, 1963).
- Planning Considerations for Statewide Inventories of Critical Environmental Areas: A Reference Guide (Smithsonian Institution, Center for Natural Areas, Office of International and Environmental Programs, 1974).
- Proceedings of the Symposium on Management Techniques for Preserving Endangered Birds, 1977 (U.S. Fish and Wildlife Service, Department of the Interior, 1978).
- Roberts, R. J., Fish Pathology (Bailliere Tindall, 1978).
- Sabol, K., ed., Transactions of the 43rd North American Wildlife and Natural Resources Conference (Wildlife Management Institute, 1978).
- Smart, M., ed., Proceedings of the International Conference on Conservation of Wetlands and Waterfowl (International Waterfowl Research Board, 1976).
- Smith, R. L., Ecology and Field Biology (Harper and Row, Publishers, 1974).
- Spotte, S. H., Fish and Invertebrate Culture: Water Management in Closed Systems (Wiley-Interscience, 1970).
- Tillman, R., ed., Proceedings of the First National Symposium on Environmental Concerns in Rights-of-Way Management (Department of Wildlife and Fisheries, Mississippi State University, 1976).
- Warren, A. and I. B. Goldsmith, eds., Conservation in Practice (John Wiley and Sons, 1974).
- Wildlife and Water Management: Striking a Balance (Soil Conservation Society of America, 1973).
- Wildlife Management Guide for the National Forests in Missouri (USDA Forestry Service, 1973).

Annual report of the Wildlife Management Institute

Biological Conservation

Botanical Review

Copeia

Ecology

Ecological Monographs

Endangered Species Lists (U.S. Department of the Interior)

Environmental Science and Technology

Field

Fisheries

Hydrobiologia

Journal of Applied Ecology

Journal of Fish Biology

Journal of Fisheries Resource Board of Canada

Journal of Mammalogy

Journal of Wildlife Management

National Wildlife

Proceedings of the Annual Tall Timbers Fire Ecology Conference

Sport Fishery Abstracts

Transactions of the American Fisheries Society

Transactions of the North American Wildlife and Natural Resources Conference

U.S. Fish and Wildlife Service circulars

U.S. Fish and Wildlife Service Fishery Bulletin

U.S. Public Health Service publications

Water Resources

Wildlife Monographs

Wildlife Resource and Management Leaflets (U.S. Biol. Survey)

Wildlife Review

Wildlife Society Bulletin

Forest Management and Regulation

- Alexander, Robert R. and Carleton B. Edminster, Regulations and Control of Cut Under Uneven-aged Management, USDA Forest Service Research Paper RM-182 (Rocky Mountain Forest and Range Experiment Station, 1977), 7 pp.
- Alford, L. P. and H. Russell Beatty, Principles of Industrial Management (The Ronald Press Company, 1951), 779 pp.
- Barnes, R. L. and C. W. Ralston, Soil Factors Related to the Growth and Yield of Slash Pine Plantations, Florida Agriculture Experiment Station Bulletin 559 (1955).
- Barney, Charles W. and Robert E. Dils, Bibliography of Clearcutting in Western Forests (College of Forestry and Natural Resources, Colorado State University, 1972), 65 pp.
- Berg, Alan B., Managing Young Douglas Fir and Western Hemlock: Economics, Yield Control, and Thinning, Proceedings of a Symposium held by Oregon State University, School of Forestry, Corvallis, Min (1969), 175 pp.
- Burk, Dale, The Clearcut Crisis: Controversy in the Bitterroot (Jursnick Printing, 1972), 152 pp.
- Coile, T. S., Relation of Soil Characteristics to Site Index of Loblolly and Shortleaf Pines in the Lower Piedmont Region of North Carolina, Duke University School of Forestry Bulletin 13 (1948), 78 pp.
- Conway, Steve, Timber Cutting Practices, A Manual on Felling and Bucking (Miller Freeman Publication, 1968), 65 pp.
- Davis, Kenneth P., Forest Management: Regulation and Valuation, 2nd ed. (McGraw-Hill Book Company, 1966), 519 pp.
- Duerr, W. A. and W. E. Bond, "Optimum Stocking of a Selection Forest," Journal of Forestry, Vol 50 (1952), pp 12-16.
- Duerr, William A., Fundamentals of Forestry Economics (McGraw-Hill, 1960).
- Duerr, William A., Dennis E. Taegarden, Sam Guttenberg, and Neils B. Christiansen, Forest Resource Management, Pre. Ed. (Oregon State University Bookstores Inc., 1974).

- The Effects of Clear-cut Harvesting on Forest Soils -- A Summary of Major Research (American Forest Institute, 1971), 24 pp.
- Froehlich, H. A., "Logging Debris -- Managing a Problem," In Forest Land Uses and Stream Environment (Oregon State University, 1971), pp 112-117.
- Gessel, S. P. and D. W. Cole, "Influence of Removal of Forest Cover on Movement of Water and Associated Elements Through Soil," J. Amer. Water Works Assoc., Vol 57, No. 10 (1965), pp 1301-1310.
- Gould, E. M., "Planning for Forest Development on Small Holdings," Journal of Forestry (October 1978), pp 792-795.
- Gross, L. S., Timber Management Plans on the National Forests (U.S. Department of Agriculture, 1950), 55 pp.
- Hanzlik, E. J., "Determination of the Annual Cut on a Sustained Yield Basis for Virgin American Forests," Journal of Forestry, Vol 20, No. 6 (1922), pp 611-625.
- Hermann, Richard K. and Denis P. Lavender, Even-age Management, Oregon State University, Paper No. 848 (1973), 250 pp.
- Jensen, H. A., Forest Inventories and Stand Structure Studies, Second Industrial Forest Seminar (Yale School of Forestry, 1955).
- McCulley, R. D., Management of Natural Slash Pine Stands in the Flatwoods of South Georgia and North Florida, USDA Forest Service, Southern Forest Experiment Station Circular No. 845 (1950).
- Managing Young Forests in the Douglas Fir Region, Proceedings of a Symposium held by Oregon State University, School of Forestry, Volume 3, Paper No. 734 (1970), 224 pp.
- Managing Young Forests in the Douglas Fir Region, Proceedings of a Symposium held by Oregon State University, School of Forestry, Volume 4 (1972), 234 pp.
- Meyer, Arthur H., Arthur B. Recknagel, Donald D. Stevenson, and Ronald A. Bartoo, Forest Management, 2nd ed. (The Ronald Press Company, 1961), 282 pp.
- Morgan, H. E., The Environment of High Yield Forestry (S. J. Hall Lectureship in Industrial Forestry, University of California, School of Forestry and Conservation, 1969).
- Osborne, J. G., "A Continuous Inventory Basis for Determining Growth, Mortality and Yield," In Timber Management Plans on the National Forests, by L. S. Gross (USDA Forest Service, 1950), pp 40-45.
- Patterson, A. F., Techniques of Forest Management Plan Preparation (University of Georgia, School of Forestry, 1957).



- Reynolds, R. R., "Growing Stock in all Aged Forest," Journal of Forestry, Vol 52 (1954), pp 744-747.
- Roach, Benjamin A. and Samuel F. Gingrich, Even-aged Silviculture for Upland Central Hardwoods, Northeastern Forest Experiment Station, USDA Forest Service Agriculture Handbook 355 (1968), 39 pp.
- Simmons, Fred C., Handbook for Eastern Timber Harvesting (USDA Forest Service, Northeastern Area State and Private Forestry, 1979), 180 pp.
- Stoddard, Charles H., Essentials of Forestry Practice (Ronald Press Company, 1959), 258 pp.
- Steinbrenner, E. C., "The Effect of Repeated Tractor Trips on the Physical Properties of Forest Soils," Northwest Sci., Vol 29 (1955), pp 155-159.
- Sullivan, Michael J., Regeneration of Tree Seedlings after Clearcutting on Some Upper Slope Habitat Types in the Oregon Cascade Range, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service Research Paper PNW-245 (1978), 17 pp.
- Thompson, Emmett F., "Traditional Forest Regulation Models -- An Economic Critique," Journal of Forestry (November 1966), pp 750-752.
- Urie, Dean H., "Estimated Groundwater Yield Following Strip Cutting in Pine Plantations," Water Resources Research, Vol 7, No. 6 (1971), pp 1497-1510.
- U.S. Senate, "Clearcutting" Practices on National Timberlands, Hearings before the sub-committee on public lands of the Committee on Interior and Insular Affairs, 92nd Congress (Government Printing Office, 1971), 1040 pp.
- Wahlenberg, W. G., "An Early Test of Levels of Growing Stock in Appalachian Hardwoods," Journal of Forestry, Vol 54 (1956), pp 106-114.
- Walker, N., "Growing Stock Volumes in Unmanaged and Managed Forests," Journal of Forestry, Vol 54 (1956), pp 378-383.
- Widner, Ralph R., Forests and Forestry in the American States (The National Association of State Foresters, 1966-67), 594 pp.
- Williams, A. M., Jr., "Five Years of Sustained Yield Operation," Journal of Forestry, Vol 48 (1950), pp 269-271.
- Worthington, Norman P. and George R. Staebler, Commercial Thinning of Douglas Fir in the Pacific Northwest, USDA Pacific Northwest Forest and Range Experiment Station, Technical Bulletin No. 1230 (1961), 124 pp.
- Youngberg, C. T., "Some Site Factors Affecting the Success of Reforestation and Afforestation Activities in the Willamette Valley Foothills," Soil Sci. Soc. Amer. Proc., Vol 19 (1955), pp 368-372.

Zahner, R., Field Procedures for Soil-Site Classification of Pine Land in South Arkansas and North Louisiana, USDA Forest Service, Southern Forest Experiment Station Occas. Paper No. 155 (1957).

*Economic Aspects of Management*

Adams, Thomas C., Production Rates in Commercial Thinning of Young Growth Douglas Fir, Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service Research Paper PNW-41 (1967), 35 pp.

Flora, Donald, Economic Guides for a Method of Pre-commercial Thinning of Ponderosa Pine in the Northwest, USDA Forest Service Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-31 (1966), 10 pp.

Hillier, Frederick S. and Gerald J. Lieberman, Introduction to Operations Research (Holden-Day, Inc., 1967), 639 pp.

Kock, Peter, Utilization of the Southern Pines, Volume I: The Raw Materials, USDA Forest Service, Southern Forest Experiment Station Agriculture Handbook No. 420 (1972), 734 pp.

Marty, Robert, Charles Rindt, and John Fedkiw, A Guide for Evaluating Reforestation and Stand Improvement Projects in Timber Management Planning on the National Forests, USDA Forest Service Handbook No. 304 (1966).

Morgan, H. E., The Environment of High Yield Forestry (S. J. Hall Lectureship in Industrial Forestry, University of California, School of Forestry and Conservation, 1969).

Staebler, George R. and W. Show, "An Analysis of Investment in Pruning," Journal of Forestry (November 1952), pp 819-823.

Taegarden, Dennis E., Economics of Replacing Young Growth Ponderosa Pine Stands, A Case Study, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station Research Paper PSW-47 (1968).

Worthington, Norman P., Labor Requirements in Thinning Douglas Fir and Western Hemlock on Two Experimental Forests in Western Washington, USDA Pacific Northwest Forest and Range Experiment Station Research Note 43 (1966), 13 pp.

*Growth and Yield*

Barrett, James W., Response of Ponderosa Pine Pole Stands to Thinning, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service Research Note PNW-77, (1968), 11 pp.

Barrett, J. P. and L. J. Goldsmith, Predicting Growth of Eastern White Pine, N. H. Agriculture Experiment Station Bulletin 499 (1973), 28 pp.

Belanger, R. P. and Brander, E. V., Influence of Site Index and Thinning on the Growth of Planted Loblolly Pine, Georgia Forest Research Council Research Paper No. 57 (1968), 7 pp.

- Buckman, Robert E., Twenty-two-year Results of Pre-commercial Thinning Experiment in Jack Pine, Lake States Forest Experiment Station, USDA Forest Service Research Note LS-46 (1964), 2 pp.
- Chapelle, D. E. and T. C. Nelson, "Estimation of Optional Stocking Levels and Rotation Ages of Loblolly Pine," Forest Science, Vol 10 (1964), pp 471-502.
- Gilmore, A. R. and W. R. Boggess, Growth and Yield from Row Thinnings in a Shortleaf Pine Plantation in Southern Illinois, Department of Forestry, University of Illinois, Forestry Note No. 126 (1969), 3 pp.
- Grano, Charles X., Growth of Planted Loblolly Pine after Row and Selective Thinning, Southern Forest Experiment Station, USDA Forest Service, Research Note SO-123 (1971), 3 pp.
- Husch, Bertrum, Charles I. Miller, and Thomas Beers, Forest Mensuration, 2nd ed. (Ronald Press, 1972), 410 pp.
- Little, S. and J. J. Mohr, Five Year Effects from Row Thinnings in Loblolly Pine Plantations of Eastern Maryland, Northeast Forest Experiment Station, U.S. Forest Service Research Paper NE-12 (1963), 15 pp.
- Little, S., J. J. Mohr, and P. V. Mook, Ten-year Effects from Row Thinnings in Loblolly Pine Plantations of Eastern Maryland, Northeast Forest Experiment Station, USDA Forest Service Research Note NE-77 (1968), 8 pp.
- Long, H. D., A Proposed Method of Estimating the Growth of Pulpwood Stands, Pulp and Paper Research Institute Woodlands Section Research Index 880 (F-2), (1947), 8 pp.
- MacKinney, A. L. and L. E. Chockey, Volume, Yield and Growth of Loblolly Pine in the Mid-Atlantic Region, U.S. Forest Service, Appalachian Forest Experiment Station Technical Note 33 (1939), 30 pp.
- McArdle, Richard E., The Yield of Douglas Fir in the Pacific Northwest, USDA Pacific Northwest Forest and Range Experiment Station Technical Bulletin 201, Revised edition (1961), 74 pp.
- Osborne, J. G. and F. X. Schumacker, "The Construction of Normal Yield and Stand Tables for Even-aged Timber Stands," Journal of Agriculture Research, Vol 51 (1935), pp 547-563.
- Reakema, Donald L. and David Bruce, Effects of Thinning on Yield of Douglas Fir, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service General Technical Report PNW-58 (1977).
- Seidel, K. W., Growth of Young Even-aged Western Larch Stands after Thinning in Eastern Oregon, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service Research Note PNW-165 (1971), 12 pp.

- Staebler, George R., "Management Pays Added Profits in Young Douglas Fir," The Timberman, Vol LV, No. 4 (February 1954).
- Staebler, George R., Gross Yield and Mortality Tables for Fully Stocked Stands of Douglas Fir, USDA Pacific Northwest Forest and Range Experiment Station, Research Paper 14, 22 pp.
- Williamson, Richard L. and Frank E. Price, Initial Thinning Effects in 70 to 150-year-old Douglas Fir -- Western Oregon and Washington, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service Research Paper PNW-117 (1971), 15 pp.
- Forest Protection Aspects of Management*
- Air Operations for Forest, Brush and Grass Fires, National Fires Protection Association, FSP-9A (1975).
- Bennett, W. H., C. W. Chellman, and W. R. Holt, Insect Enemies of Southern Pines, USDA Forest Service, South Forest Experiment Station Occas. Paper 164 (1958), 35 pp.
- Bennett, W. H., "Silvicultural Control of Southern Forest Insects," In Insects in Southern Forests, C. B. Marlin, ed. (Louisiana State University Press, 1965), pp 52-54.
- Burgen, Robert E., Jack D. Cohen, and John E. Denning, Manually Calculating Fire-Danger Ratings -- 1978 National Fire-Danger Rating System, Inter-mountain Forest and Range Experiment Station, USDA Forest Service General Technical Report INT-40 (1977), 50 pp.
- Casey, James, "Fighting Wildfires," Fire Engineering, Vol 124 (September 1971), pp 82-85.
- Coleman, Ronney J., Management of Fire Service Operations (Duxbury Press, 1978), 560 pp.
- Craighead, F. C., Insect Enemies of Eastern Forests, USDA Misc. Pub. 657 (1949), pp 7, 14, 18-20.
- Davis, K. P., Forest Fires: Control and Use (McGraw-Hill Book Company, 1959), 584 pp.
- Dixon, J. C. and E. A. Osgood, Southern Pine Beetle: A Review of Present Knowledge, USDA Forest Service Southeast Forest Experiment Station Paper 128 (1961), 34 pp.
- Donoghue, Linda R. and Von J. Johnson, Prescribed Burning in the North Central States, North Central Forest Experiment Station, USDA Forest Service Research Paper NC-111 (1975), 8 pp.

- Driver, C. H. and J. H. Ginns, Jr., Practical Control of Fomes Annosus in Intensive Forest Management, contr. 5 (University of Washington, College of Forest Resources, 1968), 8 pp.
- Forest Fire Fighting Fundamentals (U.S. Forest Service, 1958).
- Fuguay, Donald M., Robert G. Baughman, and Don J. Latham, A Model for Predicting Lightning Fire Ignition in Wildlands Fuels, Intermountain Forests and Range Experiment Station, USDA Forest Service Research Paper INT-217 (1979), 21 pp.
- Hall, J. Alfred, Forest Fuels, Prescribed Fire, and Air Quality, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service Report (1972), 44 pp.
- Hawksworth, F. G., Dwarf Mistletoe of Ponderosa Pine in the Southwest, USDA Technical Bulletin 1246 (1961), 112 pp.
- Hazardous Materials Transportation Accidents, National Fire Protection Association Bulletin 74-1 (1974).
- Introduction to the Fundamentals of Fire Behavior (U.S. Forest Service, n.d.).
- Meidl, James H., Explosive and Toxic Hazardous Materials (Glencoe Press, 1970).
- Morris, R. F., "The Dynamics of Epidemic Spruce Budworm Populations," Mem. Ent. Soc. Canada, Vol 31 (1963), pp 190-192, 194, 196, 201-202, 219, 318.
- Natural Role of Fire (U.S. Government Printing Office, 1973).
- Roussopowlos, Peter J. and Von J. Johnson, Help in Making Fuel Management Decisions, North Central Forest Experiment Station, USDA Forest Service Research Paper NC-112 (1975), 16 pp.
- Shigo, A. L. and G. Yelenosky, Nematodes Inhabit Soils of Forest and Clearcut Areas, USDA Forest Service Northeast Experiment Station Research Note 101 (1960), 4 pp.
- Suggested Guide for the Use of Insecticides to Control Insects Affecting Crops, Livestock, Households, Forests and Forest Products, USDA Agriculture Handbook 331 rev. (1968), 273 pp.
- Weir, L. C. and A. L. S. Johnson, "Preliminary Results of a Study to Control Poria Root Rot of Douglas Fir," Bi-M. Research Notes, Vol 26 (1970) pp 39-40.
- Statistics and Sampling Techniques*
- Avery, G., Foresters Guide to Aerial Photo Interpretation, Forest Service, USDA, Southern Forest Experiment Station Occas. Paper No. 156 (1957).

- Briegleb, P. A., "Progress in Estimating Trend of Normality Percentage in Second-Growth Douglas Fir," Journal of Forestry, Vol 40 (1942), pp 705-793.
- Cochran, William G., Sampling Techniques, 2nd. ed. (John Wiley & Sons, 1963), 413 pp.
- Dilworth, J. R., Log Scaling and Timber Cruising, Revised edition (Oregon State University Coop. Association, 1964), 386 pp.
- Freese, Frank, Elementary Forest Sampling, USDA Southern Forest Experiment Station Agriculture Handbook No. 232 (1962), 91 pp.
- Huntsberger, David V., Statistical Inference, 2nd Edition (Allyn and Bacon, 1967), 398 pp.
- Loomis, R. D., Aerial Photogrammetry Applied to Forest Surveying (Pulp and Papers Research Institute, Canada, Woodlands Sect. Research Index 849 [A-2-b], 1946), 6 pp.
- Schumacker, F. X. and R. A. Chapman, Sampling Methods in Forestry and Range Management, Duke University School of Forestry Bulletin 7 (1948).
- Spurr, Stephen H., Forest Inventory (Ronald Press Company, 1952), 476 pp.
- Spurr, Stephen H., Aerial Photographs in Forestry (Ronald Press Company, 1954), 340 pp.
- Steel, Robert G. D. and James H. Torrie, Principles and Procedures of Statistics (McGraw-Hill Book Company, 1960), 481 pp.

#### Outdoor Recreation

- Adams, Robert L., Robert C. Lewis and Bruce H. Drake, Outdoor Recreation: A Legacy for America; Appendix A -- An Economic Analysis (U.S. Dept. of the Interior, Office of the Economic Analysis, 1973), 239 pp + appendices.
- Anderson, Dorothy H., Earl C. Leatherberry, and David W. Lime, An Annotated Bibliography on River Recreation, General Technical Report NC-41 (U.S. Forest Service, 1978), 62 pp.
- Argow, Keith A. and John Fedkiw, "Recreation User Fee Income -- How Far Does It Go Toward Meeting Costs?" Journal of Forestry, Vol 61, No. 10 (1963).
- Babbitt, H. E., Sewage and Sewage Treatment (Wiley, 1947).
- Bacon, Warren R. and Asa D. Twombly, "Managing the Visual Resource Through Timber Harvest; Concepts and Achievements" (Paper presented to Society of American Foresters Convention, 1977).

- Brooks, L., "Multiple-Use Aspects: Recreation Implications," Proceedings of the Annual Meeting of the Canadian Institute of Foresters (1968).
- Burch, W. R., "Two Concepts for Guiding Recreation Management Decisions," Journal of Forestry, Vol 62, No. 10 (1964), pp 707-712.
- Burke, H. D., "Picnic-Table Use Depends Upon Distance From Parking Area," Journal of Forestry, Vol 62, No. 10 (1964), p 753.
- Bury, Richard L., "Recreation Carrying Capacity -- Hypothesis or Reality?" Parks and Recreation, Vol 11, No. 1 (1976), pp 22-25, 56-58.
- Campbell, Frederick L., John C. Hendee, and Roger N. Clark, "Law and Order in Public Parks," Parks and Recreation, Vol 3, No. 12 (1968), pp 28-31, 51-55.
- Caskey, G. B. and D. G. Wright, Coasting and Tobogganing Facilities, Management Aids Bulletin No. 62 (National Recreation and Park Association, 1966).
- Cheek, N. H., Jr., D. R. Field, and R. J. Burdge, Leisure and Recreation Places (Ann Arbor Science Publishers, 1976), 172 pp.
- Clawson, Marion and Burnell Held, The Federal Lands: Their Use and Management (Johns Hopkins, 1957).
- Clawson, Marion and Jack L. Knetsh, Economics of Outdoor Recreation (Johns Hopkins, 1966).
- Clawson, Marion, The Federal Lands Since 1956 -- Recent Trends in Use and Management (Johns Hopkins Univ. Press, 1967).
- Coffman, John D., "How Much and What Kind of Forest Land Should be Devoted Exclusively to Recreation and Aesthetics?" Journal of Forestry, Vol 35, No. 2 (February 1937).
- Cordell, H. K. and D. R. Talhelm, Planting Grass Appears Impractical for Improving Deteriorated Recreation Sites, U.S. Forest Service Research Paper SE 105 (1969).
- Cottrell, Richard L., "Site Design for the Future; Lessons From the Past," In D. M. Knudson, ed., Managing Recreation Resources for Century III (Purdue University, 1976), pp 62-68.
- Cox, L. D., The Design and Development of Picnic Grounds, New York State University, College of Forestry Bulletin, Vol 13, No. 3-C (1940).
- David, C., "Legal Problems and Liability in Outdoor Recreation," Park Maintenance, Vol 19, No. 12 (1966).
- Davis, G. D., "Meeting Recreation, Park and Wilderness Needs," American Forest, Vol 82, No. 3 (1976), p 12.

- Dotzenko, A. D., N. T. Papamichos, and D. S. Romine, "Effect of Recreational Use on Soil and Moisture Conditions in Rocky Mountain National Park," Journal of Soil and Water Conservation, Vol 22, No. 5 (1967), pp 196-197.
- Drinking Water Standards, Publication No. 956 (U.S. Public Health Service, 1962).
- Driver, B. L., ed., Elements of Outdoor Recreation Planning (University of Michigan, 1970).
- Environmental Health Guide for Travel Trailer Parking Areas (U.S. Public Health Service, 1966).
- Environmental Health Practice in Recreation Areas -- A Guide to the Planning, Design, Operation, and Maintenance of Recreation Areas (U.S. Public Health Service, 1966).
- Field, Donald R. and Joseph T. O'Leary, "Social Groups as a Basis for Assessing Participation in Selected Water Activities," Journal of Leisure Research, Vol 5 (Spring 1973), pp 16-25.
- Frank, Bernard, "When Can Forest Recreation Be Considered as Exclusive or Dominant?" Journal of Forestry, Vol 50, No. 4 (1952).
- Frederick Burke Foundation, Federal Agencies and Outdoor Recreation, Outdoor Recreation Resources Review Commission Study Report No. 13 (U.S. Government Printing Office, 1962).
- Frissell, S. S., Jr. and D. P. Duncan, "Campsite Preference and Deterioration," Journal of Forestry, Vol 63 (1965), pp 256-260.
- Gaylor, E. L. and C. C. Rombold, Handbook for Ski Slope Development, National Recreation and Park Association, Management Aids Bulletin No. 36 (1964).
- Gilchrist, M., "Strategies for Preserving Scenic Rivers: The Maryland Experience," Landscape Architecture, Vol 62, No. 1 (1971), pp 35-42.
- Green, Bernal L. and H. A. Wadsworth, Campers -- What Affects Participation and What Do They Want?, Purdue University, Agric. Ex. Sta. Research Bulletin No. 823 (1966), 23 pp.
- Gunn, C. A., Planning Winter Sports Areas, Michigan State University, Cooperative Extension Service Circular R-306 (1958).
- Hart, William J., A Systems Approach to Park Planning (Int. Union for Conservation of Nature and Natural Resources, 1966).
- Heinselman, M. I., "Vegetation Management in Wilderness Areas and Primitive Parks," Journal of Forestry, Vol 63, No. 6 (1965).
- Helgath, Sheila F., Trail Deterioration in the Selway-Bitterroot Wilderness, U.S. Forest Service Research Note INT-193 (1975).



- Hendee, John C., "Appreciative vs Consumptive Uses of Wildlife Refuges: Studies of Who Gets What and Trends in Use," (Paper presented at the Thirty-fourth North American Wildlife and Natural Resources Conference, 1969).
- Herrington, R. B. and W. G. Beardsley, Improvement and Maintenance of Campground Vegetation in Central Idaho, U.S. Forest Service Research Paper INT 87 (1970), 9 pp.
- Holecek, Donald F. and Richard W. Westfall, Public Recreation on Private Lands -- the Landowner's Perspective, Michigan State Univ., AES Research Report No. 335 (1977), 11 pp.
- Horney, R. L., Snowmobiling, National Recreation and Park Association, Management Aids Bulletin No. 89 (1970).
- Jacobs, P., Site Planning Process, Activity Allocation (Nova Scotia Technical College, 1970).
- James, G. and T. Ripley, Instructions for Using Traffic Counters to Establish Recreation Visits and Use, U.S. Forest Service, Southeast Forest Experiment Station Paper SE-3 (1963).
- Jubenville, Alan, Outdoor Recreation Planning (W. B. Saunders Co., 1976), 399 pp.
- LaPage, W. F., 1967, Some Observations on Campground Trampling and Groundcover Response, U.S. Forest Service Research Paper NE-68 (1976), 3 pp.
- Leopold, L., Quantitative Comparison of Some Aesthetic Factors Among Rivers, Geologic Survey Circular 620 (1969).
- Lime, D. W. and G. H. Stankey, "Carrying Capacity: Maintaining Outdoor Recreation Quality," In Recreation Symposium Proceedings (State University of New York, College of Forestry, 1971).
- Litton, Burgon, Jr., Forest Landscape Description and Inventories -- A Basis for Land Planning and Design, U.S. Forest Service, Research Paper PSW-49 (1968), 21 pp.
- Litton, Burton and Robert Twiss, "The Forest Landscape: Some Elements of Visual Analysis," In Proceedings, Society of American Foresters Meetings (1966), pp 208-223.
- Lucas, Robert C., The Recreational Use of the Quetico-Superior Area, U.S. Forest Service Research Paper LS-8 (1964), 50 pp.
- Lutz, H. J., "Soil Conditions of Picnic Grounds in Public Forest Parks," Journal of Forestry, Vol 43, No. 2 (1945), pp 121-127.
- McEwen, Douglas and S. Ross Tocher, "Zone Management: Key to Controlling Recreational Impact in Developed Campsites," Journal of Forestry, Vol 74, No. 2 (1976), pp 90-93.

- McIntyre, A. C., Wood Chips for the Land, Soil Conservation Leaflet, No. 323 (U.S. Government Printing Office, 1959).
- Meinecke, E. P., Camp Planning and Camp Reconstruction (U.S. Forest Service, California Region, n.d.).
- National Park Service and Bureau of Outdoor Recreation, 1978, National Urban Recreation Study; Technical Reports, Volume 1. "Urban Open Space, Existing Conditions, Opportunities and Issues" (U.S. Department of the Interior, 1978).
- National Recreation and Park Association, Management Aid Series (1967):  
 Bulletin No. 8, "Small Lake Management Manual and Survey."  
 Bulletin No. 44, "Lake Zoning for Recreation."  
 Bulletin No. 51, "Public Beaches."  
 Bulletin No. 54, "Marinas."  
 Bulletin No. 70, "Evaluating Water Based Recreation Facilities and Areas."
- Orr, H. R., "Analytical Approach to Design," Park Maintenance, Vol 20, No. 2 (1967), pp 34-37.
- Outdoor Recreation for the Physically Handicapped (Bureau of Outdoor Recreation, 1967).
- Planning Consideration for Winter Sports Resort Development (Rocky Mountain Region, U.S. Forest Service, 1972).
- Protection of Outdoor Recreation Values of Rivers; Task Force Report (Heritage Conservation and Recreation Service, U.S. Dept. of the Interior, 1978), 13 pp + appendix.
- Ripley, Thomas H., Tree and Shrub Response to Recreation Use, U.S. Forest Service, Southeastern Forest Experiment Station, Research Note, No. 171 (1962).
- Ripley, Thomas H., Tree and Shrub Response to Recreation Use, U.S. Forest Service Research Note SE-171 (1962), 2 pp.
- Ripley, Thomas H., "Rehabilitation of Forest Recreation Sites," In Proceedings, Society of American Foresters Annual Meeting (1966).
- Roewekamp, F. W., "Landscaping Recreational Areas," Parks and Recreation, Vol 48, No. 12 (1965).
- Rombold, C. C., Natural Ice Skating Surfaces, National Recreation and Park Association, Management Aids Bulletin No. 37 (1964).
- Sessoms, H. D., "New Bases for Recreation Planning," Journal of the American Institute of Planners, Vol 30, No. 1 (1964), pp 26-33.

- Soloman, J. H., Camp Site Development (Girl Scouts of America, 1959).
- Sport Fishing -- Today and Tomorrow, Outdoor Recreation Resources Review Commission Study Report No. 7 (U.S. Government Printing Office, 1962).
- Strand, Hans, "Outdoor Recreation from an Economic Viewpoint," Norwegian Forest Research Institute, Vol 22, No. 84 (1967), pp 161-187.
- Sytls, F. G., "Variables Which Must Be Considered in Outdoor Recreation Planning," In Elements of Outdoor Recreation Planning, B. L. Driver, ed. (University of Michigan, 1970), pp 49-60.
- Tocher, Ross, J. A. Wagar, and John D. Hunt, "Sound Management Prevents Worn Out Recreation Sites," Parks and Recreation, Vol 48, No. 3 (1965).
- Trends in American Living and Outdoor Recreation, Outdoor Recreation Resources Review Commission Study Report No. 22 (U.S. Government Printing Office, 1962).
- Twiss, Robert H., "Research on Forest Environment Design," In Proceedings, Society of American Foresters Annual Meeting (1966).
- Violence and Vandalism (National School Public Relations Association, 1975), 80 pp.
- Waga, J. A., Campgrounds for Many Tastes, U.S. Forest Service Research Paper INT-6 (1963).
- Wagar, J. V. K., "Some Major Principles of Recreational Land Use Planning," Journal of Forestry, Vol 49, No. 6 (1951).
- Water and Recreation -- Values and Opportunities, Outdoor Recreation Resources Review Commission Study Report No. 10 (U.S. Government Printing Office, 1962).
- Wendling, Robert C., "The Evolution of Off-Road Vehicle Policy: Chaos or Rational Planning?" (Paper presented to Society of Park and Recreation Educators, Symposium on Leisure Research, 1977).
- Winter Recreation and the National Parks: A Management Policy and a Development Program (Canadian Department of Northern Affairs and National Resources, Natural and Historic Resources Branch, 1965).
- Working Drawings of Basic Facilities Campground Developments, U.S. Department of Agriculture Information Bulletin No. 264 (U.S. Forest Service, 1962).
- Young, R. A. and A. R. Gilmore, "Effects of Various Camping Intensities on Soil Properties in Illinois Campgrounds," Soil Sci. Soc. Am. Proc., Vol 40 (1976), pp 908-911.
- Young, R. A., "Camping Intensity Effects on Vegetative Groundcover in Illinois Campgrounds," Jour. Soil and Water Cons., Vol 33, No. 1 (1978), pp 36-39.

## Training

### *Obtaining Data Parameters*

Goran, W. D. and R. E. Riggins, Graphic Materials to Support Biophysical Quantitative Environmental Impact Analysis -- Sources of Existing Materials, Technical Report N-68/ADA069097 (U.S. Army Construction Engineering Research Laboratory [CERL], March 1979).

Green, A. J., D. D. Randolph, and A. A. Rula, The Effect of Military Transportation Activities on the Environment, Miscellaneous Paper M-73-15 (U.S. Army Engineer Waterways Experiment Station, December 1973).

### Local Soil Conservation Service.

Severinghaus, William D., Guidelines for Terrestrial Ecosystem Survey, Technical Report N-89/ADA86526 (CERL, May 1980).

For information on terrain analysis, contact the Terrain Analysis Center, U.S. Army Engineering Topographic Laboratories, Fort Belvoir, VA.

### *Implementing Proper Management Plans*

Many Army regulations are relevant to management of training activities:

AR 105-87, Electronic Warfare (DA, August 1976).

AR 200-1, Environmental Protection and Enhancement (DA, December 1973).

AR 210-20, Master Planning for Army Installation (DA, January 1976).

AR 210-21, Training Areas and Facilities for Ground Troops (DA, 15 November 1978).

AR 210-30, Selection of Sites for Army Installations (DA, 15 October 1979).

AR 220-55, Field and Command Post Exercises (DA, 1 July 1978).

AR 350-1, Army Training (DA, 25 April 1975).

AR 350-4, Qualification and Familiarization with Weapons and Weapon Systems (DA, 24 September 1973).

AR 385-62, Regulations for Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat (DA, 5 January 1977).

AR 385-63, Regulations for Firing Ammunition for Training, Target Practice, and Combat (DA, February 1978).

AR 420-74, Natural Resources -- Land, Forest and Wildlife Management (DA, 1 July 1977).

AR 740-1, Storage and Supply Activity Operations (DA, April 1971).

Keown, Malcolm P. and Marshall R. Weathersby, Baseline Elements and Information Sources for Environmental Quality Management of Military Installations, Technical Report M-76-10 (Mobility and Environmental Systems Laboratory, U.S. Army Engineer Waterways Experiment Station, September 1976).

Lozar, Robert C., J. Robert Anderson, and Harold Balbach, Data Requirements for Army Land Use Planning and Management, Interim Report N-55/ADA062599 (CERL, November 1978).

Training Land, Unit Training Land Requirements, Training Circular No. 25-1 (Headquarters, DA, 4 August 1978).

Training Ranges, Army Range Requirements, Training Circular No. 25-2 (Headquarters, DA, 10 March 1980).

## APPENDIX A:

### DATA PARAMETERS

The definition for each parameter is a synthesis of definitions submitted by the participants in this project. The following is an index of data parameters defined:

#### DATA PARAMETERS INDEX

##### A. Soil Parameters

1. Fertility
2. Stability
3. Depth to Parental Material/Bedrock
4. Series and Type Classification
5. Soil Horizon/Profile
6. Texture
7. Structure
8. Consistence
9. Color
10. Reaction
11. Chemical Composition
12. Organic Matter or Content
13. Exchangeable - Sodium Fraction
14. Permeability
15. Available Water Capacity
16. Depth to Seasonally High Water Table
17. Soil Capability to Class, Subclass Unit
18. Soil Productivity
19. Susceptibility to Sheet Rill Erosion
20. Susceptibility to Gully Erosion
21. The Universal Soil Loss Equations (USLE)
22. Soil Loss Tolerance
23. Rainfall and Runoff Factor (R)
24. Slope Length and Steepness Factor (LS)
25. Soil Erodibility Factor (K)
26. Cover and Management Factor (C)
27. Support Practice Factor (P)
28. Susceptibility to Wind Erosion
29. The Wind Erosion Equation
30. Conventional Agricultural Practices
31. Soil Fertility Improvement
32. Erosion Control
33. Erosion Control Facilities
34. Shrink - Swell Potential
35. Presumptive Bearing Value
36. Corrosion Potential
37. Trafficability/Bearing Strength of Subsurface Strata
38. Overflow/Flooding Hazard
39. AASHTO - Unified Classification
40. Engineering Data (Properties)
41. Soil Analyses
42. Soil Maps
43. Water Seepage and Retaining Properties
44. Erosion From Human Activity
45. Rocks, Bedrock Composition
46. Soil Nutrient Deficiencies
47. Soil Toxicities

##### B. Climatic Parameters

1. Air Temperature (monthly mean, max., min.)
2. Snowfall (monthly)
3. Snow Accumulation
4. Thunderstorm Patterns (monthly)
5. Sunlight Duration
6. Solar Radiation
7. Precipitation (amount)
8. Precipitation (distribution)
9. Precipitation (type)
10. Atmospheric Temperature Changes
11. Frost Free Period
12. Winds
13. Evaporation and Transpiration
14. Storms
15. Length of Growing Season
16. Average Date of First and Last Freeze
17. Degree Days Heating
18. Degree Days Cooling
19. Mean Number Days of Cloud Cover/Month
20. Precipitation (number of days)
21. Snowfall (number of days)
22. Per Month Freeze - Thaw Transitions
23. Wind Chill Factor
24. Effect of Temperature Extreme on Equipment
25. Effect of Temperature Extremes on Transportation
26. Effect of Storms on Equipment and Transportation
27. Visibility Conditions
28. Altitude of Clouds
29. Humidity (seasonal patterns)
30. Humidity (daily patterns)

##### C. Existing Structural Facilities

1. Corrals
2. Fencing and Gates (permanent + temporary)
3. Protective Barricades
4. Magazines/Igloos
5. Piers/Docks
6. Recreational Structures
7. Open Loading Docks
8. Flag Poles
9. Radio Towers
10. Mock Villages
11. Bunkers
12. Grandstands
13. Targets
14. Observation Towers

15. Revetments
  16. Pits
  17. Concrete Pillboxes
  18. Launcher Sites
  19. Ammunition Dumps
  20. Radar Facilities
  21. Dams
  22. Airfield + Heliports (functional, abandoned)
  23. Railroads
  24. Walks
  25. Sanitary Landfills
  26. Telephone Network
  27. Radio Network
  28. Cemeteries
  29. Roads - 28 subunits
  30. Buildings - 18 subunits
  31. Water System
  32. Steam System
  33. Sanitary Sewer System
  34. Industrial Sewer System
  35. Electrical Distribution System
  36. Compressed Air System
  37. Natural Gas System
  38. Coal Storage Facilities
  39. Fuel Oil Storage System
  40. On Post Structural Resources - 6 subunits
  41. Artificial Waterways
  42. Archaeological Sites
  43. Windmills & Windpumps
  44. Pipeline Pumping Stations
  45. Transmission Lines & Substation
  46. Cattleguards
  47. Cultural & Historic Sites
  48. Snow Removal (Roads, Walks, Cost)
  49. Storm Safety Facilities
  50. Transportation Fuel Storage Areas
  51. Restoring Storm Damaged Facilities
- D. Aquatic Biotic Parameters
1. Aquatic Plants
  2. Phytoplankton Productivity
  3. Aquatic Pest Plants
  4. Fish Economic Value
  5. Fish Undesirables
  6. Fish Growth
  7. Fish Parasites
  8. Fish Population - 8 subunits
  9. Impact Fishing
  10. Vehicular Damage
  11. Invertebrate Fauna

#### E. Aquatic Natural Abiotic Parameters

1. Lakes (location, size)
2. Lakes (shoreline)
3. Streams (location, size, flow)
4. Lakes and Streams - 7 subunits
5. Ground Water Resources/Table
6. Watershed/Drainage/Discharge Characteristics
7. Springs
8. Marsh/Swamp (size & location)
9. Eutrophication
10. Suspended Solids
11. Use By Fish & Wildlife
12. Tides
13. Inland Waterways
14. Coastal Waterways
15. Water Bodies Bordering Lands
16. Salt Water Types

#### F. Aquatic Man-Influenced Abiotic Parameters

1. Fishing Areas
2. Boat Launches
3. Swimming Area
4. Maintained Shoreline/Beaches
5. Reservoirs
6. Water Sites Shared With Non-Military Users
7. Streams (impoundments upon)
8. Availability of Water for Livestock
9. Surface Water Contributions & Withdrawal
10. Water Quality/Pollution Levels
11. Impact of Grazing
12. Water Resource Value for Recreation
13. Domestic Water Availability for Recreational Areas
14. Irrigation & Its Effects (Water Vegetation)
15. Amphibious Movement and Suitability
16. Water Rights
17. Range and Maneuver Sites
18. Projected Military Usage
19. Military/Agricultural Land Use Coordination
20. Impact/Restricted Area
21. Military/Fishing Coordination
22. Military/Outdoor Recreation Coordination
23. Training Impacts - 3 subunits

#### G. Terrestrial Natural Abiotic Parameters

1. Topographic Maps (20' contour)
2. Terrain Analysis Maps
3. Elevation
4. Slope Length
5. Slope Orientation/Aspect
6. Land Form Variety

7. Rock Form Features
8. Air Quality
9. Topographic Feature References
10. Subsurface Vibration Transmission
11. Mass Wastage (degree of instability)
12. Tectonic Activity
13. Sites for Sources of Engineering Materials
14. Sites for Valuable Subsurface Material
15. Atmosphere Impacts -- 3 subunits
16. Aerial Photographs

#### H. Terrestrial Man-Influenced Abiotic Parameters

1. Hunting Acreage
2. Campgrounds/#Units
3. Picnic Grounds/#Units
4. Off Road Recreational Vehicle (Type & Acreage)
5. Animal Salt & Mineral Distribution Points
6. Pesticides Program
7. Structures for Animal Habitat
8. Excavation Sites (Quarries/Pits)
9. Trails - 8 Types
10. Herbicide Program
11. Firebreaks and Fire Control
12. Integrated Pest Management System
13. Noise Levels and Derivation (Training On-Post, Off-Post)
14. Burying Personnel Waste Materials
15. Excavating Trenches, Gun Emplacements, Foxholes, Fill, Road Surfacing, Earthworks
16. Protected/Impact/Range Areas
17. Military/Forestry, Hunting, Agriculture, Recreation Coordination
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#### I. Military Parameters

1. Weapon Systems
2. Electronic Combat
3. Types of Training Units
4. Tracked Vehicles
5. Wheeled Vehicles
6. Fixed Wing Aircraft
7. Rotary Wing Aircraft
8. Amphibious Vehicles
9. Water Craft
10. Cross Country Movement
11. Training Area Land Requirements
12. Other Training Unit Requirements
13. Engineering Restrictions to Excavations

#### J. Terrestrial Animal Parameters

1. Game Animal Populations (general)
2. Non-Game Animal Populations (general)
3. Populations (Specific) - 15 factors
4. Predator - Prey Interactions
5. Avian Fauna
6. Migratory Species (waterfowl)
7. Mammal Fauna
8. Herpetological Fauna
9. Invertebrate Fauna
10. Threatened and Endangered Species
11. Parasites
12. Pathogens
13. Nesting Sites/Density

#### K. Terrestrial Plant Parameters

1. Critical Area
2. Vegetative Pattern Diversity
3. Type Vegetation
4. Tree Size Class
5. Overstory Density
6. Forest Reproduction
7. Ground Cover Density
8. Pest/Poisonous Plants
9. Pest/Weed Species
10. Potential Natural Vegetation
11. Species Composition
12. Species Value
13. Height Diversities
14. Distribution of Vegetation
15. Successional Stage
16. Tree Growth/Yield
17. Shrub Growth
18. Grass Growth
19. Mast Production
20. Cavities
21. Seasonal Variations in Vegetation
22. Susceptibility to Fire
23. Disturbance Tolerance
24. Protected Species
25. Vegetative Concealment
26. Vegetative Cover
27. Forest Resource Maps
28. Forest Type Maps/Forestry Classification
29. Timber Sale Contract Parameters - 15 subparameters
30. Forest Insect Protection Program
31. Forest Disease Protection Program
32. Forest Climatic Damage Data
33. Plant Associations
34. Temperature Survival Data
35. Thermoperiodicity Data



36. Light Tolerance
  37. Moisture Tolerance
  38. Species Natural Range
  39. Species Population Data
  40. Natural Regeneration Potential
  41. Artificial Regeneration Potential/Methods
  42. Forest Management Model Data
- L. Terrestrial Man-Influenced Biotic Parameters
1. Human Use of Range and Habitat
  2. Impact Hunting and Trapping
  3. Vehicular Damage
  4. Wildlife Management Sites
  5. Forestation Sites
  6. Seeding
  7. Burning
  8. Brush Control
  9. Mowing
  10. Fertilization
  11. Cultivation
  12. Pruning
  13. Agricultural - 17 subparameters
  14. Pests/Insects/Damage Control
  15. Pests/Other
  16. Predators/Control
  17. Poison levels in Animals
  18. Feral Dogs/Cats
  19. Wind Breaks
  20. Impact of Browsing/Grazing
  21. Forest Fire Protection
  22. Trespass Data
  23. Silvicultural Practices - 5 subparameters
- M. Terrestrial General Biotic Parameters
1. Habitat Composition
  2. Special Features
  3. Habitat Use (General)
  4. Habitat Use (Ruminants)
  5. Habitat Use (Birds)
  6. Shoreline Habitat
  7. Habitat Interface
  8. Habitat/Edge
  9. Open Field/Grass Habitat
- N. Population/People Parameters
1. Total Family Income
  2. Educational Level of Household
  3. Place of Residence
  4. Census Region
  5. Age
  6. Race
  7. Sex
  8. Marital Status
  9. Family Size
  10. Handicapped
  11. Days Worked per Week
  12. Vacation
  13. Total Population in Influence Zone
  14. Population Within (units of distance)
  15. Travel Cost
  16. Travel Time, Based on Population
  17. Agricultural Demand for Land
  18. Agricultural Cost & Benefits
  19. Agricultural Leasing Agreements
  20. Army-Unique Demands - Housing, Postal Service, Recreation, Religious, Schools
  21. Cawntonment Facilities
  22. Restricted Areas
  23. Religion
  24. Life Style
  25. Transient/Permanent
  26. Recreational Activities & Interests
  27. Off/On Post Resource Demands
  28. Displacement of Previous Users
  29. On/Off Post Employment
  30. Hunter/Trapper/Fisherman Attitudes & Values
  31. Hunter/Trapper/Fisherman Economic Values
  32. Storm Warning Procedures
  33. Training for Storm Preparation
  34. Hunter/Trapper/Fishing Quotas
  35. Land Area Ownership
  36. Land Area Control
  37. Land Area Survey Data
  38. Original Land Survey & Corner Data
  39. Platt Books
  40. Land Use/Zoning Data
  41. Legal Description/Forestry Areas
  42. Aims/Goals of Land Owner
- O. Surrounding Area of Parameters
1. Substitute Recreational Areas Within 100 miles
  2. Travel Cost to Substitute Recreational Area
  3. Travel Time
  4. Fee Schedule for Substitute Recreational Areas
  5. Quality of Substitute Recreational Areas
  6. Off-Post Agricultural Land-Use
  7. Off-Post Resources
  8. Off-Post Land Use
  9. Off-Post Fire Protection
  10. Training Access Adjacent to Urban Settlement (noise)

## Soil Parameters

1. **Fertility:** The chemical composition used to assess a soil's potential use. Fertility can be measured quantitatively by determining: levels of acidity (pH); nutrient composition by major, secondary, and micronutrients available to plant growth; critical mineral levels for plant growth; and toxicities (acidity/alkalinity) of specific elements detrimental to plant growth.

2. **Stability:** The ability of soil to withstand different forces (e.g., compaction, erosion) without changing its character; stability is a function of texture, structure, slope, permeability, and shrink-swell potential.

3. **Depth to parental material/bedrock:** The total depth to solid rock beneath the soil and superficial rock. If the parent material is consolidated rock, this depth may be indicated as the total depth of all soil horizons. However, soils may develop from materials deposited by ice, wind, or water. In such cases, the depth to bedrock is the depth to solid rock beneath these deposited materials. The depth to bedrock affects such properties as: the amount of overburden that must be removed to obtain bedrock materials; the engineering properties of soil (such as suitability for foundations, burying materials, roads, foundations); soil loss tolerance; and slope stability.

4. **Series and type classification:** "Series" refers to a group of soils developed from a particular kind of parent material and essentially alike in all major profile characteristics, except the texture of the "A" horizon. This classification provides information on soil characteristics such as arrangement, kind and thickness of horizons, color, structure, reaction, consistence, and texture below the "A" horizon. The U.S. Soil Conservation Service (SCS) produces detailed soil maps with soils identified and delineated according to series classification. Soil type is a subdivision of series in which the "A" horizon texture is also uniform within the type. The following are examples of different soil types:

a. Medium to well-drained silts, sandy clay and clay loams, heavy clay and muck soils.

b. Gravelly and sandy loams, moist but well-drained sands.

c. Dry sands, gravels, rock and eroded soils.

Soil series is the classification of most concern to agricultural land users. Describing soil characteristics and determining the location and extent of each soil unit (or type) is important to understanding the limitations to training activities, and in planning the use of installation lands during training.

5. **Soil horizon/profile:** The layers of soil, approximately parallel to the surface, that have distinct characteristics produced by soil-forming processes. Major horizons are:

"O" horizon: A layer formed on the upper part of the mineral soil consisting of a high percentage of decaying plant residues.

"A" horizon: The upper mineral horizon (just below the "O" horizon) in which humus accumulates and living organisms are active. This horizon may have lost salts, clay, or oxides to leaching.

"B" horizon: Mineral horizon below the "A" horizon distinguished by an accumulation of leached materials or changes in structure or color from the "A" horizon. The "A" and "B" horizons together (as well as the "O" horizon, if present) are the solum, the part of the profile in which soil formation activities are present.

"C" horizon: The weathered rock material beneath the solum.

"R" layer: Consolidated rock beneath the soil.

There are many intermediary horizons, but not all soils have all of these major horizons. Properties in the "A", "O", and "B" horizons are of most significance to plant growth. Agricultural land managers need to know the kinds of horizons present; their arrangement; the thickness of each; the texture, structure, and composition of the upper horizons; and the depth to bedrock. Considering these factors is important when an installation plans training activities that disturb the ground surface, such as digging foxholes, trenches, latrine pits, and gun emplacements; burying fuel tanks and toxic materials; making roadcuts or borrowing soil for fill; and excavating for foundations or building materials.

6. Texture: Refers to the size of soil particles and is expressed as the relative proportions of sand (0.05 to 2 mm), silt (0.002 to 0.05 mm) and clay (<0.002 mm) particles in a mass of soil. Soil textures are generally grouped into classes, from coarse to fine, as follows:

- Sand (coarse, fine, very fine)
- Loamy sand (coarse, fine, very fine)
- Sandy loam (coarse, fine, very fine)
- Loam
- Silty loam
- Silt
- Sandy clay loam
- Clay loam
- Silty clay loam
- Sandy clay
- Silty clay
- Clay

Stones and gravel larger than 2 mm are not considered in determinations of soil texture. If stones and gravel are present in quantities large enough to affect soil use and management, they should be specifically indicated in soil surveys.

Soil texture relates to soil infiltration and permeability rates, water-holding capacity, compactability, aeration, and fertility. For example, coarser soils are well aerated and absorb water rapidly; they also have a lower water-holding capacity, and easily lose available plant nutrients. Soil

texture may vary considerably between soil horizons due to water action moving clay and soluble clay products from the "A" to the "B" horizon, and the weathering of silt and sand in the "B" horizon.

Agricultural land managers need to know both the textures of the "A" and "B" horizons, and the effects of these textures on range or crop management. Relevant information for coordinators of training activities includes (for each soil mapping unit) soil texture class (at each horizon), and the percent or relative abundance of stone and gravel particles.

7. Structure: The arrangement of soil particles into compound particles or clusters; usually expressed in descriptive terms such as: platy, prismatic, columnar, blocky, granular, subangular, and crumb. Single-grain soils (such as beaches) and massive soils (such as hard pans) are without structure. Structure affects soil density; the more aggregated soils, such as subangular and crumb, are more porous and penetrable. In affecting soil density, structure also affects the movement of air and water in soils, root penetration and aeration, the compactability of soils, and the relation of water infiltration to water runoff (and thus, the tendency of water flow to dislodge soil particles). Structure also relates to seedbed preparation; for example, soils with poor structure may require more tillage.

8. Consistence: The resistance of soil to deformation, the coherence of the soil mass, the ease with which a lump of soil can be crushed by the fingers. Consistence can be expressed as friable, firm, plastic, sticky, hard, soft, and cemented. Loose soils are noncoherent when wet or moist, whereas plastic and sticky soils easily deform under pressure and are coherent when wet. Soft soils are powdery when dry and are moderately resistant to pressure, whereas cemented soils are hard and brittle either wet or dry. Consistence is an important factor in predicting the response of soils to pressure and moisture. It indicates to the land manager problems from the movement of vehicles across soils, and the ease with which soils can be tilled.

9. Color: Usually expressed according to the Munsell color system, which specifies the relative degree of hue, value, and chroma. Soil color results from the organic and mineral content of the soil but can also indicate drainage conditions. On cropland, soil color can be an important indication of the available nutrients at a site and the kinds of treatment that should be applied to supplement soil fertility. Color can also be a distinguishing feature between soil types and soil horizons.

10. Reaction: The degree of acidity or alkalinity in a soil expressed numerically as pH, which is the negative logarithm of the hydrogen-ion activity. Values for pH are commonly grouped into the following ranges:

Extremely acid	Less than 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	More than 9.1

Soil reaction is an important characteristic in determining proper soil treatment and in selecting the proper crop varieties to grow on a site. Reaction should be tested periodically, especially on cropland, because cropping activities may change the pH level and require changes in soil treatment.

11. Chemical composition: The chemical makeup of the soil, especially levels of available nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. This makeup can include several minor elements such as iron, manganese, zinc, copper, molybdenum, and boron. Adequate quantities of chemical elements in soils are essential for the growth and reproduction of plants. Information on the chemical composition of soils is essential to assess the need for soil improvement practices, such as additions of chemical fertilizer or manure, rotations of crops, periods of fallow or rest, and tillage practices. Chemical composition must be checked often because agricultural practices have ongoing effects on levels of available nutrients.

12. Organic matter or content: The organic content of soil is composed of plant and animal matter in various stages of decomposition. Humus is organic matter in the soil which is still decomposing but has lost its original structure. Depending on temperature (which affects rates of biological activities), organic matter in the soil is humus. The organic content of soil is concentrated in the upper horizon and decreases rapidly in lower horizons. Organic content is usually expressed as a percentage, and is an important indicator of soil fertility, as well as a determinant of the appropriate levels of soil fertilization.

13. Exchangeable sodium fraction: The rate of exchangeable sodium to the remaining exchangeable cations in soil. In certain areas, particularly those with low rainfall and high evapotranspiration, sufficient levels of exchangeable sodium in the upper soil horizon limit both the kinds of plant species that can survive and the vigor of the species that do tolerate such conditions. Agricultural land managers should have this information -- especially in regions where alkalinity is an inhibiting factor.

14. Permeability: The rate at which air and water are transmitted through a particular soil; may vary between horizons and soil types. These rates are generally expressed in inches per hour (or millimeters per hour) and are categorized in Table A1.

Table A1

	Permeability Rates	
	<u>Inches/hour</u>	<u>Millimeters/hour</u>
Very slow	less than 0.06	less than 1.5
Slow	0.06 to 0.20	1.5 to 5
Moderately slow	0.20 to 0.63	5 to 16
Moderate	0.63 to 2.00	16 to 51
Moderately rapid	2.00 to 6.3	51 to 160
Rapid	6.3 to 20.0	160 to 500

Information on permeability and infiltration (the downward entry of water into soil) is relevant to soil drainage characteristics, and to levels of absorption or runoff. The movement of soluble materials from the "A" to "B" horizons may also be affected by soil permeability.

On slopes, soils with slow rates of permeability may be more subject to erosion, while soils with high rates are less subject to erosion. In areas with few slopes, soils having slow rates of permeability may present tillage problems, requiring artificial methods, such as use of tiles, to improve drainage.

Soils with slow permeability rates can be soggy, slippery, or sticky. These conditions limit military training activities, including the cross-country movement of troops and vehicles, and various soil disturbing activities (such as digging, burrowing, excavating, burying). On sites susceptible to erosion (such as steep slopes) slow rates of permeability may increase the amount of run-off and, therefore, increase soil movement.

15. Available water capacity: The capacity of a soil to hold water that can be used by plants. Soil water-holding capacities are classed in Table A2. The ability of vegetation to withstand periods of low precipitation or high evapotranspiration, the selection of crops or varieties to grow on a site, and evaluations of irrigation and other water supply improvement measures are all affected by available water capacity.

16. Depth to high water table: The water table is the upper surface of groundwater, or that level in the ground where the water is at atmospheric pressure. In some places, the water table may be separated from a lower water table by a dry impermeable zone.

As water tables vary from season to season, the depth to the seasonally high water table is related to drainage, soil permeability, water-holding capacity, root aeration, and soil management.

In poorly drained soils, a high water table may limit cross-country movement, excavation, and other activities which disturb soil. High water tables can result in flooding of low lying structures, supplies, and facilities. For each soil mapping unit, relevant information includes: depth to seasonally

Table A2

Water-Holding Capacities

Very high	12 in. (305 mm) or higher
High	9 to 12 in. (229 to 305 mm)
Moderate	6 to 9 in. (152 to 229 mm)
Low	3 to 6 in. (76 to 152 mm)
Very low	Less than 3 in. (76 mm)

high water table (in inches and feet, or millimeters and meters), season or period during which water table is highest, and normal duration of high water table.

17. Soil capability class: Soils are grouped by their limitations into classes, subclasses, and units. These groupings are indicated in soil survey reports, but may also be available for unsurveyed areas. Capability groupings indicate the suitability of soils for agricultural uses (especially field crops).

Capability classes are designated by Roman numerals I through VIII, with higher numerals indicating progressively greater restrictions. Classes I through IV can be feasibly used for field crops, while classes V through VII are more suitable for grazing use.

Capability subclasses are designated by adding small letters -- e, w, s, or c -- to the numerals. Particular erosion hazards are denoted by e; w represents restrictions resulting from wetness, s indicates shallow soils, and c represents climatic restrictions. Capability units are soil groupings within the classes, indicated by Arabic numerals, which are enough alike to be treated with the same cropping or grazing practices. Information about such grouping is valuable in developing management plans for agricultural out-lease sites.

18. Productivity: Predicted or average yield of soils for crop growth; useful in assessing the value of a site for possible use in crop production and in determining management techniques on out-lease land already producing crops.

19. Susceptibility to sheet and rill erosion: The susceptibility of the land to the loss of topsoil resulting from the intermittent movement of water flowing as a sheet; influenced by the amount and distribution of precipitation, the degree and length of slopes, the amount and type of vegetation cover, and changes in temperature. To assess the susceptibility of croplands and grazing land to rainfall erosion, information on all of these characteristics is needed. The Universal Soil Loss Equation (USLE) is an effective tool in predicting sheet and rill erosion.

Training activities frequently reduce vegetative cover and expose soils to wind and water erosion. Extensive erosion (beyond soil loss tolerance levels) diminishes the aesthetic value of lands, reduces soil fertility and may reduce the trafficability and training value of lands. Eroded materials often cause problems later by contributing sediment to surface water bodies. Also relevant to sheet and rill erosion losses are land use practices (such as burning, strawing bare fields, contour and terrace farming) and facilities (such as waterways and catch basins) which are designed to decrease erosion losses or sediment contribution. Lands should be mapped or rated according to susceptibility to erosion and, when possible, the use of the land should be adjusted to such ratings.

20. Susceptibility to gully erosion: Gully erosion occurs on sites when the volume of runoff water is concentrated into channels; the water action

cuts downward, undermining and detaching soil particles. Properties affecting the susceptibility of a site to gully erosion are slope, soil texture, soil structure, and soil permeability.

Agricultural managers should have information about the occurrence and formation of gullies on agricultural out-lease sites, the effects of agricultural activities on gully formation, and the measures to reduce such erosion. This erosion significantly affects training land and may cause sites to be unfit for cross-country traffic. The USLE is not effective in predicting gully erosion.

21. The Universal Soil Loss Equation: A method of estimating potential soil loss due to sheet and rill erosion; developed by the U.S. Department of Agriculture (USDA), various State experiment stations, and the SCS. It does not estimate soil erosion losses from gullies and stream banks. The equation is as follows:

$$A = R \times LS \times K \times C \times P \quad [\text{Eq A1}]$$

where A = the soil erosion loss (tons per acre per year)  
R = rainfall  
LS = the length and steepness of slope  
K = soil erodibility  
C = vegetative cover  
P = conservation practices.

The equation is generally considered the most accurate tool available for predicting soil losses. Managers should know of its availability, application, and limitations, as well as the specific factors that comprise the equation.

The USLE has been adapted to croplands, rangelands, and to larger areas, such as watersheds, with mixed land uses. Although normally used for agricultural fields, the equation can be adapted to relatively small training sites (such as armored personnel carrier training courses) to evaluate the potential value of increasing vegetative cover or constructing sediment catch basins. The USLE is also used to determine whether a site is exceeding soil loss tolerances. Application to larger areas may require modifications such as determining C values from aerial photographs (with spot field verification) and LS values from topographic maps (also with spot field verification).

22. Soil loss tolerance: The maximum level of soil erosion that will permit continued and indefinite use (generally agricultural) of a site without degradation. Factors involved are soil depth, properties affecting root development (e.g., texture, structure, permeability), gully prevention, on-field sediment problems, seeding losses, soil organic matter reductions, and plant nutrient losses.

In many areas of the United States, soil loss tolerance levels have been or are being legislated to reduce erosion from agricultural and construction activities, which reduces sediment contributions to surface waters. However,



sediment contributions to surface waters do not correlate directly with erosion losses because eroded materials may be deposited before reaching streams. Also, not all soil characteristics relevant to erosion tolerance levels (such as soil depth) are relevant to tolerance sediment levels in streams.

The soil loss tolerance levels on all agricultural out-lease sites should be known, as should all legislation or regulations that have set tolerance limits relevant to such sites.

23. Rainfall and runoff factor (R): The elements that contribute to the rainfall and runoff factor R for each storm are total storm energy, E, expressed in hundreds of foot-tons per acre, and maximum 30-minute intensity, I, expressed in inches (or millimeters) per hour. The average annual sum of storm EI values for a given locality is the R value for that area. The USDA has published R values for areas throughout the United States, and this information should be available to agricultural out-lease managers.

Calculations to determine R values do not include erosive runoff from thaw, snowmelt, or irrigation; however, there is an R subfactor which can be added to include thaw and snowmelt where these factors are significant.

24. Slope length and steepness (LS): This information is used in the USLE to determine potential soil loss from a particular slope at a particular site. LS is a numerical factor derived by determining both slope length and slope steepness at a particular site, then combining the two factors; it must be independently determined for each slope if there are several slopes at a particular site. Tables for determining LS are available from the SCS.

25. Soil erodibility (K): The soil properties that directly affect the erodibility of soils are texture, structure, depth, and percent of organic matter. The SCS has evaluated these factors for most identified soil series in the United States and has assigned to each series a numerical soil erodibility factor called K, which is used to predict potential soil loss from a given area in the USLE. Agricultural land managers should know the K value for all soil series occurring on land outleased for agricultural purposes.

26. Cover and management factor (C): The protection from the direct erosive effects of raindrops and runoff provided by vegetation cover and vegetative debris; on range or pastureland, this C factor is determined by the type, percent of ground cover (grasses or broadleaf herbaceous plants). On cropland, this factor is determined by the type of crop, the sequence or rotation of crops, tillage practices, crop residues remaining on fields, and the stage of crop development.

Managers should know how C factors affect potential soil losses, and what cropping and management factors (such as tillage) might be changed if potential losses exceed tolerance limits. The USDA, SCS and many State extension services have tables that compute these elements to determine the C factor.

27. Support practice factor: This factor computes the effects of specific erosion prevention measures such as contouring, stripcropping, and terracing. One of the most important uses of the USLE is to determine the potential value of each of these specific measures by solving the equation for P (conservation practices) rather than for A (soil erosion loss).

Agricultural out-lease managers should know where potential erosion losses warrant prevention measures, which measures are most appropriate for the site, what the cost/benefit is for such measures, and how their application affects lessees.

28. Susceptibility to wind erosion: Wind erosion causes loss of topsoil and other upper soil layers, along with associated flora; it occurs most often in exposed areas.

The susceptibility of a site to wind erosion is determined by the cloddiness, surface roughness, and surface moisture of the soil; the direction and velocity of the wind; the amount, kind, and orientation of the vegetative cover; and the distance across a field along the direction of the wind's force.

Loss of soil from wind erosion indicates possible overuse (grazing, human activity, etc.) and a need for immediate reclamation action. Where wind erosion occurs, land managers should know the various ways that overusing land can contribute to wind erosion, and the measures that might prevent such erosion.

29. Wind erosion equation: Determines potential average annual erosion, E, that will occur at a given agricultural site. The equation is as follows:

$$E = f (I', K', C', L', V) \quad [\text{Eq A2}]$$

where E = potential average annual erosion, usually expressed in tons per acre

I' = a soil-erodibility index

K' = soil-ridge roughness factor

C' = a climatic factor

L' = a median unsheltered travel distance across field

V = equivalent quantity of vegetative cover.

Solution with computer assistance is recommended; this allows reasonable evaluation of the multiple factors involved in wind erosion and the value of various control techniques. Agricultural land managers should know of the availability of this equation, its applications and limitations, the factors that comprise the equation, and specific control measures that might be applied.

30. Conventional agricultural practices: The installation should assess whether conventional practices (cropping, grazing) might conflict with military land use or contribute to environmental degradation. Degradation may include excessive erosion, reduction of groundwater resources, rangeland retrogression, reduction of wildlife habitat or excessive stream sediments.

If conventional practices might result in land use or environmental problems, information should be obtained on alternative practices and the effects

of these practices on agricultural productivity, the demand for agricultural use of installation lands, and the economic value of the land.

31. Soil fertility improvement: Assessments of current and alternative fertility improvement practices in terms of effects on soil fertility, costs, feasibility, and environmental effects. Of particular concern should be off-post environmental effects, such as the use of fertilizers which pollute downstream water on agricultural out-lease sites.

For past treatment programs, the levels and kinds of chemical application and resulting effects on productivity should be known. Any legislation, regulations, or policies relating to the application, use, or secondary effects of soil fertility improvement chemicals should also be known.

32. Erosion control: Specific control measures should be used where wind or water erosion exceeds tolerable limits or causes problems downwind or downstream. Information about the most appropriate measures in terms of both economic and environmental costs and benefits should be obtained. Control methods should be considered for all types of erosion resulting from agricultural, forestry, and construction practices, including sheet and rill, gully, and wind erosion.

33. Erosion control facilities: Grassed waterways, wind barriers, shelterbelts, land modifications (terracing, benching), diversions, subsurface drains, etc. Relevant information includes type, location, date of installation or construction, condition, and purpose. Each facility should be assessed in terms of its effectiveness in preventing erosion and its impact on total erosion losses.

34. Shrink-swell potential: Soils swell and shrink through wetting and drying conditions. The degree to which soils shrink and swell depends on the amount of montmorillonite clay in the soil, or the percent of exchangeable sodium in the cation exchange capacity. Characteristically, soils with a high shrink-swell potential develop surface cracks when dry and are sticky and slippery when wet. Such soils inhibit cross-country movement during wet periods and also limit road construction and other engineering uses.

35. Presumptive bearing value: The ability of a soil, without the benefit of gravel or other surface improvements, to support foot and vehicle traffic. One method of calculating bearing strength is to use a cone penetrometer to determine cone index (CI), which is defined as the shearing resistance of a medium. The remolding index (RI) expresses the proportion of the original strength that the medium will retain under a moving vehicle. The product of the CI and RI is the rating cone index (RCI). The RCI will predict how a given soil (with the wetness measured) will support vehicle traffic. However, different vehicles cause different stresses on soils. The stress that a specific vehicle creates in passing once over a soil is expressed as vehicle cone index (VCI). The RCI must be equal to, or larger than, the VCI to allow a particular vehicle to pass over a particular soil. For multiple vehicles to pass, the RCI must be significantly higher than the VCI.

36. Corrosion potential: The potential of a soil to be worn away by the chemical processes of acid reactions and solutions.

37. Trafficability: An index number relating to how many times a vehicle can pass over a given area of soil without getting stuck.

38. Overflow/flooding hazard: If the discharge of a river cannot be accommodated within its normal channel, water spreads over adjoining ground upon which crops or forests normally flourish. This flood hazard must be considered when the site for a structure is being selected.

39. AASHO (unified classification): American Association of State Highway Officials -- responsible for developing a soil textural classification scheme.

40. Engineering data properties: For several resource management disciplines, various engineering uses of soils must be investigated. These include: burying waste materials; excavating for trenches, gun emplacements, foxholes, etc.; removing materials for fill, road surfacing, the building of earthworks, etc.; supporting building foundations; building roads. To determine the suitability of various sites for these engineering uses, the manager should know the engineering properties (or limitations) of each soil type.

41. Soil analysis: An examination of soil to determine its physical and chemical properties; important for assessing potential use of an area. The characteristics to be analyzed will vary with the management program (forestry, agriculture, range management).

42. Soil maps: Maps which show distribution of soil types or other soil mapping units in relation to prominent physical and cultural features in an area. For resource management, it may be desirable to group and map soils according to their use limitations; such limitations include erodibility, compactability, and trafficability. Soils may be grouped and mapped according to their engineering properties, as is done in installation terrain analysis reports from the U.S. Army Engineering Topographic Laboratory.

43. Water seepage/retaining properties: The rate and volume of water absorbed by the soil after a rainfall. Retaining properties refer to a soil's water holding capacity (see Permeability, p 44).

44. Erosion from human activity: Human activities inducing soil erosion include logging operations, road construction, off-road vehicle use, and many others. Areas affected by human use should be monitored seasonally -- or as needed, depending on levels of activity.

45. Rocks, bedrock composition: "Rocks" refers to the kind, size, and number of rock pieces at or near the ground surface. The percent of ground surface that is exposed bare rock; the hardness, size and shape of these rocks; and their effect on surface roughness at agricultural out-lease sites should be known. Rocks at or near the surface affect the workability of soils; rocks large enough to contribute to surface roughness affect the movement of livestock.

"Bedrock," the solid rock layer under soils, only minimally affects agricultural activities unless it is at or near the surface. Relevant information includes depth to bedrock, location of out-crops, and the effects of near-surface bedrock on soil characteristics and vegetation.

46. Soil nutrient deficiencies: A lack of soil elements (phosphorus, nitrogen, potassium) that are essential for plant growth and development. The land manager should know of any deficiencies to determine the limiting factors to healthy plant growth.

47. Soil toxicities: Contaminants may be found in the soil in the form of toxic chemicals or viruses, bacteria, fungi, protozoa, and other parasites. Because these agents can spread disease, contaminated soils should be monitored and designated "off-limits," depending on the use of the area.

### Climatic Parameters

1. Air temperatures: Per month mean daily maximum; per month mean daily minimum; per month record maximum; per month record minimum; maximum and minimum seasonal temperatures recorded during summer and winter months. An important variable is the number of times the temperature drops below or rises above freezing. This fluctuation influences the condition of man-made surfaces (roads, runways), water availability, plant development, and livestock health.

Temperature monitoring is useful for planning the timing of management programs, and predicting floral and faunal changes. Changes in temperature affect the training environment, namely troop performance and equipment functioning. Changes also affect soil temperature, resulting in alterations of physical and hydrological properties of soil.

2. Snowfall (monthly): Mean monthly amounts, and the range of high and low monthly levels; measured daily in inches (millimeters).

3. Snow Accumulation: Total number of inches (millimeters) of snow on the ground after compaction, melting, evaporation, and absorption of snowfall.

4. Thunderstorm patterns: Frequency -- (a) over eight storms per month, (b) four to eight per month, (c) fewer than four per month; occurrence -- seasonality, mean annual occurrence; types of storms -- especially lightning storms; and storm intensity.

5. Sunlight duration: Total average annual hours of sunlight available, and the distribution of available sunlight (determined by day length and cloud cover) throughout the year. Day length is relevant to flowering and reproduction of plants; affects the timing of planting, cultivation, mowing, and harvesting; determines the period during which livestock are allowed on specific pastures or range units.

6. Solar radiation: The amount of light energy available to a site; significantly affected by latitude. Southerly locations will receive more direct radiation from the sun for longer periods during the year than the northern hemisphere. Amounts should be recorded monthly and annually.

Solar radiation affects the energy available for green plants, crops, and range growth and development; influences rates of evaporation and transpiration; and also affects the comfort of training personnel.

7. Precipitation (amount): Usually the only source of moisture contributed to agricultural systems. Record the average annual and monthly precipitation, and the high and low range of precipitation received in past record years. Rates of evapotranspiration and moisture retention capacities of soil and plants affect the degree to which moisture is used. Precipitation rates are usually the same throughout an installation; variations should be noted.

8. Precipitation distribution (1): Average monthly precipitation levels; monthly high and low amounts; occurrence of droughts and excessive rainfalls and their frequency. Use of precipitation in agricultural systems depends on regional distribution; distribution patterns affect crop and livestock productivity.

9. Precipitation (type): Significantly affects availability of moisture. Record the average annual precipitation by types -- rain, snow, sleet, hail, freezing rain; the period during which each is likely to occur; the frequency and intensity of sleet, hail, freezing rain; the impact of these precipitation forms on crops, livestock, training equipment, and buildings and grounds. Also note the percent of snowmelt that is absorbed into or drained off the ground.

10. Frost-free period: Number of days between the last frost in the spring and the first frost in the fall; this is a period of plant reproduction and growth. The manager needs to know the average annual number of frost-free days and the high and low ranges of this period. The frost-free dates affect planting and harvesting times and indicate the seasons suitable for land grazing.

11. Winds: The horizontal movement of air caused by temperature differences in the earth's atmosphere. Determine mean monthly wind speed (mph [km/hr]), high and low range in wind speed per month, highest recorded wind speed, prevailing wind directions for each month and season, mean number of days with high surface winds and no precipitation, and wind chill factor.

Winds may affect rates and amount of erosion, may bring moisture to dry land or dry saturated land, and may cause stress in training personnel when combined with extreme temperature and precipitation.

12. Evaporation and transpiration: The conversion of liquid water from soils, water bodies, animals, or plants into atmospheric water vapor. Rates (expressed in inches or millimeters) increase with wind speed and solar radiation intensity. Determine average rates of evaporation per month and water availability and the relationship of evaporation rates to precipitation rates. Useful in selecting crops and varieties for agricultural sites; helps determine water quantities and periods for irrigation.

13. Storms: Type (wind storm, dust storm, hurricane, thunderstorm, hail storm, snow storm, tornado); average annual intensity, frequency, months of

occurrence for each type. Since storms may damage crops, livestock, facilities, and supplies, and may injure unprotected persons, installations need to take appropriate precautions.

14. Length of growing season: Frost-free days are determined by the average date of first frost and average date of last frost; mean, maximum, and minimum temperatures for day and night should be recorded.

15. Degree days heating: Unit for estimating energy required to heat buildings; one degree day for each degree the daily mean temperature falls below 65°F (18.3°C).

16. Degree days cooling: Unit for estimating energy required to cool buildings; one degree day for each degree the daily mean temperature rises above 75°F (23.9°C).

17. Mean number of days of cloud cover/month: Relevant to visibility conditions; visibility may be improved by artificial lighting and equipment.

18. Snowfall (number of days): Mean number of days on which snow falls. Special training programs may be designed for areas with snow and ice cover.

19. Per month freeze/thaw transitions: Mean number of times that temperature passes the freezing point going up or down.

20. Wind chill factor: Effect of wind and temperature on skin. High winds create a lower temperature and may produce stress in training personnel.

21. Effect of temperature extremes on equipment: Extremes in temperature may affect performance of weapon systems, vehicle mobility, supply needs, and personnel performance.

22. Effect of temperature extremes on transportation: Freezing and thawing extremes may influence transportation facilities, cross-country mobility.

23. Effect of storms on equipment and transportation: An installation must (a) know warning procedures for on-coming storms and procedures for storm safety preparations by personnel, (b) equip existing facilities with means to minimize damages, (c) realize possible impacts of each storm as well as duration and severity of impacts, (d) organize procedures for restoring facilities that have been damaged by storms.

24. Visibility conditions: Information relevant to visibility conditions includes:

a. For each month, the mean number of days with cloud cover.

b. For each month, the mean number of days with cloud ceilings at certain altitudes (for example, 1000 ft [0.3 km], 2000 ft [0.6 km], 5000 ft [1.5 km], 10,000 ft [3 km]) and the resultant visibility from the ground (in miles or kilometers) at each altitude.

- c. Season or period during which atmospheric dust reduces visibility.
- d. Source of dust and extent and duration of dust problems.
- e. Training activities causing dust, and dust control procedures (e.g., oiling roads).
- f. Recorded occurrences of visibility reductions from smoke.
- g. Location, extent, and duration of smoke problems, and impacts of such occurrences.
- h. Contribution of training activities to smoke problems, and mitigating procedures (such as fire control).
- i. Location, type, power, and range of artificial light, as well as rate of energy consumption.
- j. Location, type, limitations, and range of remote sensing equipment that operates beyond the visible light range.

Conditions affecting visibility include: the presence or absence of sunlight, the presence or absence of clouds in the atmosphere, the altitude of any clouds in the atmosphere, the presence or absence of particles (such as dust) in the atmosphere, the presence or absence of smoke in the atmosphere.

The conditions affecting visibility may hinder the movement of troops and equipment, and may impair effectiveness of various weapon systems. Visibility during training can be improved in specific areas or for specific vehicles by artificial lights and by equipment (such as radar and sonar) which "sees" without visible light.

25. Altitude of clouds: The height of clouds in the atmosphere; may affect visibility.

26. Humidity (seasonal patterns): The measure of water vapor content in the air. Note seasonal patterns of ranges; day and night minimums and maximums, especially during fire seasons; mean highs and lows during the growing season.

27. Humidity (daily patterns): Daily patterns of ranges; see Humidity (seasonal patterns).

#### Existing Structural Facilities

1. Corrals: A livestock containment facility. Manager must know location, capacity, condition, type, purpose, purchase and construction costs, and Army or post regulations regarding corrals. Repair needs for existing corrals must be monitored. Useful when military activities require temporary or permanent removal of livestock.

2. Fencing and gates: Location, type, condition, and extent of fences on land available for outleasing; economic value of fence maintenance,



construction, and removal. Federal specifications should be consulted regarding types of fence material, depth and spacing of posts, and types of gates (chain link -- fabric, posts; barbed wire -- wire, posts).

When placing fences on grazing lands, managers should consider species and class of grazing stock; size, shape and topography of the grazing units; range conditions; number of animals to be grazed; length of grazing season; and location of available water. Other considerations in planning the construction, maintenance, and removal of fencing are wildlife movement and military movement, both of which can be hindered by fencing. Cross-country military activity can also damage and destroy fencing. Frequent activities may require managers to add special maneuver gates.

3. Protective barricades: Types -- timber barricades or earth barricades (slope, elevation, vegetative cover should be known).

4. Magazines/igloos: Pertinent information includes types of roofs, walls, floors, doors, and earth covering.

5. Piers/docks: Obtain information on location, foundations, and platforms.

6. Recreational structures: Relevant information includes special use structures (e.g., picnic shelters, fireplaces, grills, boat launches, campgrounds), and the number of these units.

7. Open loading docks: Include information on location, size, and type of access to loading docks.

8. Flag pole: Include information on location and height.

9. Military features: Of obvious importance to a training program is information on all features that relate to the current, past, or future training program. Such features include:

a. Radio towers: Structures designated to handle traffic control, particularly air, by monitoring and recording transmissions through a specific frequency.

b. Mock villages: A model built to scale of a village or town; used to simulate attack and defense of populated/developed areas.

c. Bunkers: Location, construction, purpose, and size.

d. Grandstands: Location, construction, and size.

e. Targets: Area designated and numbered for firing practice.

f. Observation towers: Location, size, area observed.

g. Abandoned airstrips: An unimproved surface which has been adapted for take-off or landing of aircraft; has minimal facilities.

h. Revetments: A barricade to provide shelter; need to know location and size.

i. Pits: Location and size.

j. Concrete pillboxes: A small, low concrete fortification housing machine guns, antitank weapons, etc.

k. Launcher sites: Any area from which missiles can be launched from surface to the air, or surface to surface.

l. Ammunition dumps: Site used to discard used ammunition.

Relevant information about these features includes: identification (name and number); location (grid reference or coordinate reference); status (active, abandoned, occasionally used); purpose; condition; maintenance requirements; frequency of use; use coordination; danger or obstructions these features might represent to training activities, and precautions against these dangers.

10. Radar facilities: Equipment which detects and determines the position, velocity, and other characteristics of distant objects by deflecting high frequency radio waves from their surfaces. Such equipment may be used to aim artillery fire, direct and control air traffic, or determine air tactical maneuvers. Relevant information includes: identification and location of stationary facilities (type of housing, type of radar unit, range of unit, usage and limitations); identification of facilities for mobile usage; maintenance requirements; operation training requirements; coordination of usage with nonmilitary radar.

11. Dams: Information necessary includes use, location, and size of dam; type of construction; size and number of spillways and outlets.

12. Airfields: Sites prepared for aircraft to take off and land. Airstrips are generally less developed than airfields, having fewer navigation aids and support facilities. Airfields are occasionally used as sites for tactical maneuvering of ground troops and vehicles during training activities, and are also used for incoming and outgoing delivery of equipment, supplies, and troops.

Information should include: Location (grid reference or geographic coordinates); elevation (in feet or meters above sea level); runways (length, width, azimuth, surface, condition and maximum weight-bearing capacity, drainage conditions); hangers and support buildings (size, type, condition, location); fueling facilities; navigational aids (lights, control towers, radar, communications); repair facilities; obstructions (tower locations and height, transmission lines, vegetation cover); taxiways and parking areas (length, width, surface type, bearing capacity, condition); traffic volume (normal usage); operational status.

13. Helicopter land zones: Sites prepared for take-off and landing of rotary-winged aircraft. Information includes: Identification (name and number); location (geographic coordinates or Universal Transverse Mercator [UTM] grid reference); dimensions (size and shape in meters or feet); azimuth

(in range of degrees); elevation; type of surface material; obstructions to air approach (hills, towers, transmission lines); other restraints to aircraft use; access (surface roads and cross-country trafficability); season or period of operation; use status.

14. Railroads: May serve as barriers to tactical movement of terrestrial and aquatic vehicles and troops. Information includes: Line identification (number, name, ownership); location of route; length (on the installation); spurs (location, length, purpose); station or docking facilities; connecting lines; characteristics of the track (gage, rail weight, grade, ties, rails, spikes, switches, derails); number of tracks per line; condition and maintenance responsibility; ballast material; traffic volume; bridges (location, feature crossed, width, clearance, materials, length, deck material, type of structure).

15. Walks: May be concrete, asphalt, or gravel; maintenance procedures include crack sealing, patching, armor coating, blading, and regravelling.

16. Sanitary landfills: Site for disposal of domestic or industrial nontoxic wastes.

17. Telephone network: The telephone network consists of the equipment and capacities of the telecommunication system as they relate to training environment. The following information about the telephone network should be gathered:

a. The location of all network lines and other network facilities on the training landscape;

b. The height and clearance of above-ground transmission lines at all sites where lines cross roads that are near or in training areas;

c. The depth at which lines are buried; types of protective housing and training activities which could affect these lines;

d. The location of above-ground lines that might interfere with air traffic, heights of these lines, and their relation to airfields, airstrips, helipads, and drop zones.

Information relevant to the telecommunication system includes:

a. Lines and networks available for communication in training areas;

b. Central control of communication for training areas (location of central control, type of facilities, hours staffed, normal usage);

c. Location of stationary sites with telecommunication facilities in training areas;

d. Mobile telecommunication facilities;

e. Uses for telecommunication in coordinating training activities, and alternative systems for such uses.

18. Radio network: Radio and television facilities (towers and broadcast centers) that are on or near the training landscape. Information includes:

a. The location of all broadcasting facilities, such as towers, and their relationship to training areas;

b. The location of towers with respect to air traffic and air take-off and landing zones;

c. Types of radio (and television) systems operated on the installation, and use of these systems in training activities;

d. Centers for coordinating and broadcasting radio and television transmissions used in training activities;

e. Stationary and mobile receiving and sending locations on the training landscape;

f. Mobile receiving and sending capacities;

g. Normal usage for radio and television communication systems in training situations;

h. Alternative or back-up communication methods;

i. Relationship of electronic warfare activities to radio and television communications.

19. Cemeteries: Protected area where military training activities are prohibited. Include identification (name, number, type), location, protection (fence, posted signs), season of prohibited use, and impact of site on adjacent land use.

20. Roads: Primary means by which troops, weapons, equipment, and supplies are moved across the training environment. Included are hard-surface roads, improved roads, unimproved roads, with the exception of tank trails. Information requirements include location, extent of use, width, surface type, weight limitations, shoulder width and composition, and condition.

a. Location of all installation roads: Unimpeded access to and from leasing sites is required for crop and range land activities; access needed for tilling, planting, cultivating, harvesting, and moving equipment and livestock. Any military traffic which interferes with other uses of installation roads should be identified.

b. Shoulders: Width, material, condition; maintenance includes mowing, slope control, weed control, erosion control.

c. Bridges: Serve as a link in the training environment transportation system; location, capacity, and condition of a bridge affect troop movement. Information to include:

- (1) Bridge number and name
- (2) Route bridge is on
- (3) Bridge location (grid reference)
- (4) Feature crossed (river, road, railroad, etc.)
- (5) Status
- (6) Capacity or military load classification (in tons or metric tons)
- (7) Length and width (in meters or feet)
- (8) Vertical clearance approaches
- (9) Type of structure
- (10) Construction materials
- (11) Condition structural integrity
- (12) Maintenance responsibility (ownership) painting inspections
- (13) Normal usage patterns
- (14) Capacity to accommodate (or obstruct) high water flow; capacity rating
- (15) Socioeconomic data pertaining to land use.

d. Culverts: Drains constructed of pipe or masonry which cross under roads or embankments; allow surface drainage without interfering with road traffic. Important in road improvements; affect mobility of ground troops and vehicles. Pertinent information includes:

- (1) Culvert name, number or identifying designation
- (2) Route along which culvert occurs
- (3) Location
- (4) Surface water feature (if known)
- (5) Size (diameter in meters or feet)
- (6) Type (structure and material)
- (7) Condition
- (8) Effect on road capacity
- (9) Maintenance responsibility
- (10) Capacity to accommodate highwater flow
- (11) Flow rate
- (12) Clogging and cause (e.g., beaver dam or naturally accumulating debris).

e. Signs: Location and readability should be known.

f. Easements/Ownership: Rights afforded a person or group to make limited use of another party's property, especially agricultural out-leases.

g. Fords: Shallow places in streams and rivers that can be crossed by vehicles, animals, or on foot. Identify the ways fords affect the mobility of ground troops and equipment performing extensive off-road maneuvers during training exercises. Because existing bridges are often unable to support heavy military vehicles, fords may be used during maneuvers. However, vehicles crossing streams and rivers at fords may cause extensive ecological damage to waterways by increasing sediments, changing bottom conditions, releasing lubricant and fuel pollutants, and directly destroying aquatic flora and fauna. Information relevant to fords on training lands includes:

- (1) Identification or designation
- (2) Location
- (3) Route, if any, along which ford occurs

- (4) Hydrologic feature crossed (name of stream, river, canal, pond, or other water body)
- (5) Water depth at normal flow (and at low and high flow)
- (6) Velocity of water at normal flow (and at low and high flow)
- (7) Width of water body at ford site
- (8) Surface strength of bottom and banks
- (9) Bank slopes
- (10) Surface bottom composition (gravel, sand, silt, etc.)
- (11) Type and amount of bank and aquatic vegetation cover (during various seasons)
- (12) Alternative routes, if ford is impassable or unusable
- (13) Impact of crossing on stream ecology and downstream users
- (14) Improvements to fording site (such as bank leveling or surfacing, upstream dams, gravel applications to bottom)
- (15) Usage
- (16) Seasons or periods of unsafe conditions
- (17) Investigate the possibility of using mobile bridges at specific fording sites.

h. Road length: Expressed in miles or kilometers.

i. Mile load classification.

j. Road width: Expressed in feet or meters.

k. Surface conditions: Physical character of a road surface -- e.g., surfaced, unimproved.

l. Drainage improvements: Grading, culverts, ditches.

m. Drainage problems: Type of problem, frequency or season of occurrence, mitigation procedures, location or section of road.

n. Traffic regulation facilities: Signs, center strips, lights on each road.

o. Maintenance responsibility: Government or individual legally responsible.

p. Surface strength: This may be expressed as a Rating Cone Index (RCI), a unitless value that indicates bearing strength; of particular interest for unsurfaced roads.

q. Usage rates: Vehicles per unit of time, preferably per day or hour.

r. Commercial traffic: Vehicle type; per unit of time, preferably per day or hour.

s. Parking areas: May be composed of concrete, asphalt, gravel; maintenance includes crack sealing, patching, arm or coating, blading, and regravelling.

t. Construction: On smaller installations, road building may be of little concern since access to the area may be adequate. On large installations

involving large acreages of timber stands, road access may be a matter of considerable concern. The person in charge of the forest or other natural resource will have to make important decisions about the locations of new access roads and the types of roads that would efficiently serve the area. A cost analysis is most often used. Before construction, the installation should collect this information:

- (1) Class of road  
(For year-round use and main line access: Class 1 -- paved road, Class 2 -- black top, Class 3 -- crushed rock gravel, Class 4 -- dirt.  
Seasonal use: branch line roads
- (2) Length -- feet or miles (meters or kilometers)
- (3) Width -- two lane or one lane with turnouts
- (4) Grade specifications -- maximum adverse, 10 percent; minimum favorable, 20 percent.
- (5) Required structures -- bridges, culverts, or retaining walls
- (6) Volume of cuts and fills
- (7) Speed specifications -- (15 mph [25 km/hr], 30 mph [50 km/hr] or more)
- (8) Blasting
- (9) Steep grades

21. Buildings: Facility with a floor, walls and roof used to house personnel, offices, equipment, storage, etc. Include information on:

- a. Location
- b. Wall type: Masonry, metal, frame, siding, finish coating for both interior and exterior
- c. Roof type: Trusses, deck, roofing
- d. Window and door type: Millwork, hardware, glazing
- e. Floor type: Wood, concrete, covering
- f. Foundation and footing type
- g. Paint (interior)
- h. Paint (exterior)
- i. Electrical system: Distribution panel, electrical circuits

j. Electrical distribution system: Electrical generation plant, distribution system, substations, transformers and switches

k. Water system (potable and nonpotable)

l. Sewer systems, industrial: Treatment plants, collection lines, pumps and equipment

m. Heating system: Steam, hot water, forced air

n. Air conditioning

o. Ventilation system

p. Installed equipment

q. Lightning protection system

r. Fire protection: fire alarm system, sprinklers, fire hydrants

s. Permits, restrictions.

22. Water system: All physical structures that relate to obtaining, storing, or delivering water; includes pumps, wells (drawdown and pump capacity should be known), reservoirs, water tanks, water towers, distribution lines, piping, chlorination and other treating equipment, fire hydrants. Other relevant information includes:

a. The location of all physical structures relating to water resources on lands used for training;

b. The status and use of these physical structures (e.g., water trough for cattle, seasonal usage);

c. The relationship of training activities and sites to these physical structures; possible damages to these structures that might occur from training activities;

d. Ownership of these structures;

e. Sites where water is available for troop and training uses; include quantities available, periods of availability, and types of uses for which water is suitable;

f. Results of periodic testing of water quality: biological factors, organic chemicals, inorganic chemicals, radionuclides.

23. Steam system, boiler plant: boilers; fuel systems -- coal handling equipment, natural gas lines, diesel fuel pumps and lines, steam distribution system, condensate return system.

24. Compressed air system: Compressed air plants, air compressors, air distribution.



25. Natural gas system: The physical elements of the natural gas delivery system include pipelines, pipeheads, pumping stations, gas distribution mains, regulators and meters, cathodic protection. Include information on the following:

a. The location of all natural gas pipelines, pipeheads, pumping stations and other facilities that relate to the natural gas delivery system and occur on the training landscape;

b. Ownership of each facility;

c. Type of pipeline (diameter, capacity, thickness, and pressure);

d. Sites where military traffic crosses buried pipeline;

e. Depth to which pipelines are buried and pipeline bearing strength;

f. Possible disturbances of natural gas network by training activities, and measures to avoid such disturbances;

g. Installation use of natural gas, sites where consumption occurs, and periods and types of usage.

26. Coal storage facilities: Know storage area, unloading system.

27. Fuel oil storage system: Know number of storage tanks, unloading system, distribution system.

28. On-post structural resources:

a. Housing

b. Recreation

(1) Indoor

(2) Outdoor

(3) Group

(4) Individual

(5) Strenuous

(6) Sedentary

(7) Arts and crafts

(8) Entertainment -- movies, dancing, picnics, games

c. Religion

d. Schools

e. Shops, stores.

29. Artificial waterways: Man-made routes for transportation or site improvement; waterways include slope, location, construction, seeding, and mowing of aquatic or terrestrial overgrowths. Examples of artificial waterways include navigable streams, navigable lakes formed by dams, canals, sea-ways.

30. Archeological sites: Because Federal law requires the protection of archeological and historical sites, the manager should know about any such sites on leasable or training areas and about whether agricultural activities or training might damage these sites (Appendix D). Managers should know if archeological or historical surveys have been conducted on lands available for outleasing and if any specific sites, or likely areas for sites, have been identified. Data should be available on the location of those sites, their contents and type (e.g., campsite, graveyard, flaking station), and the relative value of these sites. It may be necessary to prohibit agricultural or military activity on particular sites, or to temporarily halt activity until more can be determined about the areas.

31. Windmills and windpumps.

32. Pipeline pumping station: Station to pump materials (liquid or gas) through a pipeline system.

33. Transmission lines and substation: Many structures on the training landscape relate to transportation and communication facilities, or directly to training use, and are discussed in these other contexts. However, information on all cultural features that occur on maneuver areas, ranges, or other sites used for training is relevant to the management of training activities. These features include:

- Nontactical buildings (structures present before Army use of the land, warehouses, etc.)
- Communications towers
- Windmills and windpumps
- Pipeline pumping stations
- Transmission lines
- Power substations
- Fences
- Corrals
- Sanitary landfills
- Stocktrails and walkways
- Camps (recreation)
- Piers and docks
- Oxidation ponds
- Recreation facilities

The effects of these features on military training activities should be assessed. Many of these features (such as transmission lines, power substations, fences, and windmills) hinder the cross-country or aerial movement of troops and vehicles. Therefore, training procedures may have to be adjusted, both for the safety of personnel involved and for the protection of the cultural features. Relevant information concerning all nonmilitary features includes identification, status, ownership, condition, potential and actual damage caused by military activities, location, purpose, easement involved, and potential hazards to training and necessary precautions.

34. Cattleguards: The location, type, purpose, and condition of all cattleguards on the installation, and the needs for any additional cattleguards; purchase and installation costs, and specific regulations or policies regarding the type of cattleguards to be installed; methods of installation.

The effects of cattleguards on installation wildlife movement should also be known.

35. Cultural and historic sites: Structures or areas valuable because of their prehistoric, historic, or cultural significance. Locate and describe such features.

36. Storm safety facilities: Any facility built to withstand, and be used as a precaution against, unusually violent weather.

37. Transportation fuel storage areas: Any area where fuels -- particularly petroleum, oil, lubricants (POLs) -- are stored in large quantities.

#### Aquatic Biotic Parameters

1. Aquatic plants: Plants associated with lakes, ponds, streams; include composition, quantity, economics, aesthetics, and nutritive values. Give total listing with seasonal evaluation of selected species.

2. Phytoplankton productivity: Composition and quantity of aquatic microflora used as food by fish or other managed species; useful when assessing carrying capacity and overall productivity of a given area. Evaluate seasonally.

3. Aquatic pest plants: Types, quantities, and conditions of water plants (including algae) considered noxious, nonaesthetic, or detrimental to the balance of an aquatic system; may indicate that a management program is needed. Monitor seasonally; more often when "blooms" are present or predicted.

4. Fish (economic value): Worth of game and other species and of a given program, consideration of fishing revenues, as well as aesthetic values; values may be positive or negative. Yearly review of assessment.

5. Fish (undesirable): Type and numbers of fish considered undesirable in managed or other waters; indicates effectiveness of or need for management programs. Periodic assessment; depends on particular fauna and area.

6. Fish growth: Growth of individuals in fish populations -- especially game, rare, or indicator species -- calculated from scale measurements. Weights of fish are used to assess water quality, conditions, and fishing quotas. Periodic monitoring for selected species.

7. Fish parasites: Content and numbers of ecto- and endoparasites of fish species; enumeration may be used to assess effectiveness of or need for management programs. Evaluate parasites from trapped, caught, or culled stock, as available.

8. Fish populations: Classified as very few, moderate, abundant.

a. Size: Families, genera, and species of fish known or thought to inhabit the area under consideration. Note economic and other values, niche,

and condition. Periodic census following complete survey of fauna; note seasonal variations.

b. Reproduction: Number of individuals born for each species. Information taken from trapping, etc.; indicates habitat quality, population trends, and quotas allowable. Evaluation at least once per cycle for managed species.

c. Movement: Movement by groups or individuals within or between habitats and habitat types. Useful for determining requirements for given fauna; may indicate changing habitat conditions. Seasonal monitoring, particularly of managed groups.

d. Mortality: Proportion of a given population dying per year; indicates trends in species population dynamics, habitat quality, and suitability; exact causes (e.g., fishing, predation, pollution, should be known). Assess annually for possible trends.

e. Diet: Animal and vegetable matter consumed by managed species; determined by fecal exams, stomach analysis, etc. Useful in determining future dietary needs, adequacy of range, and carrying capacity. Note composition of diet and quantity of food consumed. Depth of analysis depends on value of species and impact on other forms; note seasonal variations.

f. Sex ratio: Proportion of females to males in a managed population; useful in determining reproductive potential and fishing quotas. Evaluated with assessments of population size.

g. Migration: Regular seasonal or annual movements; generally predictable and resulting from normal changes in habitat; important to distinguish from nonmigratory or random movements. Valuable in planning, especially land uses. Once information is established, usually updating is needed only periodically for changes in list of species managed.

h. Stress periods: Loss of viability resulting from abnormal or severe climatic conditions or change in habitat conditions. Indicates need for management procedures to maintain balances or may indicate shortages of resources. Monitor periodically during harsh conditions, more often if stress is suspected, or if fragile fauna are present.

9. Impact of fishing activities: Reduction in population because of fishing. Used to consider quotas, population sizes, and carrying capacities. Yearly assessment, noting year-to-year trends.

10. Vehicular damage: On- or off-road damage to habitat and subsequent effects on wildlife due to activity caused by vehicles; includes erosion, road kills, salt poisoning (winter), interruption of movement patterns. Assess yearly, noting seasonal and long-term trends.

11. Invertebrate fauna: Species used as food, acting as pests, or otherwise integral to ecological system. Seasonal census, or more often with important species.

## Aquatic Natural Abiotic Parameters

### 1. Lakes: Freshwater bodies, including ponds.

a. Dropoff to 5 ft (1.5 m) depth: Waterline to a 5 ft (1.5 m) depth; bottom composed of sand, gravel, rock, mud.

b. Dropoff to 4 ft (1.2 m) depth: Distance from waterline to a 4 ft (1.2 m) depth: (1) 100 ft (30 m) or more, (2) 50 to 100 ft (15 to 30 m), (3) 25 to 50 ft (7.5 to 15 m), (4) 0 to 25 ft (0 to 7.5 m).

c. Lake shoreline: Quantity (length), configurations, condition, and erosive characteristics of habitat directly adjacent to large water bodies (know location, slope, surrounding vegetation). Shorelines should be monitored annually. Shoreline may be described as: (1) irregular shoreline -- many coves, bays; (2) undulating shoreline; (3) straight shoreline -- few coves; (4) size -- 50 acres (20 ha) or larger, 5 to 50 acres (2 to 20 ha), smaller than 5 acres (2 ha).

2. Streams: The features of surface drainage, including dry streambeds. Watercourses that cross or form the boundaries of training land can affect training activities or watercourses with drainage basins that extend into training land; relationship of surface water resources to all agricultural out-lease sites should be known.

Information on flow should include:

a. Numerous or unusual changing flow characteristics

b. Meandering and flow characteristics

c. Intermittent or small perennial streams with little or no flow fluctuations. Information includes:

- (1) Identification (name)
- (2) Location (to and from)
- (3) Length (and portion which crosses military lands)
- (4) Origin (and relationship to training lands)
- (5) Period of flow (if intermittent)
- (6) Flooding regime
- (7) Size of drainage basin (if primary stream)
- (8) Contributing streams (if secondary or higher order stream)
- (9) Watercourse or body to which streams contribute and point of confluence
- (10) Width and depth
- (11) Bottom characteristics
- (12) Velocity
- (13) Discharge
- (14) Water quality
- (15) Bank characteristics
- (16) Established fording sites
- (17) Bridges.

3. Characteristics of lakes and streams:

a. Temperature: Maximum, minimum, and average temperatures for given bodies of water; may indicate pollution levels, eutrophication, suitability as habitat; should be monitored seasonally.

b. Shoreline fluctuations: Little or more, moderate, major detractions less than half a season.

c. Shoreline material: (First 20 ft [6 m] beyond water) may be sand, gravel, rock, silt, clay.

4. Color and turbidity: Turbidity in water is a measure of the degree of interference with light transmission caused by the presence of suspended solids. In natural circumstances, clay and silt particles, microorganisms, and organic debris contribute to a certain level of turbidity. Information relevant to turbidity in surface waters includes: Normal or acceptable turbidity levels in affected water bodies; training activities that increase turbidity; the levels and duration of those increases; methods to control such impacts; effects of increased turbidity on surface water ecology and other water uses.

5. Groundwater resources: Water beneath the earth's surface between saturated soil and rock. Supplying wells and springs, it is the sole or major source of usable water on many installations with water. The amount of groundwater is closely associated with vigor of flora, and thus browsing capacity. Information relevant to groundwater includes:

a. The general availability of groundwater resources and trends in groundwater levels and usage, seasonal availabilities;

b. Depth to groundwater sources, level of supply;

c. Amount, utility, quality;

d. Type of formation in which groundwater occurs;

e. Replacement rates;

f. Well sites on installation lands;

g. Well source, depth, yield and quality of yield (color, mineral content, pH, total dissolved solids);

h. Naturally occurring springs (location, source, level of flow, season or period of flow, value of site for wildlife, contributions to surface waters; may aid in determining carrying capacity).

Also relevant is the feasibility of pumping or otherwise transporting the water to the agricultural site, and the suitability of the groundwater for irrigation of crops or for grazing livestock. The long-term effects of agricultural withdrawals should also be considered in terms of regional groundwater resources, anticipated long-term needs, expected yield, pumping and replenishment rate, and the relationship of groundwater resources to the structural stability of an area.

6. Watersheds/drainage/discharge: Drainage systems are described in terms of location, degree of slope, and capacity. Details about watersheds located in agricultural outlease sites should be known. This information should include (1) the general topographic and land use characteristics within the drainage systems, and (2) the amounts and kinds of withdrawals from and contributions to those drainage systems made by on-post agricultural activities. Among the elements to be considered are the percent of land area that the on-post agricultural sites comprise within each watershed, amounts of water withdrawals from groundwater resources, and the quantity and quality of contributions to the drainage systems.

Of particular concern are sediment contributions to surface waters, increased runoff from cropped, overgrazed, or burned lands, and in some irrigated areas, increases in water salinity. Included in drainage systems are springs: location, quality and value of any source of natural water into a given habitat, aquatic or terrestrial, should be known. Springs should be evaluated yearly, with seasonal monitoring.

In some areas, there are intergovernmental and regulatory districts organized by watershed; the installation should have information about the districts' boundaries and regulatory programs.

7. Marshes: Generally, lowland areas covered by shallow and sometimes temporary or intermittent waters; often areas of highest wildlife productivity. Susceptibility to drainage, and relative importance to waterfowl (on a seasonal basis), aquatic vertebrates, and associated fauna should be assessed. Include evaluation of vegetation with respect to density and composition.

8. Eutrophication: Enrichment of a body of water with respect to various nutrients; excess of nutrients often results in loss of desirable plants and animals. Eutrophic water bodies may contain sewage or fertilizers; eutrophication may reflect age of water body. Seasonal monitoring, especially in suspected areas.

9. Suspended solids: Particulate matter, either organic or inorganic, inert or not, or materials not in solution; potentially a cause of silting, clouding. Monitor at least seasonally, more often where increasing values are recorded. Suspended solids indicate local pollution (natural or resulting from influence of man) and aquatic carrying capacities.

10. Use by fish and wildlife: Activities of fish and wildlife in or around a given body of water or water system; evaluation needed for planning management programs and assessing quality. Seasonal monitoring, noting annual and long-term trends; should be assessed economically and aesthetically.

11. Tides: The relative rise and fall of the surface of oceans, seas, and other water bodies caused by the attraction of the moon and sun. On installations where training occurs in a tidal environment, include daily, monthly and annual information on high and low tides, as well as the resultant intertidal zone. Information is needed about undercurrents, land configurations above and below the water level, and the effect of tidal movement on sea-to-land and land-to-sea access.

12. Inland waterways: Standing bodies of water such as ponds, lakes, marshes, and swamps. Relevant information concerning each standing water body includes:

- a. Identification of each water body
- b. Type (lake, marsh, swamp)
- c. Location and extent (area in square miles or hectares)
- d. Capacity (acre-feet or cubic meters)
- e. Regime (extent to which the water body rises and falls with seasonal variations in precipitation and groundwater levels)
- f. Suitability of water body for amphibious or aquatic training (depth, bank characteristics, turbidity, bottom characteristics)
- g. Whether these water bodies border nonmilitary lands, and if so, extent to which these waters are used for nonmilitary purposes
- h. Value as water source, wildlife habitat, recreation site.

13. Coastal waterways: Large bodies of water (such as oceans, seas, navigable lakes, and navigable inland waterways). Information relevant to coastal waters includes:

- a. Shoreline configurations, including off-shore islands, reefs, tidal zones, lagoons and bays, terraces and cliffs
- b. Length of shoreline
- c. Points of access to coastal water
- d. Suitability of shoreline and beach for training activity navigation facilities
- e. Suitability of coastal water for amphibious or aquatic training
- f. Wave action
- g. Water depth and rate of dropoff
- h. Use of coastal waters for nonmilitary purposes.

14. Water bodies bordering lands: Extent to which water bodies border nonmilitary land.

15. Salt water types: Ocean, bays, canals, tidal marshes, bogs.



### Aquatic Man-Influenced Abiotic Parameters

1. Fishing areas: Site designated acceptable for fishing.
2. Boat launch: Site designated for the launching of water craft into a water body; give number of sites.
3. Swimming area: Site open for swimming.
4. Maintained shoreline/beaches: Location, slope, vegetation cover; information may be used as topographic data on maps.
5. Reservoir: An artificial or impounded stream or river creating a lake or pond. Information includes: Identification (name and number), location, approximate water surface area at capacity (in acres or hectares), capacity (in acre-feet or hectare-meters), water-holding structure, purpose of the reservoir, potential of the reservoir for amphibious training.
6. Accessibility from road: Ability to get from a road to surface water resources for recreation. Distances may be:
  - a. <1/4 mi (0.4 km) from existing road
  - b. 1/4 to 1 mi (0.4 to 1.6 km)
  - c. 1 to 2 mi (1.6 to 3.2 km)
  - d. >2 mi (3.2 km).
7. Water sites shared with nonmilitary uses: Ponds, lakes, marshes, swamps. Know whether these water bodies border nonmilitary lands; if so, note how often these waters are used for nonmilitary purposes.
8. Streams (impoundments upon): Agricultural out-lease managers should have information on all water impoundments near out-leased lands; all potential springs and streams where water might be impounded also should be noted. Relevant information concerning existing impoundments includes the location, capacity, and fluctuations and trends in quantity, quality, purpose. For possible impoundment sites, relevant information includes location, potential capacity, agricultural water needs, costs of construction, impacts on aquatic and terrestrial organisms, effect on military and other land use, and possible value for nonagricultural uses. Army or other regulations may be pertinent to the construction of impoundments.
9. Livestock water needs and uses: The availability of water affects the type of animal which can be grazed and the grazing practices used. Type of terrain is also considered when assessing distances to water (Table A3). Livestock water requirements are listed in Table A4. The availability of water for grazing animals is also affected by the type of source (stream, stream impoundment, spring, lake, trough) as well as dependability and access (bank steepness and stability) to that water source.
10. Surface water contributions: Agricultural out-lease managers should know the contributions of agricultural processes to surface waters. Of

Table A3  
Distances to Water

<u>Terrain</u>	<u>Travel Distance to Water in Miles (kilometers)</u>
Rough	1/4 to 1/2 (0.4 to 0.8)
Rolling	3/8 to 3/4 (0.6 to 1.2)
Level	3/4 to 1 (1.2 to 1.6)

Table A4  
Livestock Water Requirements

<u>Animal</u>	<u>Gal/Day (L)</u>
Cows	10 to 15 (37.8 to 56.8)
Sheep	1/2 to 1 (1.9 to 3.78)
Goats	1/2 to 1 (1.9 to 3.78)
Horses	10 to 12 (37.8 to 45.4)
Elk	2 to 3 (7.57 to 11.4)
Deer	1/2 to 1 (1.9 to 3.78)
Antelope	1/2 to 1 (1.9 to 3.78)

particular concern are contributions that degrade water quality, such as increased salinity (where soluble salt levels in the upper soil horizon are high), excessive nutrient enrichment (where soils are treated with fertilizer), and increases in sediment levels. If contributions degrade surface waters, installations should see what measures could be taken to reduce or eliminate the problem. Relevant to such assessments are the costs and feasibility of preventive measures; the nature, concentration, and season or period of the contributions; pertinent Federal, State or local legislation or policies concerning water quality; the effects of the contributions on other users or on any living organisms in the receiving waters.

11. Surface water withdrawal: Increase or decrease of volume of water in a given system; necessary for planning programs, assessing impact of irrigation on cover plants. Seasonal monitoring of long-term trends should be conducted.

Data on the quantity, quality, period of usage, and source of all water withdrawals should be available. If the source is a flowing water body, the rate of flow at all periods of withdrawal, and any relevant fluctuations in quality should be known. For standing water sources, information should include fluctuations and trends in total volume, fluctuations, and trends in water quality, evaporation rates, and periods during which the source is frozen. Also relevant is the effect of withdrawals on each of these sources. The quality of the water is of particular concern when supplies are withdrawn for croplands and livestock. For example, excessive salinity might degrade soil, damage crops, or harm animals.

12. Water quality: Levels of any minerals, compounds, salts, toxins, phosphates, pH, carbon dioxide, oxygen, mercury, alkalinity, or salinity in water which influence faunal or floral quality. May indicate pollution, seepage or overuse of given lake, pond, or stream. Should be monitored monthly in selected areas.

13. Pollution levels: Quantities of various toxic, noxious, or otherwise undesirable substances or conditions in water; influences productivity and aesthetic values. The manager should know the capacity of the system to withstand pollution. Monthly monitoring, especially in heavily used areas or those near pollutants.

14. Impact of grazing: Effect of nearby grazing on water quality, vegetation, and fauna of a given aquatic system; impacts used in planning programs and assessing activity, noting overuse. Should be evaluated yearly, noting long-term trends.

15. Domestic water availability for recreational areas: Water may be available for recreation at varying costs, or unavailable. Water may also be evaluated in terms of its recreational value.

16. Irrigation and its effects on water vegetation: Where irrigation is practiced, agricultural out-lease managers should know the economic and environmental costs/benefits of such practices. The various methods of irrigation should be assessed in terms of conventional irrigation techniques in the region, required capital investments for each method, and the types of physical facilities needed for each. Particular attention should be given to permanent or semipermanent alterations to Army lands.

Other factors important to irrigation are the location of water; quantity and quality of water available for irrigation; irrigation's effects on other water users, on organisms living in the water, on riparian and backwater communities, and on the long term availability of water in the area. Include data on irrigation equipment, frequency of irrigation, irrigation methods.

Irrigation's effects may include changes in flora and fauna resulting from artificial water mechanisms. Assess in terms of management plans, changes needed, change in balance, species lost, water level variations, resources lost, and water quality. Evaluate seasonally, noting year to year trends.

17. Amphibious movement: The in-water movement of military vehicles able to operate both on land and in water. Information concerning amphibious movement should include:

- a. Identification of water bodies in which amphibious movement is possible;
- b. Location and extent of these water bodies, as well as depth and bottom characteristics;
- c. Seasonal variations and limitations in water depth and aquatic ecology;

d. Bank characteristics (slopes and materials) and their relationship to amphibious movement;

e. Suitability of water bodies for particular types of amphibious training;

f. Impact of amphibious activities on aquatic ecology, and procedures to control such impacts.

18. Water rights: The legal rights to the use of water -- *riparian* rights (right to control water by virtue of ownership of banks along the water), *appropriated* rights (exclusive use of water based on priority appropriation without limitation of use to riparian), and *prescribed* rights (rights to which legal title is acquired by long possession).

19. Range and maneuver sites: Include natural hydraulic features and limitations due to natural features (such as wetlands).

20. Military/agricultural land use coordination: Certain types of agricultural activities, such as grazing and hay mowing, occur in the training environment and are affected by, and may affect, training activities. Agricultural activities must be coordinated to minimize interference with training. Information relevant to this coordination includes:

a. Areas on-post where agricultural activities are permitted and prohibited (for example, areas with live duds, artillery points, firing fans);

b. Season or periods of use;

c. On-post coordinating authority;

d. Identification and access procedures for personnel involved in agricultural activities;

e. Procedures to coordinate training schedules with agricultural use of training lands;

f. Use of post roads, water supply and other facilities by agricultural personnel;

g. Relationship of agricultural activities to fire control in training areas;

h. Location of all facilities (such as corrals, buildings, fences, cat-tleguards, water-impoundments) that relate to agricultural land use;

i. Coordination in the placement of facilities that relate to the movement of troops and vehicles.

Other useful information includes descriptive terms (range names) and procedures for maintaining communication (field radio or telephone systems). There may be specific requirements for access to leased sites including clearance through range control, and use of specific routes and specific types of vehicles.

21. Impact areas: Sites designed to receive artillery fire, often from more than one point. Impact areas are frequently contaminated by duds from live fire; therefore, movement in and around these areas is severely restricted. Installations may have one large impact area or several small ones. On some installations, impact areas are also used for air training exercises. Relevant information concerning each impact area includes:

- Identification
- Location and extent
- Protection (fencing, posted signs, closed roadways)
- Contamination
- Terrain circumstances
- Status
- Firing points (location, facilities, access, type of use)
- Danger zones
- Drainage features
- Access routes
- Periods and levels of use
- Noise dynamics
- Use by aircraft
- Use-coordination procedures.

22. Restricted areas: Where training is permitted but restricted due to various environmental circumstances. Such sites might include:

- a. Water sites shared with nonmilitary users (such as lakes and reservoirs), and with shorelines only partially on military lands
- b. Noncontiguous or peripheral sites where the movements of training forces are restricted by access or size limitation
- c. Wildlife management sites.

Relevant information concerning restricted sites includes: identification; location and extent; protection (fencing, posted signs); type of uses prohibited and permitted; season or period (e.g., night) of prohibited use; authority to contact concerning the area.

23. Military/outdoor recreation coordination: On-post recreational activity may occur at specific sites designated exclusively for recreation; however, activities may also use the training environment. When recreational activities (such as off-road vehicle use, hiking, fishing, cross-country skiing) do occur in the training environment, they must be coordinated to minimize interference with training. Information relevant to this coordination includes:

- a. Areas on-post where recreational activities are permitted or prohibited
- b. Seasons or periods of expected use
- c. Authority on-post for permits, regulation, and enforcement of recreation activity

- d. Permitted or prohibited use of post roads and other facilities
- e. Procedures for coordination with range control personnel.

The overriding factor determining the type and amount of recreational use on any installation is the policy of the U.S. Army for that particular site. There may be a demand for the activity, and site conditions may be good for recreational purposes; however, if Army policy restricts use, there is no need to plan for that area. If Army policy does not restrict use of a site, the type and amount of recreational use is guided by physical characteristics of the site, and the "demand" from potential users. In recreational planning and management, both of these components must be considered.

24. Parameters affected by training:

a. Water quality -- Many military training activities can affect the quality of surface and groundwaters. These activities include:

(1) Storage of materials (especially toxic materials) at waste sites where contaminated water seeps into ground surface waters.

(2) Aquatic and amphibious training activities that result in toxic emission into water bodies.

(3) Washing vehicles in water bodies.

(4) Contamination of maneuver and impact areas; the introduction of toxins into water bodies from the resultant runoff.

(5) Spilling or dumping oil and fuel waste materials from bivouac and other training sites; the resultant biological enrichment of water bodies.

b. Sediment load -- Materials that are either suspended in, or settle to the bottom of water bodies. Sediment contributions to water bodies can be significantly increased due to training activities such as amphibious and aquatic training activities, vehicles fording streams, devegetation of maneuver and range areas and subsequent increases in the dislodging of soil particles due to rill and gully erosion, and release or discharge of water materials into water bodies.

Information relevant to sediment contributions includes:

(1) Normal or acceptable sediment levels in affected waters;

(2) Identification of training activities that increase sediment levels and methods to reduce such contributions;

(3) Impact of increased sediments on aquatic flora and fauna and on other water users;

(4) Identification of suitable procedures and sites for measures to reduce sediment contributions (such as catchment basins, grassed waterways, terraces).

c. Turbidity -- A measure of the degree of interference with light transmission caused by the presence of suspended solids. In natural circumstances, clay and silt particles, microorganism and organic debris will all contribute to turbidity levels. However, several training activities significantly increase surface water (and groundwater) turbidity, altering the ecology, aesthetic enjoyment, and treatment requirements for surface water users:

- (1) Aquatic training activities
- (2) Crossing of streams by vehicles
- (3) Washing vehicles in streams
- (4) Devegetation of maneuver and range areas; subsequent increases in erosion and sediment contributions to surface waters
- (5) Discharging waste into streams (and stimulating bacterial and algal growths)
- (6) Subsurface vibrations from ordnance impact and other training activities (increasing groundwater turbidity).

Information relevant to turbidity in surface waters includes normal or acceptable turbidity levels in affected water bodies; training activities that increase turbidity, the level and duration of those increases, and methods to mitigate such impacts; impacts of increased turbidity on surface water ecology and other water users, both on- and off-post.

#### Terrestrial Natural Abiotic Parameters

1. Topographic maps: Important tools used to study landforms. The configuration of the land surface is represented by contour lines on these maps, which provide information about the location of hills and watercourses, roads and impoundments, and other natural and cultural features. The surface feature information should be presented in an accurate, updated, and readable format at a scale large enough to include all significant features. These maps can be obtained from the Defense Mapping Agency and the U.S. Geological Survey. Managers of Army training programs use topographic maps for planning attack and retreat strategies, aiming artillery weapons, locating bivouac sites, coordinating aerial assistance to ground troops, and other training activities.

2. Terrain analysis maps: Terrain analysis maps should provide information on general terrain, elevations (high and low points), range in elevation (typical relief), characteristic slopes (steepness, length, and orientation), prominent landscape features (e.g., escarpments, rock out-crops, steep-walled ravines, and drainage features).

For the training environment, maps are useful to categorize surface configurations by type, and to describe each type by location and extent. Information about the surface configuration is essential for planning and participating in large-scale training events, and for selecting suitable areas for specific training activities. Also, surface configuration is an important

element in tactical strategies for planning the placement of troops and weapons, and in ground-to-air interactions.

3. Elevation: The height of the land surface above sea level, expressed in meters or feet. The elevation of the land surface reflects landforms, slopes, and surface drainage characteristics.

Natural resource managers may need this information for describing sites assessing potential climax communities, and making decisions about crop or grazing management programs. Generally, variations in elevation on a specific leasable site within an installation would be too small to significantly affect management plans; however, at some sites in rough or steep terrain, changes in elevation are associated with variations in soil type, percent of exposed rock, moisture availability, and dominant plant species. For example, Yakima Firing Center's terrain is characterized by high ridges and intervening valleys that vary from over 4000 ft (1217.7 m) to about 500 ft (152.4 m) above sea level. There is a wide variation in dominant plant communities and grazing potentials from the top to the bottom of these ridges.

Information about land-surface elevation is vital to the planning of ground movement of troops and vehicles, the firing of artillery, and all air navigation activities. This information is usually available in both topographic maps and aeronautical charts. On installations where training occurs on inland waterways, coastal waters, lakes, and other water bodies, information about the land-surface elevation below the water level is also relevant.

4. Slope length: Slope refers to the angle at which a given stretch of land inclines from the horizontal. Slopes characterize landforms and affect the development of soils and vegetative communities. The more steeply the land slopes, the less developed and more susceptible to damage are soils and vegetation.

Slope length is the distance from the top of a slope (the ridge) -- or point of original overland flow (watershed) -- to one of three areas: (1) the bottom of the slope, (2) where the slope gradient decreases enough that sediment deposits begin, (3) where runoff becomes a concentrated flow or enters a well-defined channel. Slope length affects site properties as slope steepness does, but most directly affects drainage characteristics and erosion potential. Slope length calculated with slope steepness determines LS (length slope and steepness factor) in the USLE. Information should be known about slope length, slope length averages, and the range of slope length for all agricultural out-lease sites.

5. Slope orientation: The direction a slope faces. Generally in the northern hemisphere, south- and west-facing slopes are exposed to periods of direct sunlight longer than north- and east-facing slopes. Variations in direct exposure to sunlight result in variations in soil temperature and moisture characteristics, and this affects vegetative characteristics. Where moisture is a limiting factor, a difference in slope orientation can result in significant differences in the vegetative communities.

Information on slope orientation, expressed by compass direction, should be available for all agricultural out-lease sites. On one range site, slopes



may have differing orientations, and information on the prevalent orientation may be useful.

6. Landform variety: The physical characteristics of the land surface -- such as high ridges, rolling hills, flat plains, steep valleys, and broad floodplains. Landforms' variety may be extreme with several dominant features, may be limited, or may be moderate. It is useful to categorize landform varieties by type and describe each by location and extent (preferably on a map).

Information concerning the surface configuration is essential for planning and participating in large-scale training exercises; for selecting suitable areas for specific training activities; for the placement of troops and weapons, and for ground-to-air interactions during tactical maneuvers.

7. Rock form features: Bedrock influences the shape, size, and development of erosional landforms. These features can take the form of thin layers lying horizontally, tilted, folded, or broken. Resource managers should determine whether the area has any significant rock features, and whether these features have any value as a scenic resource.

8. Air quality: Levels of pollution and lengths of exposure at which adverse effects on health and welfare can occur. Pollutant levels and atmospheric conditions affect the quality of air. Military sources of air pollution include windborne fugitive dust from training exercises and particulate emissions from vehicles and smokestacks. Resource managers must make sure their activities do not conflict with prescribed air quality standards. Air quality should be monitored when air pollutant levels exceed the maximum acceptable level.

9. Topographic feature references: Surface information must be available in an accurate, updated, and readable format at a scale large enough to include all significant features. This information should also be presented with accurate latitude, longitude, and elevation reference. Generally, topographic maps for installations are available from both the Defense Mapping Agency and the U.S. Geological Survey. (When an installation plans a training program, the location of natural and cultural features must be known.)

10. Subsurface vibration transmission: If subsurface material such as unfractured rock strata is a suitable transmission medium, then vibration problems may result. In training situations, subsurface vibrations may be caused by ordnance impacts, testing of weapon systems producing low-frequency waves or high-amplitude impulses, blasting for excavation or quarrying, or by movement of heavy equipment. Problems that may result from subsurface vibration transmission include the physical movement of structures, vibrations of surface materials, and possibly landslides, soil slump, mass wasting, and the fracturing of impoundment structures.

Relevant information includes the type and thickness of subsurface formations, the transmissiveness of each strata, and the location and type of sites of possible impact (impoundments, escarpments, and structures near the site of disturbance).

11. Mass wastage: The downslope movement of materials by falling, rolling, sliding, or flowing; may result from alternate freezing and thawing, from changing moisture conditions, or from earthquake vibrations. Training activities (such as cross-country traffic) that reduce vegetation on steep slopes, or the firing of vibration-producing artillery may also contribute to mass wastage. Sites of mass wastage significantly limit training, engineering, and other uses. Relevant information concerning such sites includes site location and extent, slope steepness and length, type of mass wastage (rockfall, landslide, slump, earthflow, solifluction, soil creep), materials involved, degree of instability, area of use limitation, type of use limitation, and engineering use limitations.

12. Tectonic activity: Processes that deform and rupture the earth's crust with energy from within the earth. Such processes can either be diastrophic (the breaking, bending, and warping of the earth's crust) or volcanic (the movement of molten rock from within the earth onto the earth's crust). The likelihood or risk of tectonic activity occurring at an installation can, in part, be assessed by the historical record of seismic events that have occurred within a 50, 100, or 150 mi (80,160 or 240 km) radius of the installation. This historical record should include the date and locality, or center, of the disturbance as well as the intensity and range over which it was felt. Geologic structural features (such as fault traces, anticlinal axis, and synclinal axis) on or near an installation are also relevant. Toxic and explosive materials should not be stored near such features.

13. Atmospheric impacts: Effects of different activities on air quality; such contributions include dust from off-road vehicle traffic, smoke from fires and explosives, emissions from vehicle fuel consumption, odors from waste sites and weapons firing, gases used in training activities, and the possible emission of radioactive and other toxic substances. The installation should have information about each type of atmospheric contribution (on-post and off-post) resulting from ongoing activities, health and nuisance hazards posed by such contributions, and procedures to reduce such contributions. All off-post problems resulting from such on-post contributions should be known.

14. Aerial photographs: Vital in determining locations and measurements of surface features; can be taken or obtained in a variety of formats -- large or small scale; black and white, color, or infrared (especially useful for identifying hardwood-stand areas and for detecting plant disease). Aerial photos may be of special value in determining changes over time (day to day, season to season).

15. Sites having valuable subsurface materials: These sites may consist of oil, gas, or other valuable minerals. Information relevant to such sites includes: site identification, location, quality of material, extent of deposit, status of site, access to site, overburden, and seepage problems.

## Terrestrial Man-Influenced Abiotic Parameters

1. Hunting acreage: Amount of available land on an installation used for hunting.
2. Campgrounds: Include the number of campgrounds, location, size of areas designated as campgrounds, and facilities available, such as water, toilets.
3. Picnic grounds: Include the number of picnic grounds, location, and size of areas designated as picnic grounds.
4. Off-road recreational vehicles: Recreational vehicles (e.g., trail-bikes, snowmobiles) that are operated off major roads. Include type of vehicle, average number driven, size of vehicle; amount of acreage devoted to off-road vehicle trails should be measured.
5. Animal salt and mineral distribution: Blocks of exposed deposits of sodium chloride, potassium chloride, and other salts and minerals used by animals, especially ungulates, as supplements to diet. Include minimum amounts necessary to maintain several species. Information to be considered in checking distribution includes the type of terrain, the proper distribution of livestock for efficient forage, the location of key habitats for wildlife, and the general salt requirements for grazing animals. Salt can be distributed in a grazing unit to encourage more even grazing of forage plants. Generally, this means that salt should be placed far enough from key habitat areas to protect wildlife. The rougher the terrain, the closer salt blocks should be to each other -- livestock are less mobile on rough terrain. General salting requirements for grazing animals are listed in Table A5. The number of blocks needed should be reviewed seasonally. Requirements vary with climate, geographic area, kinds of forage available, and stage of forage growth.
6. Pesticide program: Application of animal or pest-controlling chemicals, organic or inorganic. Relevant information includes the location where pesticide is to be applied, specific chemicals used, and quantities. The installation should establish procedures for proper application of pesticides, bio-magnification, assessing program efficiency, and evaluating impact on habitat. Should be monitored continually, with periodic impact assessment.

Table A5  
Salting Requirements

<u>Livestock</u>	<u>Amount of Salt</u>
Cows	1-1/2 to 3 lbs/month (0.7 to 1.4 kg)
Horses	2 to 3-1/2 lbs/month (0.9 to 1.6 kg)
Sheep and goats	1/4 to 1/2 lbs/month (0.12 to 0.22 kg)

7. Structures for animal habitat: Man-made structures, such as bridges or piers, which can be used by animal species. Conduct a complete inventory with annual monitoring, specifying any maintenance of existing structures.

8. Excavation sites: Both rock quarries and borrow pits used to obtain engineering materials. These sites may consist of limestone, clay, gravel, or sand. Information relevant to such sites includes site identification (name and/or number), location, quality of material, extent of deposit, status of site, access to site, overburden, and seepage problems.

9. Trails: Trails can be used for hiking, motorcycling, cross-country skiing, horseback riding, bicycling, nature walks, livestock, and tactical vehicles. Important information includes identification, location, number of trails on post, length (miles or kilometers), status, purpose, ownership, easement involved, condition, potential hazards to training and necessary precautions, and potential (and actual) damage incurred by military activities.

The effects of these features on military training activities should be assessed. Use of trails can hinder the movement of troops and vehicles; therefore, training procedures may have to be adjusted, both for the safety of personnel involved in training activities and for the protection of the trail users.

a. Hiking trails: Trails on-post used by pedestrians as part of training or as a recreational activity.

b. Motorcycle trails: Areas on-post that have been designated suitable for motorcycle and trailbike use.

c. Cross-country skiing trails: Trails or areas that have been established (usually by the outdoor recreation office) specifically for cross-country skiing.

d. Horseback riding trails: Trails used specifically for horseback riding.

e. Bicycle trails: Trails designated solely for bicycle use.

f. Nature trails: Trails that have been set up to help people become more aware of natural resources and wildlife.

g. Stock trails and walkways: Walkways can provide livestock access to marshlands or areas subject to overflow, providing more sources of forage. Stock trails serve the same function in steep, rough areas, and areas of dense brush or forest. Location of fences should relate to the location and utility of walkways and stocktrails.

h. Tactical vehicle trails: Unsurfaced routes constructed for tracked and wheeled vehicle traffic, including tanks, armored personnel carriers (APCs), engineering and rescue vehicles. Information relevant to tactical vehicle trails includes: route designation (name or number); route location (grid reference to and from); route length; types of military vehicles permitted and prohibited; improvements; maintenance; status; surface composition (soil composition and surface improvements); surface strength (this may be

expressed as an RCI, a unitless value that indicates relative bearing strength and that may vary from section to section); surface geometry (elevation profile along the trails, including ruts, etc.); visibility problems (vehicle generation of dust); vegetation; trail width; road crossings; stream crossings; rate of usage; and drainage problems (area of problem, frequency, season). Trails may or may not be officially designated, improved, and maintained. Many installations have vast networks of trails, with only a few used heavily. Improvements such as culverts, grading, and reinforcements of hard surfaced roads at crossing, need to be assessed.

10. Herbicide program: Application of plant-controlling chemicals, organic or inorganic. Relevant information includes how and where the herbicide is to be applied, number and type of chemicals used, dates of application, quantities or dilutions used, and specific target species. The effects of herbicides on non-target species, especially protected species, should also be known, as should the cycling of herbicide toxins through the soil, water, and biological environment. Furthermore, the installation should know how the use of herbicides relates to levels of tillage, the overall effect of this relationship on erosion losses, and the effectiveness of the herbicides on weed prevention. Any regulations or restrictions relating to types, levels, conditions, and methods of herbicide use should be understood.

11. Firebreaks and fire control: Location, size, quality, and type of vegetational or geological structures which may prevent or retard growth of fire. Assess with reference to prescribed burning needs, susceptibility of habitat to fire, and future management plans. The installation should conduct a complete evaluation with annual assessment.

Measures to control fires include plowing or mowing strips, cutting strips in forest areas, back-burning, or adjusting levels of grazing. On sites leased for grazing, some range perimeters (outside the firing fan) may be heavily grazed to reduce the possibility that range fires will spread. In such circumstances, the perimeters of safety around the firing ranges, problems of erosion resulting from such practices, and the value of such measures should be known.

If controlled burning is done on installation land used for agriculture, (e.g., brush control on rangeland), then firebreaks need to be established, and information about the extent and nature of such activities should be transmitted to fire control authorities.

Fire protection is important to a training program. Many training weapons and activities may cause fires, so installations must have effective procedures to prevent and control fires. Information relevant to fire protection includes: season or periods of high fire danger; precautionary measures during danger periods (including limitations to training activities); procedures to protect troops, equipment and supplies (especially flammable and explosive materials); methods used in control programs (such as fire lanes, controlled burns, selective timber harvesting, and overgrazing the perimeters of high-danger areas); and procedures for off-post coordination of fire protection and control.

12. Integrated pest management system: Consists of taking an inventory of the pest population, determining methods to effectively combat the problem,

making pest control plans operational, and reviewing the effectiveness of the chosen means of pest control.

13. Noise levels and derivation: Refers to the amount, period, and type of noises (generated by training activities) that carry to off-post areas and among people. Information includes: range of noise audibility at various intensity levels for each training activity generating noise; effects of vegetation and landforms on noise absorption and transmission; effects of winds and temperatures on noise transmission; off-post communities' perception of on-post noises (type of disturbances, areas of most significant disturbances); methods or procedures to reduce off-post noise disturbances. The manager should: (1) know the intensity and duration of sound and its impact on wildlife, particularly during breeding seasons; (2) consider especially effects on "sensitive" species; (3) monitor training activity near critical habitats; (4) evaluate noise during periods of high human activity; (5) be aware of training activities that generate noise -- e.g., firing artillery, setting off explosives, using heavy equipment (for construction or road building), and operating vehicles (ground, water, and air traffic).

14. Burying personnel waste materials: Installation regulations should be consulted to see whether this procedure is permissible on-post; if this activity is allowed, the method of burial should be indicated. Pertinent information includes the nature and quantity of waste materials, soil characteristics, water table levels, and the length of time for material to degrade.

15. Excavating trenches, gun emplacements, foxholes, fill, road surfacing, earthworks: Specific landscape adaptations required as part of a program for training units that use the environment.

16. Protected areas: Sites where training activities are prohibited. Examples of these sites include: archeological and historical sites, habitats of endangered species, recreational areas, agricultural sites, forested areas, cemeteries, and dangerous sites (e.g., fuel or munitions storage areas, power substations).

17. Impact areas: Sites designed to receive artillery fire, frequently from more than one point; often contaminated by duds from live fire. Movement in and around these areas is severely restricted due to danger from artillery fire and duds. On some installations, impact areas are also used for air training exercises. Relevant information about each impact area includes: identification; location and extent; protection (fencing, posted signs, closed roadways); contamination; terrain circumstances; status; firing points (location, facilities, access, type of use); danger zones; vegetative cover; drainage features; access routes; fire precautionary measures; periods of use; level of use; noise dynamics; use by aircraft; and use coordination procedures.

18. Range areas: Sites established for the firing of field weapons; one of the major uses of Army training lands. Relevant information includes: identification; location; range type; dimensions; capacity (squad, platoon, company, battalion); number of firing positions, points or lanes; danger zones (limit of fire, dispersion area, limit of ricochet area, safety fan); topographic circumstances (hills, escarpments); noise dynamics; facilities (lights, grandstands, towers, buildings, latrines, bivouac areas, parking);

access; target; noise limitations; level of usage; vegetative cover; maintenance; fire lanes and fire precautionary measures; and nearby sensitive areas or features.

19. Coordination of military activities with other land uses:

a. Forestry/military coordination: Necessary to coordinate forest activities with the training use of the land. Information relevant to this coordination includes: areas on-post where forest management and harvesting activities are permitted; areas where such activities are restricted or prohibited (such as live fire and permanently duded areas); impacts of training activities on harvestable timber (such as damage to trees by cross-country maneuvers); on-post coordinating authority; identification of areas used for training (such as live rifle fire) that might make wood unsuitable for wood products; use of installation roads, water supply, and other facilities by forestry personnel; identification and access procedures for forestry personnel not with the installation; identification of areas in forest management where training use is restricted (such as areas with seedlings); procedures to determine sites for harvesting, fire control and other forest management activities.

b. Hunting/military coordination: On-post hunting activities occur in the training environment, are affected by, and may affect, training activities. The hunting program must be coordinated with training activities to minimize interference. Information relevant to this coordination includes: game species' name and identification, favored habitat, and distribution; all areas on-post where hunting is permitted and areas where hunting is prohibited; beginning and ending of hunting seasons (or days within the season) for each game species; permitted and prohibited use of post roads and other facilities by hunters; regulations and enforcement of the hunting program; coordination procedures for hunting use of training lands; procedures and liabilities in cases of injury to hunters from training activities or to Army personnel from hunting; the effects of training activities on the distribution and habitats of game species.

c. Agriculture/military coordination: Certain types of agricultural activities, such as grazing and hay mowing, occur in the training environment, are affected by, and may affect, training activities. Agricultural activities must be coordinated with training to minimize interference. Information relevant to this coordination includes: areas on-post where agricultural activities are permitted and prohibited; season or periods of use; on-post coordinating authority; identification and access procedures for personnel involved in agricultural activities; procedures to coordinate training schedules with agricultural use of training lands; use of post roads, water supply, and other facilities by agricultural personnel; relationship of agricultural activities to control of fires in training areas; location of all facilities (such as corrals, buildings, fences, cattleguards, water-impoundments) relating to agricultural land-use; and coordination in placing these structures so that the movement of troops and vehicles is taken into account.

d. Recreation/military coordination: On-post recreational activity may occur both at specific sites exclusively used for recreation, and in the training environment. When recreational activities do take place in the

training environment, they must be coordinated to minimize interferences with training. Information relevant to this coordination includes: areas on-post where recreational activities are permitted; areas where activities are prohibited; seasons or periods of expected usage; authority on-post for issuing permits; regulation and enforcement of recreational activity; permitted and prohibited use of post roads and other facilities for recreation; procedures for coordination with range control personnel.

20. Areas restricted by access or noise: Areas where training is permitted but restricted due to various environmental circumstances; may include training areas next to urban settlements or other land uses where noise and other disturbances are restricted; noncontiguous or peripheral sites where the movements of training forces are restricted by access or size limitation.

Relevant information concerning restricted sites includes identification, location, and extent, protection (fencing, posted signs), type of uses that are prohibited and permitted, season or period (e.g., night) of prohibited use, and authority (office to contact concerning the area).

21. Snow removal: The description of snow removal techniques such as plowing, salting, dirt or cinder spreading, and including types of vehicles and amount of use.

22. Restoring storm-damaged facilities: The expected amount and type of average restoration of facilities required due to weather effects.

### Military Parameters

1. Weapons systems: Each of the various conventional weapon systems (rifles, machine guns, mortars, rocket launchers, grenade launchers, tank main guns, aerial guns) have specific land use requirements for firing and pose specific hazards. The following information is relevant to all weapon systems in use, or considered for use, on military installations:

Range size requirement	Noise generation
Target and facility requirements	Impact hazards
Visibility requirements	Use demand per training unit
Fire hazards	Sub-surface vibration hazards
Contamination hazards	Methods of transport
Explosive hazards	Electromagnetic impact

2. Electronic combat: Electronic devices are used to communicate, to direct fire, to maneuver, and to provide logistic support during combat. There are also electronic methods for intercepting signals and jamming or deceiving enemy devices. Some of these devices involve considerable power output, which may interfere with commercial radio and television stations within a wide radius of the installation. The manager should know the uses and limitations of electronic combat equipment, and the regulations regarding such use.

3. Types of training units: Information about the types and size of units that use a particular training environment; should include Army, Reserve, and National Guard units. Also relevant are the types of training



activities necessary to prepare each of the training units, including infantry, artillery, armor, transportation, engineer, and flight training.

4. Tracked vehicles: Vehicles designed for ground (and, in some cases, amphibious) travel that run on caterpillar treads for cross-country movement; provides the major means of off-road mechanized training maneuvers. Tanks and armored personnel carriers are the tracked vehicles most frequently used in training programs; other types include infantry fighting vehicles, bridge launchers, recovery vehicles, self-propelled howitzers, guided missile carriers, and bulldozers.

The ability of a tracked vehicle to pass over a particular landscape depends on vehicle properties as well as limiting landscape features (such as those discussed with cross-country movement on p 91). These vehicle properties can be numerically expressed as a mobility index. The equation used to obtain a mobility index is as follows:

$$\text{mobility index} = \frac{(\text{contact pressure} \times \text{weight factor})}{(\text{track factor} \times \text{grouser factor})} \times \text{bogie factor} - \text{clearance factor} \times \text{engine factor} \times \text{transmission factor}$$

The mobility index is used to determine vehicle cone index (VCI), which is defined as the minimum rating cone index (RCI) that will permit a vehicle to complete a specified number of passes. (RCI is discussed on p 50). The RCI must exceed a vehicle's VCI in order for a vehicle to pass.

Pertinent information includes: number of vehicles available and condition; capacity; angle of slope which prohibits passage; maintenance requirements; limitations to surface road movement; noise generation; vibration; parking, housing and cleaning requirements; impact on landscape features, and methods to mitigate impacts; usage by assigned training unit in each particular type of training exercise; training necessary for competency; and vehicle capacities (speed, speed restriction, range on full tank of gas, weapons).

5. Wheeled vehicles: Various types of vehicles designed for ground (and, in some cases, amphibious) travel that run on wheels; includes jeeps, a wide variety of trucks, trailers, and mobile artillery. Wheeled vehicles provide the primary means of prepared surface (on-road) transportation; some wheeled vehicles are also able to travel on unprepared (off-road) surfaces. The ability of these wheeled vehicles with off-road capacities to cross a landscape depends on certain vehicle properties (which can be expressed numerically as the mobility index) as well as limiting natural features.

Information relevant to each type of wheeled vehicle includes:

- a. Number of vehicles available and condition
- b. Location and units to which vehicles are assigned
- c. Vehicle VCI
- d. Emission factor

- e. Fuel consumption
- f. Maintenance, cleaning, housing, and parking requirements
- g. Noise generation
- h. Vibration
- i. Limiting natural features (depth at which water bodies can be safely crossed, angle of slope which prohibits passage)
- j. Impacts on landscape features, and methods to mitigate such impacts
- k. Amphibious capability
- l. Use by each type of training unit in each particular training exercise
- m. Training necessary for competency
- n. Vehicle capacities (speed, range, weapons, ease with which vehicles can be loaded onto air and water craft).

6. Fixed wing aircraft: Vehicles -- designed for aerial transport -- with wings that remain stationary in relation to the hull. Such vehicles include transport, fighter, and reconnaissance planes. Fixed-wing aircraft are a major component in training, especially in programs involving flight and airborne training. Information relevant to each type of fixed wing aircraft includes:

- a. Number of vehicles available and condition
- b. Location and units to which vehicles are assigned
- c. Landing strip and takeoff requirements (site preparation, communication and coordination, length of runway or prepared field)
- d. Vehicle dimensions and weight
- e. Fuel consumption
- f. Noise generation and emission factors
- g. Maintenance, housing, and parking requirements
- h. Amphibious capability
- i. Use by assigned training unit in each particular type of training exercise
- j. Training necessary for competency
- k. Vehicle capacities (speed, safe flight altitudes, range, load capacity, weapons, communication and sensory equipment)

1. Flight restrictions.

7. Rotary wing aircraft: Vehicles -- designed for aerial transport -- that are propelled by rotating wings; includes several different sizes and shapes of helicopters. These vehicles have major roles as transport and reconnaissance aircraft, and as tactical weapons in training activities. Information relevant to each type of rotary wing aircraft includes:

- a. Number of vehicles available and condition
- b. Location of vehicles and units to which they are assigned
- c. Landing and takeoff requirements (site preparation, communication and coordination)
- d. Vehicle dimensions and weight
- e. Fuel consumption
- f. Noise generation and emission factors
- g. Impact of takeoff and landing on natural environment, and impact of overflight on wildlife
- h. Maintenance, housing, and parking requirements
- i. Use by assigned training units in each particular type of training exercise
- j. Training necessary for competency
- k. Vehicle capabilities (speed, range in altitude, range in distance, load capacity, weapons).

8. Amphibious vehicles: Vehicles which are able to operate both on land (or in the air) and on water. Several types of military vehicles have amphibious capacities -- such as tracked or wheeled equipment and fixed wing aircraft. Use of amphibious vehicles allows military units to cross water barriers, greatly increasing their capacity for cross-country movement. Information relevant to amphibious vehicles includes:

- a. Type of vehicles with amphibious capacities
- b. Number of each type, location, and unit to which vehicles are assigned
- c. Water-movement capacity and limitation (limiting distance of travel, types of currents, water depth, bank slope)
- d. Load capacity in amphibious usage
- e. Special adaptations and maintenance for amphibious use

f. Training necessary for competency in maneuvering the vehicles

g. Use by assigned training units in each particular type of training exercise.

9. Water craft: Boats and ships designed for transportation on water bodies; includes boats and ships designed for transportation, reconnaissance, and surveillance, and for use as tactical weapons and landing strips; may be significant elements in the training programs. Information relevant to each type of water craft includes:

a. Number of craft available and condition

b. Location where craft are kept, and units to which craft are assigned

c. Docking and navigation requirements

d. Emission factors (air and water), fuel consumption, and noise generation

e. Maintenance, housing, and parking requirements

f. Use by assigned training units in each particular type of training

g. Method of ground transport (if any)

h. Vehicle depth and necessary channel depth for safe passage

i. Vehicle height and necessary bridge height for safe clearance

j. Capabilities (land capacity, range or refueling needs, weapons, stability in choppy waters, communication and sensory equipment)

k. Vehicle dimension and weight

l. Impact of use on aquatic environment and procedures for controlling negative impacts.

10. Cross-country movement: The ability of troops and vehicles to maneuver across unprepared ground surfaces. Landscape features which affect the movement of troops and vehicles include slope steepness and stability; vegetation type, height, and spacing; hydrological features; and the bearing strength and corrodibility of soils. The suitability of installation lands for training purposes should be assessed in terms of barriers and limitations to foot troops and to various types of wheeled, tracked, and amphibious vehicles; areas should be mapped according to their natural limitations so that maneuvers can be planned with regard to such limitations.

11. Training area land requirements: Each type of military unit has specific task requirements to achieve or maintain proficiency. Completion of these training tasks involves specific ground, air, and water space requirements. Installation training programs must try to match available space to these special requirements. Also relevant to calculating special requirements is the length of time needed to complete specific training tasks, and the

frequency with which those tasks need to be repeated. The Department of the Army Training Circular 25-1 identifies a procedure to calculate "Gross Land Required Per Task (km<sup>2</sup> Days)" for a special unit (e.g., tank platoon) performing specific tasks (e.g., hasty attack or active defense).<sup>2</sup> Factors considered in this calculation include:

- a. Density of unit (number of units of this type and level of organization in a division)
- b. Land requirements (these requirements are previously calculated in square kilometers for standard training procedures)
- c. Training sessions to maintain proficiency (in a year's time)
- d. Days required per session.

The resultant figure of gross land required per task (km<sup>2</sup> days) for a tank platoon (hasty attack) is 288, with density of units equaling 36; land requirements, 2 km<sup>2</sup>; training sessions to maintain proficiency, 4; and days required per session, 1.

12. Other training unit requirements: Specific requirements, other than gross land area, necessary to complete a training program for each training unit. Included in such requirements are specific landscape adaptations, such as bunkers, trenches, revetments, waste disposal sites, and earthworks; facilities such as maneuver courses, parking lots, bridges, supply buildings, storage sheds, towers, power supply, grandstands; supplies such as fuel, food, ammunition, tents, medicine; and equipment such as vehicles, weapons, refrigeration units, communication lines, radar. Such requirements should be known for each field activity (such as movement to contact, night attack, or defense of built-up area) by each training unit (e.g., mechanized infantry battalion).

13. Engineering restrictions to excavations: To determine the suitability of various sites for specific engineering uses, the properties and limitations of each soil type on the base should be known. Certain soil types may restrict activities -- such as burying waste materials, excavating for trenches, building roads, or supporting building foundations.

14. Maneuver areas: Landscapes on which training forces can conduct field exercises; these areas comprise the major land use on U.S. Army installations. Some maneuver areas are continuous or nonsegmented, so field exercises can be conducted throughout. Frequently maneuver areas are divided by impact, range, and cantonment areas. Maneuver areas simulate battlefield conditions; therefore, the size limitations of these areas, as well as the limitations resulting from their natural features, are important elements in an overall training program. The available maneuver areas may not always provide adequate space for certain training exercises. In this situation, troop experiences at sites such as national training centers may be a necessary component in a training program.

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<sup>2</sup> Training Land, Training Circular 25-1 (Headquarters, Department of the Army, 1978), Appendix A.

Information relevant to each maneuver area includes identification (name and location); size and shape; type of maneuver area (adaptation of the area to specific uses -- such as APC training course, infantry assault area, cavalry unit training area, mobile Army surgical hospital [MASH] training area); natural features (general terrain, vegetation, soil types, wildlife habitat, hydrologic features); limitations due to natural features (area of rock slides, wetlands, protected wildlife habitat, eroded areas); capacity of the area for specific training units (size of training units and types of training activity which site limitations allow); limitations due to adjacent land uses (such as a nearby urban community or highway traffic); access route to, from, and through the maneuver area; current use and use coordination; fire lanes and fire precautionary measures; military and nonmilitary features that occur in the area; and precautionary measures associated with such features.

### Terrestrial Animal Parameters

1. Game animal populations: Information is needed on estimated population size of game species (very few, moderate, abundant); variations in food and cover needs; influence of seasonal cycles of stress on crop or rangeland management programs; relevant information includes:

a. Species resident year-round -- specific habitat requirements, population dynamics

b. Species resident during nesting season or winter residents; specific habitat requirements to be protected or developed

c. Migrant species using the area for short periods of time.

As deer and antelope on rangelands compete with livestock for forage, variations in the population of these species may affect the periods and intensity of livestock use. Adjustments for game populations in croplands may be made by reducing pesticide application, reducing mowing activities, planting hedges and borders, leaving plant residues on field, or leaving patches of crops unharvested.

Agricultural out-lease managers need to know the laws regulating hunting, the areas on-post where hunting is permitted, the beginning and ending of seasons for each game species, the procedures for allowing hunters on post, and the liabilities of lessee and lessor in cases of injury to livestock, equipment, or persons. Livestock may have to be removed from ranges during particular hunting periods.

2. Non-game animal populations: Animals not hunted or trapped for food or other uses; nonpredatory animals; information should be known about population size (very few, moderate, abundant); food and cover needs, seasonal stress cycles, habitat requirements, migration patterns, predators' habitats, size, distribution, and behavior.

3. Populations (specific):

a. Size: Number of individuals belonging and remaining in a given population of managed species; described by sex and age; influenced by mortality, immigration, emigration; include necessary data to plan management programs. Conduct a census semiannually -- more frequently for threatened and endangered or indicator species; note year-to-year trends.

b. Reproduction: Number of individuals born into a species population; note evidence of reproduction from nest exams, placental scars, trapping. Indicates habitat quality, population trends, quotas allowable, etc. Evaluate at least once per cycle for managed species.

c. Sex ratios: Proportion of a managed population indicating female/male individuals. Useful in determining reproduction potential, hunting quotas, etc. Evaluated with population size assessments.

d. Movement: Movement by groups or individuals within or between habitats. Useful for determining requirements of given fauna; may indicate changing habitat conditions (abnormal). Seasonal monitoring, particularly of managed groups.

e. Mortality: Proportion of a given population dying per year; indicates trends in species population dynamics, habitat quality, and habitat suitability. Detailed with respect to causes (hunting, predation, road kills). Assess annually for possible trends.

f. Migration: Regular seasonal or annual movements; generally predictable and resulting from normal changes in habitat; important to distinguish from nonmigratory or random movements. Migration must be considered when military activities are planned. Once information is established, update periodically for changes in the types of species managed.

g. Diet: Animal and vegetable matter consumed by managed species; information on diet is derived from fecal exams, rumen analysis, etc. Useful in determining future dietary needs, adequacy of range, carrying capacity; know composition and quantity of foods consumed. Depth of analysis depends on value of species and impact on other forms; note seasonal variations.

h. Browse and forage: Twigs, shoots (with or without leaves) of shrubs, trees, or woody vines used as food by fauna; consider only material which is accessible (exclude treetops, restricted areas, etc.). Nutritional value assessed in addition to density and quantity per unit effort; include availability and nutrition information. Rough estimate needed to determine carrying capacities and suitability of a given habitat for given fauna.

i. Scat exams: Solid wastes from any of a number of mammalian carnivores; indicates feeding dynamics, predator-prey relationships. Examine periodically as found.

j. Pellet exams: Analysis of solid digestive remains from owls, raptors, etc.; indicate feeding dynamics, predator-prey relationships. Periodically examine as found.

k. Economic value: Subjective and objective economic value placed on a given species in terms of hunting and fishing income, use as a food source,

balanced populations (e.g., predators), food webs, aesthetics, and recreation. A value, which may be positive or negative, is assigned to each species and used as weighting factor in planning.

l. Winter stress: Loss of viability, resulting from abnormal or severe climatic conditions; indicates need for management procedures to maintain balance; may indicate shortages of resources. Periodic monitoring is necessary during harsh conditions, more often if stress is suspected or if fragile fauna are present.

m. Carrying capacity: Maximum number of animals in a given population that can be supported by the minimal resources available in a given area; often determined by limiting factors of critical resources. Should be estimated for each species managed; level of accuracy should reflect the significance of that species. Important in determining optimal population sizes, hunting quotas, and habitat requirements.

n. Breeding habitat: Location of, numbers, and conditions of known or potential habitat for breeding pairs of managed species; useful for projecting reproductive potential, carrying capacity, and habitat quality. Evaluate during or before breeding season; consider seasonal variation; can be derived from general habitat assessment.

o. Critical area: Identification, location, and susceptibility to impact of those areas determined critical for maintaining managed species; may include early feeding sites, overwintering grounds, breeding sites. Complete evaluation followed by annual monitoring, noting seasonal patterns.

4. Predator-prey interactions: Largely behavioral assessment of food-web interactions among fauna. Useful in determining carrying capacities; inferred from known relationships and fecal exams. Use information from population censuses.

5. Avian fauna: Families, genera, or species of birds known or believed to inhabit area under consideration. Evaluations of niches and value should be made; subjective and objective evaluation of the birds' condition. Periodic census, considering seasonal changes.

6. Migratory species: Those species moving seasonally from one location to another. Special consideration should be given to known or suspected migratory bird species; assess content, numbers, habitat use, food, breeding. Monitor during appropriate season.

7. Mammalian fauna: The families, genera, or species known or believed to inhabit an area under consideration; note value, niche, and condition. Periodic census following complete survey of selected species, noting seasonal changes.

8. Herpetological fauna: Families, genera, or species of reptiles and amphibians known or thought to inhabit an area under consideration; note values, niches, and conditions. Periodic census following complete survey.

9. Invertebrate fauna: Identification of invertebrates, especially arthropods and mollusks, known or thought to exist in an area under



consideration; significance as indicators, pests, parasites, and food should be known. Annual census following complete survey, considering seasonal variations.

10. Threatened or endangered species: Species officially listed (or under consideration) as threatened or endangered by Federal, State, or local government. Includes plant species that are critical for fauna.

Information on these species should include the name and identifying characteristics of each, places where sightings have occurred, locations of favored habitats, and relationships of these habitat locations to training areas. If training activities might negatively affect protected species or their habitats, the installation should know how to control impacts. It may be necessary to restrict training activities in certain areas during breeding seasons or perhaps year-round.

11. Parasites: Composition and numbers of endo- and ecto-parasites found on animals, living or dead; influences carrying capacities; indicates control measures needed; may indicate overcrowding or other imbalances. Spot check dead animals and live specimens when handled for other reasons; special attention to outbreaks and particularly to dangerous species; helps to assess effectiveness of or need for management programs.

12. Pathogens: Virus or bacteria known or suspected of transmitting disease, either in present host or by using host as vector in managed species. Check seasonally on bagged game, fresh carcasses, or culled stock to prevent outbreaks and subsequent faunal imbalances.

13. Nesting sites/density: Location and numbers of breeding pairs of animal species, with consideration of multiple clutching, seasonal variation; estimates future population sizes, suitability of habitat. Occurrence may restrict use of areas, establish game quotas, etc. Seasonal census during known breeding season for each managed species; special consideration to threatened and endangered species, as well as raptors.

#### Terrestrial Plant Parameters

1. Critical area: Identification, location, susceptibility to impact of those areas determined critical for maintaining managed species; may include early feeding sites, overwintering grounds, breeding sites, etc.; must note seasonal patterns. Complete evaluation followed by annual monitoring.

2. Vegetative pattern diversity: Denotes the differences in plant types: (a) many patterns, unusual or outstanding diversity, (b) continuous vegetation, few patterns, common diversity, (c) continuous vegetation, no patterns, little plant diversity.

3. Vegetation type: Describes habitats' physiognomic type -- forest, grassland, cropland, barren, shrub. For each, note species, type, height diversities, distribution of plants, density, shape, ground cover, seasonal variations, susceptibility to fire, tolerance to disturbance. Information used to assess suitability of habitat for projected use, and to determine

quality. It is most effectively presented in map format, indicating location and extent of each type. Evaluate annually.

4. Tree size class: May be distinguished by height, width, and length of branches; classified as over-mature, mature, pole size, or sapling.

5. Overstory density: Thickness or quantity of canopy growth. Helps determine sunlight availability and reproductive potential of ground cover.

6. Forest reproduction: Amount of growth in woodlands; can range from complete regrowth, to 50 percent reproduction, to little reproduction.

7. Ground cover density: Live vegetation (grasses and herbs) and vegetative debris (dead grasses, deciduous tree and shrub leaves, dead branches, pine needles, etc.) on the ground surface; also refers to the total amount of vegetation protecting the ground from the impacts of wind, raindrops and surface water flow; relates to carrying capacity and reproductive potential of fauna; must be assessed according to faunal types and cover requirements. Frequently expressed as percent cover and measured (by sampling) for each vegetative community. The combination of ground cover and canopy provides the vegetative cover (C) factor. The SCS has developed a table to determine the C factor on permanent pasture, range, and idle land.<sup>3</sup>

8. Pest/poisonous plants: Plants, usually introduced, which retard or stop growth and development of beneficial plants (i.e., food or cover resources). May occur as a result of overgrazing or other abuses. Seasonal checks of pest species help determine suitability of land for specified uses. Surveys will help locate system imbalances. The presence of certain plant species may cause physical problems for troops involved in training activities. Typical problem species include those which are poisonous by contact (such as poison ivy and poison sumac) and those which may cut or puncture skin on contact (such as agave, yuccas, smilax, and cactus), some of which may also be toxic. Relevant information concerning such species includes characteristic habitat and locations, recognizable features, type of hazard posed, season of hazard (if any), and methods of preventing, neutralizing, or treating contact problems.

9. Pest/weed species: Plants growing voluntarily that compete and interfere with the growth and reproduction of the harvestable crop or native plants. Usually, these plants benefit from agricultural preparations -- such as tillage and other human soil disturbances. Information should be known concerning the various weed species that might occur on agricultural sites in each region, including their appearance or identification, their life cycles, the problems they present for specific agricultural activities, and measures to reduce or eliminate them. Such measures include chemical treatment, cultivation, controlled burning, and hoeing.

10. Potential natural vegetation: Potential for natural vegetation (existing at a site before human disturbance) to return to its natural growth after use. Time span required for this return, and value or uniqueness of potential vegetation should be determined.

<sup>3</sup> National Range Handbook, NRH-1 (SCS, USDA, July 13, 1976).

11. Species composition: The species which can grow and survive in a specific area under prevailing conditions.

12. Species value: Worth of forest products and other species in terms of potential or realized economic or aesthetic assessment; may be positive or negative. Assessments should be reviewed annually.

13. Height diversities: Differences in the height of ground cover or forest canopies.

14. Distribution of vegetation: Species' patterns of location; usually a mixture of types within a physiognomic division. Exact boundaries often difficult to define.

15. Successional stage: Degree of advancement of vegetation towards ecological climax state; varies with species composition; gross correlation with energy state and productivity of habitat (i.e., climax often less productive and diverse). Should be assessed annually and incorporated into long-term analysis; used to determine areas for manipulation (e.g., burning retards succession) and to project future capacities of habitat.

16. Tree growth/yield: Annual production of new branches and twigs; used to indicate cover availability and successional stage; determines browse and forage capacity. Seasonal census should be taken, noting year-to-year trends. If the growing stock on the area is maintained at the proper level for optimum use of an area's growth capacity, then the cut or removal of timber products must not exceed the growth increments added to that growing stock, either annually or periodically.

17. Shrub growth: Annual production of leaves, twigs, and shoots, especially those used as food and cover; helps determine habitat vigor and potential food resources, in addition to browsing capacity and activity. Annual elevation should be done, mostly during active growing season.

18. Grass growth: Annual production of grass; used to determine grazing capacity, to give baseline data for grazing activity, to assess carrying capacities, and to indicate soil conditions. Monitored at all stages of growing season. Monthly censusing should be adequate.

19. Mast production: Annual output of plant fruit (acorns, walnuts, nuts, conifer seeds) used as food by animals; indicates carrying capacities, winter food supplies, and habitat vigor. Assess biannually for items known or believed to be used by managed fauna.

20. Cavities: Generally dead or dying trees, often near or at climax stage; a given number for each bird species are necessary to provide habitat. Minimum cavities necessary for species in area should be maintained when cutting. Yearly assessment is correlated with population numbers and management plans.

21. Seasonal variations in vegetation: In many climates, vegetation changes significantly from season to season. During cold seasons, changes include the loss of foliage on deciduous trees and shrubs, increases of dead ground vegetation, decreases in living ground vegetation. Seasonal changes in

vegetation affect training activities through: changes in concealment that vegetation provides to troops and vehicles; changes in noise absorption capacity; changes in type and degree of ground cover, which affects the protection against erosion and compaction that vegetation provides to soils; and changes in the susceptibility of vegetation to fire.

22. Susceptibility to fire: The susceptibility of a vegetative community to fires is an important element in fire control programs. Relevant information includes: seasons or periods of increased susceptibility to fire (moisture retention characteristics); burning characteristics (heat of fire, rate of spreading, smoldering); response to control procedures (controlled burning, fire lanes, overgrazing, etc.); restrictions to training programs; and ecological response of fires and impact of fires on wildlife habitat.

23. Disturbance tolerance: The ability to maintain normal growth and regular functions once vegetation has been disturbed, either naturally or by humans. Information on tolerance levels is important for determining training activities, agricultural uses, etc.

24. Protected plant species: Information should be known about the presence (or likely presence) of all plant species protected by Federal, State, or local laws. Relevant information concerning these species should include the name and identifying characteristics of each plant species, places where sightings have occurred, the locations of favored habitats, and the relationship of these habitat locations to training areas. If training activities might negatively affect protected plant species or their habitats, measures to control such impacts should also be known. Training activities may have to be restricted in certain areas during the growing season, or perhaps year-round.

25. Vegetative concealment: The extent to which surface vegetation conceals foot troops and vehicles from aerial and ground observation, and from flat-trajectory fire of small arms. Concealment from ground observation is affected by the height, spacing, and shape of trees, shrubs, and ground strata, and by seasonal variations within each stratum. Concealment from aerial observation is affected by the height, shape, density, and seasonal variation of the canopy cover. Taller, denser, and fuller vegetation provides the most effective cover. Concealment requirements vary considerably with the type of training unit (e.g., infantry, artillery, armored), the size of unit (e.g., platoon, company, brigade, battalion), and the type of training activity (e.g., exploitation, disengagement, attack). Seasonal variations affect the protection and concealment that vegetation affords. Nonwoody ground vegetation generally provides insufficient cover.

26. Forest resource maps: Specifically identifies the land areas where forest products will be harvested. Information about the location and productive capacity of forest resources can be compiled from field survey data. Site index survey data is needed. Areas of each are mapped geographically, and acreages can be determined.

27. Forest type maps: The data needed to begin development of a management plan. All management activities have to be based on a thorough knowledge of the resources available, their location's accessibility, and their relative value. Timber stand boundaries should be mapped and acreages determined.

28. Forest classification: Timber stands are classified by:
- a. Site -- potential productive capacity (i.e., high, good, fair, poor, nonproductive).
  - b. Stand origin determined and coded as (1) natural regeneration (e.g., deriving from fire, logging, old field, invasion, and (2) artificial regeneration (derived from seeding or planting).
  - c. Species composition -- major aspects (70 percent of basal area [BA] or volume).
  - d. Size classification -- sapling, pole, small saw, large saw. Land areas are classified by productivity classes: Site I, high; Site II, good; Site III, medium; Site IV, fair; Site V and less, poor.
29. Forest climate: Microclimate defined by wooded areas: influenced by wind parameters (occurrence, frequency, damages, prevailing seasonal directions); snow and ice (occurrence and damages); and floods (frequency and duration).
30. Plant associations: Plant community possessing a definite floristic composition in a given ecosystem; an interrelationship between physical (climate, soil, topography) and biological factors (e.g., animals, plants, microorganisms).
31. Temperature survival data: The range of temperatures in which a species can survive; includes minimum, maximum temperatures, resistance to freezing and heat: extremes may limit growth or kill the species.
32. Light tolerance: Ability of plants to adapt to different levels of sunlight; ability to survive a deficiency of light; ranges from tolerance, to partial sunlight, to full sunlight.
33. Moisture tolerance: Ability of plants to adapt to different levels of moisture; ability to survive a deficiency of moisture; known minimum and maximum requirements; and ability to withstand flooding or drought.
34. Species natural range: The geographic area occupied by a species; the natural distribution or occurrence of a species geographically described; includes various habitat conditions (climate, precipitation, temperature, soils, topography).
35. Species population data: Information covering characteristics of terrestrial populations; includes species type, reproductive habits and requirements, growth and yield data, reaction to competition, and principal enemies of species.
36. Natural regeneration potential: The potential for new plant growth by natural processes; re-establishment of vegetation relevant to all-aged management systems, or even-aged management systems.
37. Artificial regeneration potential/methods: Aiding plant establishment by mechanical systems: seeding, planting, tree spacing, brush removal.

## Terrestrial Man-Influenced Biotic Parameters

1. Human use of range and habitat: Patterns of range and habitat use by humans; nature of use, season, damage, reason for use should be noted. Includes behavioral effects on wildlife, disturbance of breeding. Useful in determining range of tolerable usage, need for exclosures. Should be assessed yearly, noting seasonal and long-term trends.

2. Impacts from hunting and trapping: On-post hunting activities in the training environment are affected by, and may affect, training activities. The hunting program must be coordinated with training, fish and wildlife management, agricultural outleases, and other on-going activities to minimize interferences.

Information relevant to this coordination includes name and identification of game species; favored habitat and distribution of game species; all areas on-post where hunting is permitted or prohibited; beginning and end of hunting seasons (or days within the season) for each game species; permitted use of post roads and other facilities by hunters (and prohibited use of roads and facilities); and authority on-post for permits, regulations, and enforcement of the hunting program.

In addition, fish and wildlife managers need to know the number of animals taken by hunters and trappers; this activity should be evaluated yearly, with seasonal and long-term trends noted.

Agriculture out-lease managers should determine estimated populations of game species; they should know how food and cover needs and seasonal cycles of stress may influence cropland or rangeland management programs. Variations in the populations of these game species may affect the periods and intensity of livestock use. Adjustments for game populations in croplands may be made by reducing pesticide applications, reducing mowing activities, planting hedges and borders, leaving plant residues on fields, or leaving patches of crops unharvested.

3. Vehicular damage: On- or off-road damage to habitat and subsequent effects on wildlife; includes erosion, road kills, salt poisoning (winter), interruption of movement patterns. Should be assessed yearly, noting seasonal and long-term trends.

4. Wildlife management sites: Areas which are managed for the improvement of wildlife habitat and food resources. Generally, wildlife enhancement programs are designed for specific game species -- such as quail, wild turkey, deer, rabbit, or pheasant. Management activities include: plowing strips to improve seedbeds for native grasses and forbs, planting crops on selected plots to provide supplemental food resources, fencing areas of key habitat to keep out livestock; leaving unharvested plots on harvestable croplands; controlled burning to improve conditions for certain food-producing vegetation; protection of stream side cover; planting of or promoting forest growth of preferred food species; leaving and maintaining den trees for small mammals; regulating size of cutting units to maintain good distribution of protective cover.

Relevant information concerning such programs includes: location of food plots and other enhancement sites; restrictions to training activities associated with these plots or sites; procedures for coordinating enhancement measures (such as controlled burning) with training use of the land; procedures for determining sites for food plots, controlled burning, fencing.

5. Managed forests: Areas where forest management and harvesting activities occur. These activities must be coordinated with training on the land. Information relevant to this coordination includes: areas on-post where forest management and harvesting activities are permitted or restricted (such as live fire and permanently duded areas); impacts of training activities on harvestable timber (such as damage to trees by cross-country maneuvers); identification of areas used for training (such as live rifle fire) that might result in trees unsuitable for wood products; procedures to coordinate training use of the lands with forestry activity; use of installation roads, water supply, and other facilities by forestry personnel; identification and access procedures for forestry personnel not from the installation; relationship of forestry program to fire control; identification of areas in forest management where training use is restricted (such as areas with seedlings); procedures used in determining sites for harvesting, fire control, and other forest management activities.

6. Seeding: The process of planting seeds to improve range condition, to reduce erosion, to improve soil stability, and to improve soil water retention; specific programs for seeding may be included in out-leasing arrangements. Records of seeding should specify the location and description of the land involved, including its condition, soil type, slope, the type of terrain, the seeding method, and the date and the number of acres seeded. The species seeded, whether they are native or adapted, and the seeding rate should also be indicated. When more than one species was seeded, note whether a mixture of seed was used, or whether the seed of one species was exhausted before the seed of a second species was sown. A manager should have access to such records to evaluate the success of the program and to plan future seeding programs. Consult the local SCS for guidelines on seeding rates, seed planting depths, row spacing, and seed purity.

7. Controlled burning: A management tool to improve forage production on grazing lands, to improve wildlife habitat, to release vegetative nutrients into soils on cropped or grazed lands, to reduce the hazards of uncontrolled fires in forests and grasslands, or to provide a favorable environment for certain fire-resistant species. Before an installation can begin a controlled burning program, information is needed about topographic characteristics, climatic conditions, wildlife populations, and soil and vegetation moisture conditions. Considerable preparation and coordination with on- and off-post fire control and other authorities should be done. Records should be available that specify the date, conditions, location, and success of previous controlled burns. Preparation should include establishing firebreaks (and other measures to contain fires), and monitoring wind, temperature, and moisture conditions. Disturbances of wildlife populations, especially ground nesting birds and animals, should be considered. Annual surveys of burning extent should be used in deciding where and how much prescribed burning is needed to maintain levels established by the management plan.

8. Brush control: A management practice used to make sure that brush will not interfere with other resources in the area. Brush control records should specify target species and identify location, date, and cost of control activity, and the type of control employed (controlled burning, mechanical removal, or chemical treatment). A summary of control programs should also include side effects, such as impacts on nontarget species and wildlife. Brush control activities may be a significant factor in range management plans; specific programs for control activity may be written into grazing leases. In addition, brush control affects wildlife habitat and therefore should be coordinated with wildlife management programs.

9. Mowing: managers should know the areas requiring mowing, and the average rates of growth. This information will allow them to determine mowing intervals, as well as the positive and negative impacts of mowing activities. Mowing may be necessary for controlling weeds, for reducing fire danger, for establishing a zone to deter spreading fires, for aesthetic and recreational purposes, or for increasing visibility near roads. However, mowing can affect wildlife habitat because unmowed areas may provide refuge for ground nesting birds, small mammals, herps, and other animals. Mowing can reduce the vigor of some perennial herbs and grasses, and mowing equipment may compact soils. Management plans, especially for croplands, may include regular mowing programs; leases may require mowing of specific areas (e.g., within 20 ft [6 m] of fences) at specific intervals. Relevant specifications include mowing height, frequency, locations, and mowing equipment.

10. Fertilization: The application of an organic or chemical substance making the land or soil capable of producing more vegetation or crops. For an effective fertilization program, the soil should be analyzed, appropriate fertilizer and application equipment should be chosen, and a follow-up should be done to evaluate the program.

11. Cultivation: Preparing the soil by breaking it up or loosening it to promote crop growth. Relevant information includes location of crops, methods, frequency, and equipment.

12. Pruning: The removal of live or dead branches from standing trees (usually the lower branches of young trees), and the removal of multiple leaders in plantation trees to improve their growth; also, the cutting away of excess growth, including roots, from any plant to improve its development. Important factors to be considered include location of the pruning, the species to be treated, methods and equipment to be used, and the frequency of the pruning.

13. Agricultural components: Parameters of particular interest to natural resource managers responsible for agricultural out-leases.

a. Agriculture/recreation coordination: All concurrent recreational uses of lands out-leased for agricultural purposes should be known. Relevant information includes the season (or dates) and nature of the recreational use, the means of access to those sites, and the effect of recreational activities on agricultural land use. These activities might include hunting, fishing, hiking, and camping. The lessee should be informed about such uses; it may be necessary to indicate recreational land use arrangements in the agricultural leases.



b. Accessibility to leased lands: Includes physical as well as legal access. Physical access pertains to: location of entrances, location of roads in relation to the lease site, whether Army land must be crossed to reach the site, and the presence of fences and gates. It should be realized that Army maneuvers may restrict this access at certain times. Legal access includes policies governing access, such as permits required for admittance to the installation, age of individuals allowed on installations, responsibilities or liability of the Army in case of accident.

c. Range suitability: Certain lands may not be suitable for grazing programs due to severe natural limitations. The Bureau of Land Management uses the following guidelines to prepare environmental impact statements:

- (1) Areas where the distance of water is greater than 4 mi (6.4 km)
- (2) Ranges where the carrying capacity requires more than 32 acres (12.9 ha) per animal unit month (see p 95).
- (3) Areas where slopes are greater than 50 percent
- (4) Areas where soil surface factors (SSFs) exceed 60.\*

These general guidelines are valuable to rangeland managers in assessing the suitability of lands with severe environmental restrictions.

d. Type of grazing land: Grazing land may be categorized according to its use and vegetative type. Measurements of total annual production vary according to the type of grazing land. The three major categories are:

Rangeland -- Land on which the native vegetation (potential climax community) is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. Rangeland includes natural grasslands, savannas, many wetlands, some deserts, tundra, and certain forb and shrub communities.

Grazeable woodland -- Forest land which is managed primarily for a purpose other than grazing; at least periodically, the land produces enough understory vegetation suitable for forage that can be grazed without significantly impairing wood production and other forest values.

Native pasture -- Land on which the native vegetation is forest, but which is used and managed primarily for native plants for forage. It includes cutover forest land and forested areas that were cleared and used as cropland.

e. Range site delineation: A range site is an ecological unit. It is delineated according to the presence of a distinct plant community which differs from those on surrounding range sites. Criteria for defining a range site are: (1) dominant species in the plant community, (2) proportion of a particular species to the total population, and (3) total annual production. Vegetation parameters are often indicative of other factors, such as salinity

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\* Soil surface factor (SSF) is a measurement used by the Bureau of Land Management to indicate soil erodibility. SSF takes into account soil movement, surface litter, erosion pavement, pedestalling, rills, flow patterns and gullies.

of soil or depth to the water table. Management techniques are based in part on the type of range site being used.

f. Potential rangeland climax plant community: The climax community is the dominant plant community on the range site in the absence of disturbance. In many cases, this consists of the original native plant community. Sometimes, however, a vegetative community has been altered so that introduced plants, frequently annuals, will prevail. Non-native vegetation then comprises the potential plant community. The range manager should know the major plant species and the percentage of each in the total climax community. The composition of the climax plant community is used as a standard by which to measure range conditions. The actual range composition is compared to that of the potential climax community, and a range condition class is determined. Management plans are based partially on range condition classes. However, ranges are not normally managed to produce a climax plant community, but rather are managed to maintain a balance between desirable forage species and good range condition.

g. Range composition: The plant community present on the range. Composition is recorded in terms of major species, their percent contribution to the existing plant community, and their air-dry weight per acre (hectare). In a qualitative assessment of range condition, the installation should consider the health of plants, noting those species which are desirable as forage or as members of the climax community, and which are protected by Federal or State law. With this information, management plans can be developed.

h. Range condition class: Based on the number of each major species present on a range site, a comparison is made between the actual range condition and the climax condition. A condition class is then assigned the range site (Table A6).

Information concerning range condition class is used in developing range management plans; this information should be periodically reviewed. Range

Table A6

Determining Range Condition Class

Range Condition Class	Percent of Present Plant Community Which is Climax for the Range Site
Excellent	76 to 100
Good	51 to 75
Fair	26 to 50
Poor	0 to 25

condition can be affected not only by intensity of grazing use, but also by levels of precipitation and levels of nongrazing use (e.g., military). Poor range condition may require a reduction in any or all uses adversely affecting the range.

i. Retrogression patterns: When a range site is overgrazed or otherwise abused, the composition of the plant community begins to change. Retrogression (the opposite of succession) is the series of events by which one plant community replaces another in the process of deterioration. Particular indicator species are involved in the retrogression pattern for specific plant communities; managers should know these species and the order in which they invade a site.

In describing this process, the terms "increasers," "decreasers," and "invaders" are sometimes used. "Decreasers" are climax plants which decrease in vigor and in number with overgrazing. Similarly, "increasers" are members of the climax community which increase in number under adverse conditions. "Invaders" are weeds not normally a part of the climax community which come into an abused area. The difficulty with these terms is that they are relative: one species may be an increaser under some conditions and a decreaser under others. Desirability is also not accounted for in this context. Decreasers are usually the more acceptable members of the climax community and invaders usually less acceptable; however, this is not always true. The number of increasers or decreasers present cannot be directly correlated with range condition.

j. Range trend: Any range management plan must take into account trends in range condition over a period of years. Steadily deteriorating range condition indicates that less intensive use should be made of range resources; seeding and other improvement measures should be started to arrest this deterioration. The use of forage by livestock eventually leads to changes in range condition. The following are indicators of such use:

(1) Age classes of key species -- seedlings, young plants, and mature species should be present. Since livestock prefer young plants, a stand of exclusively mature plants indicates overuse;

(2) Use of plant growth more than 1 year old;

(3) Evidence of browse lines -- browse is that part of tree and shrub growth available for grazing. A distinct browse line indicates that all browse within reach of livestock has been grazed;

(4) Relative size of plant parts -- overgrazing leads to production of small, weak leaves;

(5) Condition of animals -- severely deteriorated ranges may produce unhealthy animals; however, a range which is overgrazed may produce healthy animals. Thus, the presence of healthy animals does not necessarily indicate good range condition.

Changes in range conditions may be due to grazing management practices or environmental conditions (such as severe storms or periods of drought). Range

conditions need to be monitored year after year to determine the relationship of these factors and to develop the most effective management plan.

k. Total annual production: In general, the above-ground parts of all plants -- except mosses and lichens -- within a designated area are considered in this measurement. (On grazeable woodland and native pasture sites, plant material beyond the reach of grazing animals -- above 4-1/2 ft (1.4 m) -- is not measured. On rangeland, this material is measured.) Also not included in total annual production measurements are underground parts of plants, and, in trees and shrubs, increases in stem diameter and production from previous years.

Total annual productivity may be separated into three categories: herbage production, woody plant production, and production of forage species. Usually, total annual production is determined from sample plots measured in terms of dry weight of plant material, and expressed in pounds per acre (kilograms per hectare).

This parameter is important in assessing range conditions and range trends, and in determining range carrying capacity. The parameter should be measured yearly.

l. Forage plants' physiological need: The degree or percent to which forage species can be grazed without physiological damage. Generally, vigorous plants produce more above-ground foliage than they need for maintenance and reproduction; it is this excess which can be safely harvested by grazing animals. If plants are grazed beyond this, they become less competitive and more susceptible to damage.

m. Proper use factor (PUF): A numerical value which indicates the volume or percent of major forage plant species which may be safely grazed; may also be expressed as the percent of forage plants which must remain unharvested if these species are to remain vigorous. The value is based on the physiological needs of plants and on the range management objectives. For example, management objectives to increase vegetative ground cover or improve wildlife habitat may result in a lower PUF than a management objective to maintain current range conditions. PUF is considered when determining the amount of forage available for grazing.

n. Key species on rangeland: One to three species are designated as key species for a grazing site based on the following criteria:

(1) Palatability -- higher use made of a plant by a particular animal in a particular season than of associated plants;

(2) Percent composition -- provides more than 15 percent of the readily available forage in a grazing area (or has high productivity, or is critical to the needs of grazing animals);

(3) Compatibility with management objectives -- for example, if the objective is to improve range condition class, key species should be members of the climax community.

The criteria listed above are needed to determine location of key areas and to formulate stocking rates.

o. Key areas on rangeland: Key areas of a range are more desirable and hence more heavily grazed than others. Factors such as availability of water, type of terrain, presence of fences and natural barriers, and palatability of available forage determine whether an area is "key." Management plans should be designed to prevent overgrazing in key areas and underuse of other areas. Techniques such as adding salt and watering sites, and placing fences can encourage more even grazing patterns.

p. Animal unit equivalent: An animal unit (AU) is generally one mature cow of approximately 1000 pounds (454.54 kg), and a calf as old as 6 months, or their equivalent. It is a convenient unit for determining the relative forage requirements and grazing impacts of different kinds and classes of domestic livestock and common wildlife species. The SCS lists AU equivalents, but these may vary locally (Table A7).<sup>4</sup>

Table A7  
Animal-Unit Equivalents

<u>Kind and Class of Animal</u>	<u>Animal-Unit Equivalent</u>
Cow, dry	1.00
Cow, with calf	1.00
Bull, mature	1.25
Cattle, 1 year old	0.60
Cattle, 2 years old	0.80
Horse, mature	1.25
Sheep, mature	0.20
Lamb, 1 year old	0.15
Goat, mature	0.15
Kid, 1 year old	0.10
Deer, white-tailed, mature	0.15
Antelope, mature	0.20
Bison, mature	1.00
Sheep, Bighorn, mature	0.20

Frequently, intensity of range use is figured in terms of animal-unit months, which is the amount of forage required by an animal unit for one month. Because stocking rates are determined by animal units, managers should be familiar with the appropriate animal unit equivalent. Also, the animal unit equivalent is a valuable tool in adjusting stocking rates to wildlife populations that use the same forage materials.

q. Carrying capacity: The number of acres (hectares) to provide adequate forage for a grazing animal over a specific period of time; usually expressed as acres (hectares) per animal-unit month. Factors considered in determining carrying capacity are: total annual productivity (of forage

<sup>4</sup> National Range Handbook, NRH-1 (SCS, USDA, July 13, 1976).

species), the physiological needs of forage species, range condition trend, and management objectives.

14. Insect pests/damage and control: Greater than normal destruction or retardation of growth of flora by insects and other invertebrates; includes damage to trees and any number of abiotic habitat components. For the protection of Army personnel and facilities in training environments, information should be known about the presence (or likely presence) of each pest species that may be a problem.

Information needed on pests includes lists of species known to occur at or near a site, and those species whose home range or habitat is relevant to the site. Managers should be able to recognize or identify various species, and to understand both the associated damage resulting from the activities of each pest or predator, and the type of danger or problem posed (i.e., poisonous bite, disease vector, damage to facilities). Also useful are records of pest population fluctuations and information on life cycles, habitat requirements and natural predators (for possible biological control).

Pest control plans used in forest management and other programs should include data on probability of occurrence for native and introduced species, previous occurrences of insect attack, methods of avoiding or preventing injury or contact (i.e., inoculations, insect netting, snake boots, skin protection), methods of controlling dangerous species (i.e., draining breeding ponds, chemical spraying, introduction of predators), and secondary impacts of control methods.

Insect detection can be done with ground examinations, aerial inspections, and aerial photographs. Seasonal monitoring is necessary to plan control programs; known areas of infestation need to be monitored more frequently.

15. Pests (rodents and poisonous species) damage and control: Such animals include poisonous species (such as scorpions and snakes), annoying birds, gnawing rodents and potentially dangerous large mammals. Loss of habitat or plants through activity of small mammals, mainly rodents, often causes multiple effects. Damage may indicate excess populations or lack of natural predators; should be monitored seasonally, especially in stressful conditions. Monitor more frequently if outbreaks are suspected; assess control procedures.

16. Predators: Organisms which live by capturing and devouring other organisms. Relevant information on predators includes lists of species known to occur at or near a site, data on population fluctuations, life cycles, habitat requirements. Managers should be able to recognize or identify various predators, and should know if the species is serving as a means of pest control or if its activities are causing damage.

17. Poison levels in animals: Quantities of toxins (pesticides or herbicides) found in animals; generally taken from culled stock, fresh carcasses, etc.; may contribute to mortality; may indicate loss of adequate habitat and uncontrolled management practices. Spot checking of animals is recommended, especially when the cause of death is undetermined.

18. Feral dogs/cats: Uncontrolled domestic animals, often reverted to semi-wild state; determine composition and numbers. These animals are a nuisance to all aspects of balanced habitat. Information is used to assess the success of or need for management programs with annual evaluations of population size and distribution.

19. Windbreaks: Location, quantity, and conditions of any natural or artificial barrier to air movements. Windbreaks retard erosion, provide shelter, protect young plants. Spot check conditions following a survey, especially in stressful seasons.

20. Impact of browsing/grazing: Grazing activity (mainly by ruminants) can result in soil denudation, erosion, and inhibition of vegetative growth -- especially when the grazing capacity of an area is exceeded. Foraging effects can be measured as a percentage of current annual growth. Resistance of vegetation to browsing impacts is dependent on plant type. Grazed areas should be monitored seasonally to minimize damage, and to indicate areas needing further management considerations.

Secondary impacts on water quality and aquatic ecosystems can occur due to nearby grazing activity. A yearly evaluation of this impact should be conducted, and long-term trends noted.

21. Forest fire protection: Forest fire protection plans should consist of the following information: (a) fire occurrence data records describing destroyed material and maps showing burned areas; (b) data on whether fire was caused naturally or by humans; (c) fuel hazard data (field survey data) on high-risk areas with concentrated herbaceous fuels and on man-made slash concentrations; (d) fire presuppression plan data -- includes a fire danger rating system developed by monitoring weather conditions, a fire detection plan, fire equipment and tool needs, manpower needs and deployment plan, hazard reduction plan of operations (e.g., fire breaks, burn slash), construction of fire access roads and trails, the development of well-distributed water sources; (e) fire suppression plan data on mobilization and control plans for small and large fires; and (f) a prescribed burn hazard reduction plan for periodic reduction of fuels in forest stands.

22. Trespass data: The following forms of trespassing often occur in large forested areas: boundary line, rights of way and easement violations; encroachment of others on installation properties; cutting and removal of trees. Timber trespassing is a constant threat to high value logs (used as poles, shingle bolts, etc.), and to low value wood (such as Christmas trees). Spray damage from adjacent fields is a form of encroachment which can be extensive and costly. Livestock -- such as cattle, hogs, and other domestic animals -- ranging on an installation may stay in forested areas. Trespassing by four-wheel drive vehicles, motorcycles, and snowmobiles may also occur. This type of trespass can be serious and very difficult to control; patrolling or frequent examination of the area may be necessary.

23. Silvicultural practices:

a. Thinning: The following steps should be taken for pre-commercial thinning of a natural stand of trees -- determine species to be favored as final stand; spot thin for selected crop trees of predetermined numbers per

acre (hectare); slash all trees except those to be left (predetermined number of trees per acre [hectare] desired). For seeded stands of trees, spot thin for selected crop trees and slash all stems except selected leave trees. For plantations, selection thin to desired number stems per acre (hectare) and row thin -- every other row, every third row, etc.

The following steps are normally taken for commercial thinnings of natural stands: determine most desirable species (favored for final crop on this specific site); thin from above -- cutting larger trees (dominants and co-dominants); and thin from below -- select crop trees of desired species to a predetermined basal area per annual cut (BA/AC) (stocking level), saving dominant and co-dominant trees as final crop trees. For seeded stands of trees, spot thin for selected crop trees and slash all stems except selected trees to be left. For plantations, straight selection system from above or below, marking leave stand to predetermined BA/AC; row thin (every second row or every third row, etc.) in (1) one direction only, and (2) one direction then the other. Row thin with selection in intervening rows.

b. Mortality or sanitation cuts: Salvage of dead or dying trees (natural mortality); spot or area salvage of trees killed by insects, disease, fire, windstorms, snow or ice. These cuts are not a planned thinning operation.

c. Rehabilitation plan: A forest management plan which establishes a procedure for rehabilitating nonproductive areas (e.g., regions where it is difficult to establish new stands of trees due to competing species; areas where the invasion of undesirable species creates a problem with the existing stands).

For rehabilitating nonstocked land (brush or grasses and vines), three methods are available: (1) machine-clear brush and debris with land clearing blades, then pile and burn debris; (2) use chemical control methods, and (3) burn and broadcast.

For established stands with severe invasion of other noncommercial species, three methods are available: (1) control burn (ground fire) to control hardwood invasion, and to control some diseases; (2) chemical spray applications -- i.e., 2-4-D or 2-4-5-T; and (3) hand slash competitive species to favor selected species or crop trees.

d. Tree improvement plan: Improving the seed or the planting stock used in stand regeneration programs is becoming more important because of the increasing need to grow more on less land.

Strategies used in a tree improvement plan include: selection of superior trees; developing seed orchards from sapling trees or clonal selection; searching for superior growth performance; planting strains resistant to diseases such as rusts; and developing hybrids for superior growth performance, resistance to disease and insects, and other desirable genetic traits.

e. Pruning: Cutting off dead or unwanted parts of a woody plant to promote better growth.



f. Forest disease protection plan: Any program designed to control or prevent diseases from destroying forest resources. The plan should include types and species probability of occurrence data -- literature review data or experiences data (records of actual occurrence); historical disease attack occurrence data -- types of disease occurring, identification lists, location and extent of occurrence data, damages caused (physical description and economic estimates of damage); disease detection type data -- ground patrol and examinations of stand or tree indicators, aerial detection (direct flights, satellite, aerial photographs, either color, infrared, or satellite). Information on disease control data should include a literature review, direct silvicultural or sanitation cut methods, prescribed burning.

#### 24. Timber contracts:

a. Selected area: Before writing the contract itself, the forest manager must decide what area should be cut. The areas should be sound stands of timber that are high on the priority of the cut schedule developed with the management plan. The sale area conceivably could be in mature timber or in immature stands where a commercial thinning operation is contemplated.

b. Type of cutting: The type of cutting to be done in an area must be determined, including tree-selection cut and clear cut, or some modification thereof -- i.e., strip cutting, seed tree, or shelter wood systems.

c. Type of logging: Methods of timber removal, including clear, selective, partial, and shelter belt cutting.

d. Tree marking: Indicating on individual trees, usually the trunk, which are to be logged; also indicates boundaries. A sale area should be legally defined, with sale area maps prepared for prospective sale.

e. Access routes: Paths allowing exchange of staff, equipment, and wood material from forest to installation. Access routes should be designated and fully described. The specifications for any additional haul roads should be provided.

f. Timber volume: The total amount of timber available for cutting; estimated by species type and by log grades.

g. Description of timber to be cut: Define in terms of merchantable tree (live standing and dead or down trees of merchantable size containing 33 percent sound wood); mini-size merchantable tree (all trees 6 in. [212.4 mm] diameter at breast height [dbh] and up containing one merchantable pulpwood bolt, 4 in. [101.6 mm] minimum top diameter; mini-size merchantable chunk 10 bd. ft and/or 6 ft [1.8 m] long); method of treating trees undesignated for cut that are damaged, felled, or scaled; penalties for leaving merchantable materials on sale area; and stump heights.

h. Period of contract: Length of timber agreements -- i.e., purchaser agrees to cut and remove all merchantable timber from contract area before a specified date.

i. Cutting schedule: Breakdown of the number of units of timber to be cut during the first year, second year, etc. Especially useful if large sale of multiple-year schedule is expected.

j. Scaling procedures: If timber is to be paid for on the basis of units cut, scaling procedures, point of scaling, and units of measure to be used must be defined; estimate content of sound wood in a log or bolt using a given unit of measurement.

k. Environmental protection measures: Precautions taken to minimize damage to local resources from cutting; includes protection of waterways, prevention of erosion or soil damage, and protection of exclusion areas within sale boundaries.

l. Slash disposal/treatments: Disposing of residuals from cutting; includes broadcast burn, pile and burn, wind row and burn, limbs lopped and left in place.

m. Snag provisions: Procedure for removal of a dead tree which is leaning against live trees nearby; removal prevents further damage to healthy vegetation.

n. Fire programs: A program designed to control prescribed fires or prevent natural fires. A fire suppression plan should contain information about equipment distribution, water supplies, and crew training. Responsibilities include taking all practical steps to prevent and suppress fires, and taking initial action in response to a fire in the area.

o. Road maintenance/repair: Upkeep of access routes; define responsibilities for maintenance at the completion of timber sales.

#### Terrestrial General Biotic Parameters

1. Habitat composition: Overall quantity and quality of various habitat subtypes, including groundwater, streams, size of area, topography, and seasonal changes. Complete evaluation once, followed by updates every 5 to 10 years.

2. Special features: Man-made structures -- such as bridges and piers -- which are or may be used by animal species (e.g., barn swallows, owls). Complete inventory with annual monitoring.

3. Habitat use (general): Area traversed, food eaten, cover used, breeding grounds -- for any given population under management. Carrying capacities should be assessed. Yearly review of complete profile compiled largely from other studies.

4. Habitat use (ruminants): Area used, food eaten, cover, movement, by any of a number of hooved animals; information used to aid in planning management programs and to assess carrying capacity. Profile compiled largely from other evaluations; review yearly.

5. Habitat use (birds): Area covered, food eaten, nesting sites, cover used by any given population of birds.

6. Shoreline habitat: Quantity (length), configuration, condition, erosive characteristics of shoreline habitat (i.e., areas next to large bodies of water); annual monitoring.

7. Habitat interface: Type, quantity, and quality of soil and vegetation next to bodies of water which are or may be used as wildlife habitat; changes associated with shifting water levels should be noted; should be monitored seasonally.

8. Openfield/grass habitat: Grass-dominated areas with little or no shrub or tree growth; essential for many browsing animals such as ungulates. Assess and evaluate the quantity and quality of such habitats once during each season.

9. Edge habitat: Area where differing vegetational types intersect. Many species are restricted to such a habitat and the area generally exhibits vegetational and faunal richness and diversity. Annual checks and assessment of quantity and quality over management area should be conducted; adequacy of the habitat is determined by program needs.

#### Population/People Parameters

1. Total family income: Yearly total of a family's income from all members' jobs; measured in thousands of dollars.

2. Educational level of household: Highest year of education of the head of the household.

3. Place of residence: Location of dwellings in which installation members live; may be a house, apartment, barracks.

4. Census region: Enumeration of a population living at a specified time in a designated area.

5. Age: Age in years.

6. Race: Group of people classified on the basis of common history or nationality; e.g., Caucasian, Negro, American Indian.

7. Sex: Male or female.

8. Marital status: Married, single, divorced, widowed, re-married.

9. Family size: Number of related members living in single household.

10. Handicapped: A mental or physical deficiency that prevents or restricts normal achievements; a disability.

11. Days worked per week: Number of days spent at a paying job every seven days.

12. Vacation: Paid or unpaid absence from a job; recorded in number of days per year.

13. Agricultural demand for land: Managers of outleasing programs should know the land use demands in their locality, and how such demands are, or might be, affected by outleasing programs. Factors to consider in assessing demand are off-post land use, and the interest and willingness of the public to bid on leasable lands. Another consideration is the Army's displacement of previous landowners and the previous use of Army lands.

14. Agricultural cost and benefits: Information should be known on the costs and benefits of agricultural outleasing programs to the Army, to the community, and to the ecology. The cost and benefit to the ecology should be assessed in terms of habitat improvements and degradation as well as the effects of pesticides and herbicides.

a. Benefits: Cash income to the Army; the value of lessee-provided maintenance service; the value of conservation benefits; fire protection; the increased security provided by the presence of lessees in noncantonment areas.

b. Costs: The construction and maintenance of agriculturally related facilities; management and coordination efforts of Army personnel; the possible limitations of other uses of out-lease lands; any environmental degradation that might occur (such as increased stream sediment).

15. Agricultural leasing agreements: For agricultural outlease managers to coordinate leasing agreements, information about all Department of Defense and Army regulations relevant to leasing, as well as installation policies and restrictions, should be known. Further, it is desirable to have information on previous installation outlease agreements, prevalent leasing arrangements on neighboring commercial lands, and easements that might be affected. The legal description of available lands and the procedures for coordinating bidding should also be known.

16. Army-induced demands: Additional demands on service facilities made by military personnel. These demands may affect surrounding and dependent communities; includes demand for housing, postal service, recreation, religion, schools, and stores.

17. Cantonment facilities: Structures and facilities used by enlisted personnel for temporary housing and services.

18. Restricted areas: Areas on-base which are confined to specific uses; access prohibited to installation, military, and civilian personnel.

19. Religion: Recognition of different religious preferences on base; providing facilities to accommodate these differences.

20. Life-style: Recognition of life-style preferences; adapting installation resources, entertainment, and recreation to those preferences.

21. Permanent/transient: The percent or number of personnel or residents who are on base permanently or temporarily should be known.

22. Recreational activities: Activities taking place during non-working hours. May be indoor, outdoor, group, individual, strenuous, sedentary; includes arts and crafts, movies, dancing, picnics, games.

23. Displacement of previous users: The transfer of installation residents to another installation or to civilian residences. Should consider financial compensations and psychological effects, especially loss of family heritage.

24. Employment statistics: The numbers or percentages of an installation's military and civilian personnel working on- and off-post.

25. Hunter/trapper/fisherman attitudes: Profile of attitudes, expectations, wildlife and habitat values, preferred species, and activity patterns of hunters, trappers, and fishermen in given areas. Useful in planning conservation programs, management approaches; should be assessed every 2 to 5 years.

26. Hunter/trapper/fisherman economic values: Financial and aesthetic gain (or loss) due to hunting, trapping and fishing activities; consider revenues, losses, conservation values. Should be assessed every 2 to 5 years.

27. Hunter/trapper/fishing quotas: Amount of game that can be removed without hindering reproductive potentials, upsetting faunal balance, or otherwise detracting from overall quality of fauna or flora. Assess every 2 to 5 years in terms of population dynamics, long-range plans, and needs.

28. Storm warning procedures: A system of precautionary measures designed to minimize storm damages to military personnel, either by taking cover or evacuating.

29. Training for storm preparation: The process of educating personnel and residents about storm advances, occurrences, damages, and precautions.

30. Land area ownership: The land manager must know the legal descriptions of all land areas for which he/she is responsible; status of mineral rights and surface rights is included. This data must be developed from recorded deeds, or county court house records. Field identification and locations of all legal corners and property lines must be a part of the management program. These land ownership lease and rental rights are basic to decisions about the use of resources.

31. Land area control: Land may be controlled by long-term or short-term lease or rental agreements, including surface or mineral rights, easements and right-of-ways (for example, power line right-of-ways, pipelines, waterways). Relevant information includes building permits, mining or drilling permits, water rights, and grazing or agricultural rights.

32. Original land survey and corner data: Information needed to re-establish lost corners, and to establish or re-establish property lines that may not have been identified or previously surveyed; corner descriptions are made by original survey crew setting corners and establishing witness trees. May be established (at legally accepted locations), or not established by certified surveying procedures.

33. Plat books: Land ownership data of adjacent Federal, State, county, municipal, or private agencies.

34. Land use/zoning data: A municipal area on-base designated for a particular type of building, enterprise, or activity. On an installation, land uses include areas assigned to operational and training functions, building sites, billeting, barracks, home sites, recreation, and production of natural resources (forestry, minerals, petroleum, grazing, watersheds).

35. Legal descriptions of forestry ownership: Descriptions of land holdings in forested areas; exact boundaries of involved areas should be known. Include corner data (established, nonestablished); property line data (whether established by regular survey or not); original survey field notes.

36. Aims/goals of land owner: Forest managers must know -- and should help decide -- the use of each forested area; areas where forest production is the minor goal and associate uses are the major goals should be identified -- for example, bird sanctuaries, game preserves, watersheds.

#### Surrcunding Area Parameters

1. Substitute recreation areas: The characteristics of recreational areas nearby can greatly influence demand for any recreational area. Before recreation planning can be completed, information about other areas should be known to determine the "need" and projected use of various activities on installations. Substitute areas should be surveyed within 300 mi (480 km) of the installation.

a. Travel cost: Travel costs to substitute areas can be computed from the following: number of people in increments of 5000 living within 50, 100, 150, 200 mi (80, 160, 240, 320 km) zones of substitute areas, and within 200 mi (320 km) of the installation; estimated cost for traveling 25, 75, 125, 175 mi (40, 120, 200, 280 km) should be calculated.

b. Travel time: Number of people living within 1, 2, 3, and 4 hour travel time zones from substitute areas and within 200 mi (320 km) of installation.

c. Fee schedule: Price in dollars of fees charged at substitute areas by activity.

d. Quality: A qualitative description of the recreation areas located within 300 mi (480 km) of the installation should be available to the recreation manager.

2. Off-post agricultural land use: Information on the use of lands surrounding the installation is useful in assessing on-post land use alternatives, including the demand for agricultural uses and the importance of the installation as a wildlife refuge. Such information is also useful in assessing the contributions of on-post agricultural lands to relevant drainage systems, in determining access to leasable sites, and in preventing possible conflicts between off-post and on-post land use.

3. Off-post resources: Facilities and services existing outside installation boundaries; housing, recreational facilities, places of worship, schools, and stores.

4. Off-post land use: Information on the use of lands surrounding installations is relevant to determining the appropriate use of specific training sites. For example, locating on-post firing ranges or airfields near off-post settlements will increase noise and vibration problems in those settlements. The off-post location of a civilian airport may affect the location of on-post air traffic facilities. Generally, off-post land use would most simply be presented on a map indicating, for a specific radius around an installation, the type of land use (croplands, forest lands, parks, urban lands, grazing lands), the locations and extent of each type, and distance from the installation. Off-post features such as communication and transportation facilities are also relevant to the training use of installation lands.

5. Off-post fire protection: The capacity of off-post communities to coordinate fire protection programs and to respond to fires that might involve both military and civilian lands. Relevant information includes: identification of authorities or jurisdiction of fire protection units, and procedures for cooperation and communication in case of fire; capacities of each relevant fire protection unit to respond to fire and other emergencies; coordination of precautionary measures (such as fire breaks, special handling of explosive and toxic substances); methods each relevant fire protection unit employs in prevention and control programs, coordination necessary or advisable for controlled burning programs.

6. Impacts of installation noise on off-post communities: Off-post noise contribution refers to the amount, period, and type of noises generated by training activities and carrying to off-post areas. Such noises are produced by artillery fire, explosives, heavy equipment (construction, road building), and vehicle traffic (especially air traffic, but also ground and water traffic).

Information relevant to off-post noise contribution includes: range of noise audibility at various intensity levels for each training activity that generates noise heard off-post; effects of vegetation and landforms on noise absorption and transmission; effects of winds and temperatures on noise transmission; off-post communities' perceptions of on-post noises (types of disturbing noises, periods of greatest disturbance, areas of most significant disturbances); methods or procedures to reduce off-post noise disturbance.

APPENDIX B  
PARAMETER RANKINGS



SOIL PARAMETERS	DURATION							SEED							AVAILABILITY							TOTAL		
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES			
Fertility	4	3	3	4	3	1	5	AH	4	5	5	2	2	5	4		4	3	5	4	3	5	3	77
Stability	5	5	4	4	5	5	-		5	1	5	2	1	4	-		4	2	4	4	2	3	-	65
Depth to Parental Material/Bedrock	5	4	5	5	4	5	-		3	4	5	2	2	5	-		3	4	4	3	4	5	-	72
Series and Type Classification	5	4	5	5	4	4	-		4	5	5	3	4	4	-		5	4	5	5	4	5	-	80
Soil Horizon/Profile	5	4	5	4	4	5	-		3	5	5	2	2	5			3	4	4	4	4	4	-	72
Texture	5	3	4	4	3	5	5	AH	4	5	5	2	3	4	4		3	4	5	3	4	5	3	83
Structure	5	3	4	4	3	5	-		4	5	5	2	3	4	-		2	4	5	3	4	5	-	70
Consistence	5	3	5	4	3	4	-		3	5	3	3	3	3	-		2	4	4	3	4	4	-	65
Color	5	5	5	3	5	5	-		2	3	3	2	1	3	-		2	4	5	3	4	5	-	65
Reaction	5	4	3	3	4	2	-		2	5	3	3	1	5	-		2	4	3	3	4	5	-	68
Chemical Composition	5	4	3	4	4	2	-		2	5	5	2	1	5	-		2	3	5	3	2	5	-	62
Organic Matter or Content	4	4	3	4	4	4	-		3	5	5	2	1	4	-		2	4	5	3	4	4	-	65
Exchangeable Sodium Fraction	5	3	3	4	3	4	-		1	3	5	3	1	4	-		1	3	5	3	3	4	-	58
Permeability	5	4	3	4	4	5	-		4	4	5	3	4	3	-		1	4	5	3	4	5	-	70
Available Water Capacity	5	3	3	4	4	4	-		3	5	5	3	1	3	-		1	4	5	3	4	4	-	64
Depth to Seasonally High Water Table	5	3	3	4	4	3	-		3	4	5	2	3	5	-		1	3	5	3	3	3	-	62
Soil Capability Class, Subclass, Unit	5	4	5	4	4	5	-		1	5	5	2	1	5	-		1	4	5	4	4	5	-	69
Soil Productivity	5	3	3	4	3	2	-		3	5	5	3	1	5	-		1	4	5	3	3	5	-	63
Susceptibility to Sheet and Rill Erosion	5	3	3	4	3	4	2	AM	4	5	5	3	5	4	5		2	3	4	4	3	4	2	77
Susceptibility to Gully Erosion	5	3	3	4	3	4	2	AM	4	5	5	2	5	4	5		2	3	4	4	3	4	2	76
The Universal Soil Loss Equation (USLE)	5	5	5	5	5	0	-		1	4	5	1	4	2	-		1	5	3	5	4	0	-	60

SOIL PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Soil Loss Tolerance	5	4	5	4	4	5	-	2	4	5	3	2	2	-	1	3	3	4	4	3	-	63	
Rainfall and Run-off Factor	5	4	5	4	4	2	-	3	4	5	2	3	4	-	1	3	3	5	3	4	-	64	
Slope Length and Steepness Factor	5	5	5	4	5	5	-	3	5	5	2	3	4	-	1	4	3	4	4	5	-	72	
Soil Erodibility Factor (K)	5	4	5	4	4	5	-	2	5	5	2	3	3	-	1	3	3	5	3	4	-	66	
Cover & Management Factor	5	2	3	4	3	-	-	1	5	5	3	3	0	-	1	2	3	5	3	3	-	51	
Support Practice Factor (P)	5	3	3	4	3	-	-	1	3	5	2	2	-	-	1	3	3	4	3	3	-	48	
Susceptibility to Wind Erosion	5	4	5	4	4	5	2	AM	3	4	5	3	5	4	5	2	2	5	3	2	5	3	80
The Wind Erosion Equation	5	4	5	5	4	-	-	1	3	5	2	2	0	-	1	2	3	5	2	0	-	49	
Conventional Agricultural Practices	5	4	2	4	4	-	-	3	4	5	3	1	0	-	5	4	5	5	5	0	-	59	
Soil Fertility Improvement	5	2	3	4	2	4	-	3	4	5	2	2	5	-	3	4	5	5	3	5	-	66	
Erosion Control	5	4	3	4	4	4	4	AM	2	5	5	2	3	4	5	2	3	5	4	3	4	4	79
Erosion Control Facilities	5	3	3	5	3	3	-	2	4	5	1	3	5	-	3	3	5	5	3	4	-	65	
Shrink-Swell Potential	5	5	5	4	5	-	-	1	2	5	3	4	2	-	1	3	5	4	3	3	-	60	
Presumptive Bearing Value	5	4	5	4	4	-	-	1	1	5	1	5	3	-	1	2	5	4	2	3	-	55	
Corrosion Potential	5	-	5	4	-	-	-	1	0	5	1	0	2	-	1	0	5	4	0	5	-	38	
Stability/ Bearing Strength of Subsurface Strata	5	4	5	4	4	5	-	1	2	5	1	5	3	-	1	2	5	4	2	3	-	51	
Overflow/Flooding Hazard	4	4	5	4	4	2	-	3	3	5	2	3	5	-	3	3	5	4	3	4	-	66	
ARSD (Unified Classification)	5	-	5	4	-	-	-	1	0	5	1	0	0	-	1	0	5	5	0	0	-	32	
Engineering Data Properties	5	-	5	4	4	5	-	1	0	5	1	5	5	-	2	0	5	4	4	3	-	58	
Soil Analysis	4	3	3	4	4	2	-	3	5	5	2	1	4	-	4	4	5	4	4	5	-	66	
Soil Maps	4	4	5	4	4	4	5	AM	3	5	5	2	5	5	4	4	4	5	5	4	5	5	91
Water Seepage and Retaining Properties	5	-	5	4	5	4	-	1	0	5	2	4	4	-	3	0	5	4	3	4	-	58	

SOIL PARAMETERS	DURATION								NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES		OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	
Erosion from Human Activity	4	2	2	4	2	4	2	AM	4	4	5	3	4	4	5	4	2	3	4	2	3	2	69
Rocks, Bedrock Composition	5	4	5	4	4	5	-		1	4	5	1	3	5	-	1	3	3	4	3	4	-	62
Soil Nutrient Deficiencies	4	2	2	3	2	4	-		3	5	5	2	1	5	-	3	3	5	4	3	5	-	61
Soil Toxicities	5	2	2	3	2	2	-		1	5	5	2	2	5	-	1	2	4	4	2	5	-	54
TOTAL																							3036
Mean																							64.89

CLIMATIC PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Air Temperature	5	3	1	2	3	1	-	5	4	5	3	4	5	-	5	5	5	4	5	5	-	70	
Snowfall (Monthly)	5	3	1	3	1	4	-	5	3	4	3	5	4	-	5	5	5	4	5	5	-	70	
Snow Accumulation	5	1	1	4	1	2	-	5	2	5	3	5	4	-	5	4	5	4	4	5	-	65	
Thunderstorm Patterns (Frequency)	5	2	1	3	2	1	-	5	2	4	2	4	3	-	5	4	3	4	4	5	-	59	
Sunlight Duration	5	5	2	4	5	4	-	5	5	4	1	5	4	-	3	5	5	5	5	4	-	76	
Solar Radiation	5	1	2	3	1	4	-	1	4	4	1	3	3	-	3	5	5	4	5	3	-	57	
Precipitation (Amount)	5	1	1	2	1	1	2	AM	5	5	5	3	5	5	3	5	3	5	4	3	5	5	74
Precipitation (Distribution)	5	1	1	4	1	1	2	AM	5	5	5	3	5	5	3	5	3	5	5	3	5	5	82
Precipitation (Type)	5	1	1	4	1	1	2	AM	5	5	5	2	5	5	3	5	5	5	4	5	5	5	79
Frost Free Period	5	5	2	4	5	1	-	1	5	5	2	4	5	-	5	5	4	4	5	5	-	72	
Winds	5	1	1	3	1	2	2	AM	4	3	5	2	5	4	3	5	4	5	4	4	5	5	73
Evaporation and Transpiration	5	3	1	3	3	2	-	1	5	5	1	3	3	-	3	3	5	3	3	4	-	56	
Storms	5	3	1	4	3	1	2	AM	3	3	4	2	4	4	3	5	4	3	4	4	5	5	72
Length of Growing Season	5	5	3	4	5	3	-	1	5	4	2	4	5	-	5	5	5	5	5	5	-	76	
Degree Days Heating	5	0	1	3	1	1	-	3	0	5	1	3	3	-	5	0	5	4	5	5	-	50	
Degree Days Cooling	5	0	1	3	1	1	-	1	0	5	1	3	3	-	5	0	5	4	5	5	-	48	
Mean Number Days Cloud Cover/Mth.	5	3	1	3	3	3	-	3	4	4	1	4	1	-	3	4	4	5	4	5	-	60	
Snowfall (Number of Days)	5	3	1	4	3	3	-	4	3	4	2	4	1	-	5	4	4	5	4	5	-	69	
Per Month Freeze/Thaw Transitions	5	3	1	3	3	3	-	1	3	5	2	3	2	-	3	3	3	4	3	3	-	53	
Wind Chill Factor	5	1	1	3	1	0	-	3	4	5	1	4	2	-	5	4	4	4	4	5	-	59	
Effect of Temperature Extremes on Equipment	5	4	1	4	5	5	-	1	2	5	1	4	1	-	3	4	3	4	3	3	-	58	
Effect of Temperature Extremes on Transportation	5	4	1	4	5	2	-	1	2	5	1	4	1	-	3	4	3	4	3	3	-	55	

CLIMATIC PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL			
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES
Effect of Storms on Equipment & Transportation	5	4	1	4	5	3	-	1	2	5	1	4	2	-	3	4	3	4	3	3	-	52
Visibility Conditions	5	1	1	2	1	0	-	2	2	4	1	5	1	-	3	4	3	4	4	5	-	48
Attitude of Clouds	5	0	1	2	1	0	-	1	0	4	1	4	1	-	5	0	3	4	3	5	-	40
Humidity (Seasonal Patterns)	5	3	1	4	4	1	-	3	5	4	2	3	5	-	5	3	3	4	3	5	-	63
Humidity (Daily Patterns)	5	1	1	1	1	1	-	3	3	4	2	3	5	-	5	4	3	4	4	5	-	55
TOTAL																						1691
Mean																						62.63

EXISTING STRUCTURAL FACILITIES	DURATION							NEED							AVAILABILITY							
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Corrals	4	4	5	4	4	4	-	1	4	5	2	2	2	-	3	4	5	5	4	5	-	67
Fencing & Gates (Perm & Temp)	4	4	5	5	4	3	-	1	4	5	4	5	2	-	3	4	5	5	4	5	-	72
Protective Barricades	4	4	5	5	3	3	-	1	1	5	1	3	2	-	3	4	5	5	3	5	-	62
Magazines/Igloos	4	4	5	5	4	-	-	1	1	5	1	5	1	-	5	4	5	5	4	5	-	63
Piers/Docks	4	4	5	5	4	4	-	1	1	5	4	2	2	-	5	4	5	5	4	5	-	69
Recreational Structures	4	4	5	4	4	4	-	5	1	5	2	1	3	-	5	4	5	5	4	5	-	70
Open Loading Docks	4	4	5	5	4	5	-	1	1	5	2	2	5	-	5	4	5	5	4	5	-	71
Flag Poles	4	4	5	4	5	-	-	1	1	4	1	2	1	-	5	4	5	5	4	5	-	60
Military Features																						
Radio Towers	4	5	5	5	5	-	-	1	1	5	4	5	1	-	5	5	5	5	5	5	-	71
Mock Villages	4	4	5	4	5	5	-	1	1	5	1	5	2	-	5	5	5	5	4	5	-	71
Bunkers	4	4	5	5	4	-	-	1	1	5	1	5	2	-	5	4	5	5	4	5	-	65
Grandstands	4	4	5	5	5	-	-	1	1	4	1	5	1	-	5	4	5	5	4	5	-	64
Targets	4	4	5	4	4	5	-	1	1	5	2	5	2	-	5	4	5	5	5	5	-	71
Observation Towers	4	4	5	5	5	-	-	1	1	5	4	5	1	-	5	4	5	5	5	5	-	69
Abandoned Airstrips																						
Revetments	4	4	5	4	4	-	-	1	1	5	1	5	1	-	5	4	5	5	4	5	-	63
Pits	4	4	5	4	3	-	-	1	1	5	1	4	1	-	5	4	5	5	3	5	-	60
Concrete Pillboxes	4	4	5	5	4	5	-	1	1	5	1	5	2	-	5	4	5	5	4	5	-	70
Launcher Sites	4	4	5	5	4	5	-	1	1	5	2	5	2	-	5	4	5	5	4	5	-	71
Ammunition Dumps	4	4	5	4	3	5	-	1	3	5	2	5	3	-	5	3	5	-	3	5	-	66
Radar Facilities	4	4	5	5	3	-	-	1	1	5	4	5	1	-	5	4	5	5	5	5	-	67

EXISTING STRUCTURAL FACILITIES	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Dams	4	5	5	5	5	4	-	4	3	5	4	4	5	-	5	5	5	5	5	5	-	83	
Airfields	4	5	5	5	5	4	-	1	1	5	3	5	5	-	5	5	5	5	5	5	-	78	
Helicopter Land Zones	4	5	5	5	5	4	-	1	1	5	3	5	5	-	5	5	5	5	5	5	-	78	
Railroads	4	5	5	5	5	4	-	3	1	5	2	4	5	-	5	5	5	5	5	5	-	78	
Walks	4	4	5	5	4	-	-	4	1	5	2	3	1	-	5	4	5	5	4	5	-	66	
Sanitary Landfills	4	4	5	4	4	5	1	AM	3	1	5	2	4	2	5	5	2	5	5	3	5	4	78
Telephone Network	4	4	5	5	4	4	-	2	1	5	1	4	5	-	5	4	5	5	4	5	-	72	
Radio Network	4	4	5	5	4	3	-	1	1	5	1	4	5	-	5	4	5	5	4	5	-	70	
Cemeteries	4	5	5	5	5	5	5	AH AM	2	1	5	3	4	5	5	5	4	5	5	4	4	81	
Roads																							
Location	4	4	5	4	4	2	-	5	5	5	4	5	-	5	5	5	5	5	-	-	72		
Shoulders	4	3	5	5	3	-	-	1	3	5	1	3	-	3	4	5	5	4	-	-	54		
Bridges	4	4	5	3	4	2	-	1	3	5	4	5	-	5	4	5	5	4	-	-	53		
Culverts	4	3	5	4	3	2	-	1	2	5	3	4	-	3	3	5	5	3	-	-	55		
Signs	4	2	4	4	2	3	-	1	1	5	1	4	-	3	3	5	5	3	-	-	50		
Easements/ Ownership	4	4	5	4	4	4	-	1	5	5	1	4	-	5	3	5	5	3	-	-	52		
Fords	4	2	5	5	2	4	-	1	1	5	1	5	-	3	3	3	5	3	-	-	52		
Length	4	4	5	5	4	5	-	1	2	5	1	5	-	4	4	3	5	4	-	-	61		
Mile Load Classification	4	4	5	5	4	4	-	1	3	5	1	4	-	3	2	3	5	2	-	-	55		
Width	4	3	5	5	3	5	-	1	3	5	1	5	-	1	3	5	5	3	-	-	54		
Surface Condition	4	2	3	4	2	2	-	4	3	5	1	5	-	5	3	3	5	3	-	-	54		
Drainage Improvements	4	3	5	4	3	3	-	1	3	5	1	5	-	3	3	5	5	3	-	-	56		

EXISTING STRUCTURAL FACILITIES	DURATION							NEED							AVAILABILITY										
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL			
Drainage Problems	4	3	3	4	3	2	-	1	3	5	2	5	-	2	3	3	5	3	-				51		
Traffic Reg Facilities	4	4	5	5	3	4	-	1	2	5	1	3	-	3	4	5	5	4	-				58		
Maintenance Responsibility	4	4	5	5	4	3	-	1	1	5	1	5	-	5	4	5	5	4	-				61		
Surface Strength	4	4	3	5	4	4	-	1	3	5	1	4	-	3	2	3	5	2	-				53		
Usage Rates	4	3	3	4	3	4	-	1	3	5	1	4	-	3	2	3	5	2	-				50		
Commercial Traffic	4	3	3	4	3	2	-	1	3	5	3	4	-	3	2	3	5	3	-				51		
Parking Areas	4	4	5	4	4	-	-	3	1	5	1	5	-	3	4	5	-	4	-				52		
Construction							AM																		
Class	4	4	5	5	4	2	-	3	2	5	1	4	-	3	2	3	5	2	-				54		
Length	4	3	5	5	3	2	-	1	3	5	1	5	-	3	3	5	5	3	-				56		
Width	4	3	5	5	3	2	-	1	3	5	1	5	-	3	3	5	5	3	-				56		
Grade Specification	4	4	5	5	5	2	-	1	2	5	1	4	-	3	3	3	5	3	-				55		
Required Structures	4	4	5	5	4	2	-	1	1	4	1	4	-	3	3	3	5	3	-				53		
Volume of Cut & Fill	4	5	5	5	5	5	-	1	1	5	1	4	-	3	3	3	5	3	-				58		
Speed Specification	4	4	5	5	4	5	-	1	1	5	1	4	-	3	4	5	5	4	-				60		
Blasting	4	2	5	5	2	-	-	1	2	5	1	4	-	3	3	3	5	3	-				48		
Steep Grades	4	5	5	5	5	-	-	1	3	5	1	4	-	3	4	3	5	4	-				57		
Buildings																									
Location	5	4	5	4	5	4	-	3	3	5	3	3	5	-	5	4	5	5	4	5	-				77
Wall Type	5	N/A	5	5	5	-	-	1	N/A	5	1	2	1	-	5	N/A	5	5	3	5	-				53
Roof Type	5	N/A	5	5	5	-	-	1	N/A	5	1	2	1	-	5	N/A	5	5	3	5	-				53
Window and Door Type	5	N/A	5	N/A	-	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	N/A	5	-				43	



EXISTING STRUCTURAL FACILITIES	DURATION							NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Floor Type	5	N/A	5	5	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	43
Foundation & Footing Type	5	N/A	5	5	5	-	-	1	N/A	5	1	2	1	-	5	N/A	5	5	4	5	-	54
Paint (Interior)	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Paint (Exterior)	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Electrical Systems	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Elec Distribution System	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Water System (Pot & non)	3	N/A	5	4	4	-	-	1	N/A	5	2	3	1	-	5	N/A	5	5	4	5	-	52
Sewer System, Industrial	3	N/A	5	4	4	-	-	N/A	5	2	3	1	-	5	N/A	5	5	4	5	-	51	
Heating System	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Air Conditioning System	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Ventilation System	3	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	40
Installed Equipment	4	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	41
Lightning Protect System	4	N/A	5	4	N/A	-	-	1	N/A	5	1	N/A	1	-	5	N/A	5	5	N/A	5	-	41
Fire Protect System	3	N/A	5	4	4	-	-	1	N/A	5	1	2	2	-	5	N/A	5	5	4	5	-	51
Permits/Restrictions	4	N/A	3	5	4	2	-	1	N/A	5	1	2	1	-	5	N/A	3	5	4	4	-	49
Water System	3	N/A	5	4	4	5	-	1	N/A	5	2	3	5	-	5	N/A	5	5	4	5	-	61
Steam System	3	N/A	5	4	4	-	-	1	N/A	5	1	2	1	-	5	N/A	5	5	4	5	-	50
Compressed Air System	2	N/A	5	5	4	-	-	1	N/A	5	1	3	1	-	5	N/A	5	5	4	5	-	51
Natural Gas System	2	N/A	5	5	4	5	-	1	N/A	5	1	3	5	-	5	N/A	5	5	3	5	-	59
Coal Storage Facilities	4	N/A	5	5	4	-	-	1	N/A	5	1	1	1	-	5	N/A	5	5	4	5	-	51
Fuel Oil Storage System	3	N/A	5	5	3	-	-	1	N/A	5	1	1	1	-	5	N/A	5	5	4	5	-	49

EXISTING STRUCTURAL FACILITIES	DURATION							NEED							AVAILABILITY							TOTAL		
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES			
On-Post Structural Resources																								
Housing	4	N/A	3	5	3	-	-	1	N/A	5	1	1	1	-	5	N/A	5	5	4	5	-	-	-	48
Recreation	4	N/A	3	5	3	-	-	3	N/A	5	1	1	3	-	5	N/A	5	5	4	5	-	-	-	52
Religion	4	N/A	3	5	3	-	-	1	N/A	5	1	3	1	-	5	N/A	5	5	4	5	-	-	-	50
Schools	4	N/A	3	5	3	-	-	1	N/A	5	1	3	1	-	5	N/A	5	5	4	5	-	-	-	50
Shops, Stores	4	N/A	3	5	3	-	-	1	N/A	5	1	3	1	-	5	N/A	5	5	4	5	-	-	-	50
Artificial Waterways	4	3	5	4	4	4	-	3	5	5	3	4	5	-	2	3	5	5	4	4	-	-	-	68
Archeological Sites	5	4	5	4	4	5	2	AH AM	4	5	4	1	4	5	5	2	2	3	4	2	3	2	-	75
Windmills & Windpumps	4	3	5	5	5	4	-	1	2	5	2	5	5	-	3	3	5	5	3	5	-	-	-	70
Pipeline Pumping Stations	4	4	5	5	5	5	-	1	3	5	1	5	5	-	5	4	5	5	4	5	-	-	-	76
Transmission Lines & Substation	3	4	5	5	4	5	-	1	1	5	1	4	2	-	5	4	5	5	4	5	-	-	-	68
Cattleguards	4	4	5	4	4	3	-	1	5	4	3	4	5	-	3	4	5	4	3	4	-	-	-	65
Cultural & Historic Sites	5	4	5	5	4	4	2	AH AM	4	5	5	1	4	5	5	2	4	3	5	4	4	2	-	82
Storm Safety Facilities	3	N/A	5	4	4	-	-	1	N/A	5	1	4	1	-	5	N/A	5	5	3	5	-	-	-	51
Transportation Fuel Store Area	3	N/A	5	5	4	-	-	1	N/A	5	1	5	3	-	5	N/A	5	5	4	5	-	-	-	56
TOTAL																								566
Mean																								58.97

AQUATIC BIOTIC PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL			
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES
Aquatic Plants	4	-	3	3	-	4	-	1	-	5	4	-	3	-	3	-	3	3	-	3	-	39
Phytoplankton Productivity	4	-	3	2	-	4	-	1	5	5	-	2	-	2	-	3	2	-	3	-	36	
Aquatic Pest Plants	3	-	3	2	3	-	-	1	5	5	2	2	-	2	-	3	2	2	4	-	39	
Fish (Economic Value)	4	-	3	4	-	4	AH	1	4	5	-	5	4	2	-	1	3	-	3	2	49	
Fish (Undesirable)	4	-	3	3	-	-	-	1	5	5	-	2	-	2	-	3	3	-	4	-	35	
Fish Growth	4	-	1	3	-	-	-	1	5	5	-	2	-	2	-	1	3	-	4	-	31	
Fish Parasites	4	-	1	3	-	-	-	1	5	4	-	1	-	2	-	1	2	-	3	-	27	
Fish Populations	4	-	1	4	-	2	4	AH	4	5	5	-	4	3	3	-	3	3	-	4	2	57
Size	4	-	1	3	-	-	-	2	4	5	-	3	-	2	-	3	2	-	4	-	33	
Reproduction	4	-	1	3	-	2	-	1	5	5	-	5	-	2	-	3	2	-	3	-	36	
Movement	4	-	1	3	-	2	-	1	4	5	-	5	-	2	-	3	3	-	3	-	36	
Mortality	4	-	1	3	-	2	-	1	4	5	-	5	-	2	-	3	3	-	2	-	35	
Diet	4	-	1	3	-	4	-	1	4	5	-	3	-	2	-	3	2	-	4	-	36	
Sex Ratios	4	-	1	3	-	-	-	1	4	5	-	1	-	2	-	3	2	-	3	-	29	
Migration	4	-	1	3	-	2	-	1	4	5	-	3	-	2	-	3	3	-	4	-	35	
Stress Periods	4	-	1	4	-	2	-	1	4	5	-	3	-	2	-	3	2	-	4	-	35	
Impact of Fishing Activities	4	-	1	3	-	-	4	AH	1	5	5	-	1	2	3	-	1	2	-	3	2	37
Vehicular Damage	4	-	2	3	2	2	-	1	4	5	4	4	-	2	-	1	3	2	3	-	42	
Invertebrate Fauna	4	-	3	4	-	2	4	AH	1	3	4	-	5	3	2	-	2	3	-	4	2	46
Total																						707
Mean																						17.2

AQUATIC NATURAL ABIOTIC PARAMETERS	DURATION							AH	NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Lakes	5	4	5	5	4	5	5	AH	5	5	5	5	5	5	3	5	4	5	4	4	5	3	96
Drop-off to 5-Ft Depth	5	N/A	5	4	4	-	-	5	N/A	3	3	4	1	-	2	N/A	1	4	2	2	-	45	
Drop-off to 4-Ft Depth	5	N/A	4	4	4	-	-	5	N/A	3	2	4	1	-	1	N/A	3	4	2	3	-	45	
Lake shoreline	5	4	5	4	4	4	5	AH	5	5	4	4	4	5	3	3	3	3	4	3	5	3	87
Streams (Location Size, Flow) Characteristics of Lakes & Streams	5	4	4	3	4	4	4	AH	5	5	5	5	5	5	4	5	4	3	4	4	5	3	90
Temperature	5	N/A	2	2	3	4	-	5	N/A	4	5	3	2	-	3	N/A	3	3	3	3	-	50	
Shoreline Fluctuation	5	N/A	3	3	2	2	-	5	N/A	2	5	5	5	-	3	N/A	2	3	2	4	-	51	
Shoreline Material	5	N/A	5	4	4	-	-	5	N/A	3	4	3	2	-	2	N/A	3	4	3	3	-	50	
Color and Turbidity	4	N/A	3	3	2	4	-	5	N/A	4	4	4	1	-	2	N/A	3	3	2	4	-	48	
Groundwater Resources	5	4	5	4	3	5	-	4	5	3	4	3	4	-	3	3	3	4	3	4	-	69	
Watershed/Drainage/Discharge	5	4	5	3	4	2	-	3	5	5	3	4	5	-	2	3	4	4	3	4	-	68	
Marsh/Swamp	5	4	4	4	4	4	5	AH	3	2	5	5	3	5	3	4	3	5	3	4	5	3	83
Eutrophication	4	3	4	2	3	-	-	1	4	4	5	3	1	-	2	3	3	2	2	3	-	49	
Suspended Solids	4	3	4	2	2	2	-	1	1	4	5	3	4	-	2	2	3	2	3	3	-	50	
Use by Fish and Wildlife	4	4	3	3	3	4	-	3	4	4	5	3	5	-	2	4	3	3	4	4	-	65	
Tides	5	N/A	3	4	3	5	-	4	N/A	5	5	4	5	-	5	N/A	3	5	4	5	-	65	
Inland Waterways	5	4	3	5	4	4	-	2	4	4	5	5	5	-	5	4	3	4	4	5	-	75	
Coastal Waterways	5	4	3	4	4	4	-	2	3	4	5	5	4	-	5	4	3	5	4	5	-	73	
Water Bodies Bordering Lands	5	4	4	4	4	4	-	4	3	4	5	4	5	-	5	4	3	5	4	5	-	76	
Salt Water Types	5	N/A	4	4	4	4	-	2	N/A	4	5	2	3	-	3	N/A	3	4	3	4	-	54	
Total																						1289	
Mean																						54.45	

AQUATIC MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Fishing Area	4	4	3	3	3	4	-	5	1	5	5	2	5	-	3	5	4	4	3	5	-	66	
Boat Launch	4	N/A	5	4	4	4	5	AM	5	N/A	5	2	2	5	3	4	N/A	4	4	4	5	3	72
Swimming Area	4	N/A	5	4	3	4	-	5	N/A	5	2	2	5	-	5	N/A	4	4	4	5	-	61	
Maintained Shore-line/Beaches	4	N/A	5	3	3	4	2	AM	5	N/A	5	4	3	5	4	5	N/A	5	4	4	5	2	72
Reservoir	5	4	5	4	4	5	3	AM	5	5	5	5	3	5	5	5	5	5	4	4	5	2	93
Accessibility From Roads	5	N/A	3	5	4	2	-	5	N/A	4	2	4	5	-	3	N/A	3	4	4	5	-	58	
Water Sites Shared w/nonmil users	4	4	5	4	3	3	-	5	5	5	1	5	5	-	3	5	3	5	4	5	-	74	
Streams (Impoundments Upon)	4	4	5	4	4	4	-	5	5	5	3	3	5	-	4	5	5	4	4	5	-	78	
Livestock Water Needs and Uses	4	4	3	4	3	3	-	2	5	5	3	2	3	-	3	3	3	4	3	4	-	61	
Surface Water Contributions	4	3	3	3	3	4	-	4	5	5	4	3	4	-	3	3	3	3	2	3	-	62	
Surface Water Withdrawal	4	3	3	3	3	4	-	4	5	5	4	3	4	-	3	3	3	3	2	3	-	62	
Water Quality	4	3	1	2	2	2	-	5	5	5	5	4	5	-	3	2	3	3	2	3	-	59	
Pollution Levels	4	3	1	2	2	2	-	5	5	5	5	4	5	-	3	2	3	3	2	3	-	59	
Impact of Grazing on Water Resources	4	3	2	3	3	2	-	2	5	5	5	2	4	-	2	2	3	3	2	3	-	55	
Domestic Water Avail. for Recreation Areas	5	N/A	3	4	N/A	-	-	5	N/A	5	2	N/A	1	-	3	N/A	3	4	N/A	5	-	40	
Irrigation & Its Effects on Water Vegetation	4	4	3	3	N/A	4	-	2	5	5	5	N/A	4	-	2	2	3	3	N/A	3	-	42	
Amphibious Movements & Suitability	4	4	4	4	3	-	-	1	1	5	2	5	-	-	1	4	3	3	3	-	-	47	
Water Rights	4	4	5	4	-	5	-	3	5	5	2	4	5	-	5	3	3	5	-	5	-	67	
Range and Man-euver Sites	4	3	5	4	3	3	-	3	4	5	2	5	5	-	4	5	3	4	5	5	-	72	
Mil/Agricul. Land Use Coordination	4	1	3	4	1	2	-	1	4	5	2	4	5	-	3	3	3	5	5	4	-	59	
Impact Areas	4	N/A	3	4	2	-	-	1	N/A	5	4	5	5	-	3	N/A	3	4	5	3	-	51	
Restricted Areas	4	N/A	3	4	2	-	-	1	N/A	5	4	5	5	-	3	N/A	3	4	5	3	-	51	

AQUATIC MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Mil/Outdoor Rec Coordination	4	N/A	3	3	2	-	-	5	N/A	5	4	3	3	-	3	N/A	3	4	4	4	-	50
Parameters Affected by Training																						
Water Quality	3	1	1	3	2	-	-	5	1	5	5	4	5	-	2	1	3	3	2	3	-	49
Sediment Load	3	1	1	3	2	-	-	5	1	5	5	4	5	-	2	1	3	3	2	3	-	49
Turbidity	3	1	1	3	2	-	-	5	1	5	5	4	5	-	2	1	3	3	2	3	-	49
Total																						1560
Mean																						60.00

TERRESTRIAL NATURAL ABIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL, OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Topographic Maps	5	4	5	5	4	5	5	AM	5	4	5	3	5	5	4	5	4	5	4	5	5	5	97
Terrain Analysis Maps	5	4	5	4	4	-	5	AM	5	4	5	3	5	1	4	3	4	3	4	3	4	4	79
Elevation	5	5	5	5	5	5	-		5	4	4	2	5	5	4	5	4	5	4	4	5	-	87
Slope Length	5	5	5	4	5	5	-		5	5	4	2	4	5	-	5	3	3	4	4	5	-	78
Slope Orientation	5	5	5	4	5	5	-		5	4	4	2	5	5	-	5	3	3	4	3	5	-	77
Landform Variety	5	5	5	4	5	-	-		5	4	4	3	5	1	-	2	3	3	4	4	5	-	67
Rock Form Features	5	5	5	4	5	5	5	AM	5	2	4	2	2	5	4	2	3	3	3	3	4	5	81
Air Quality	3	2	1	2	2	2	-		3	1	5	3	5	4	-	3	3	3	3	3	4	-	52
Topographic Feature Refer	5	5	5	4	4	-	-		3	3	5	2	5	1	-	3	3	5	5	4	4	-	66
Subsurface Vibration Transmission	5	5	3	3	5	-	-		1	1	4	3	4	1	-	1	2	3	3	3	3	-	50
Mass Wastage	5	4	3	3	4	-	-		1	3	4	2	5	1	-	1	2	3	4	2	3	-	50
Tectonic Activity	4	4	3	3	4	-	2	AM	1	2	4	2	4	1	1	1	2	3	4	2	-	4	51
Atmosphere Impacts	2	2	1	3	2	-	-		2	2	5	3	5	-	-	3	2	1	4	2	-	-	39
Aerial Photographs	4	4	3	3	4	2	5	AM	4	5	5	3	5	5	4	5	4	3	4	4	3	5	84
Sites Having Valuable Subsurface Materials	5	5	3	4	4	4		AH AM	1	2	4	2	3	5		3	2	3	3	3	4	-	50
Total																							1018
Mean																							67.87

TERRESTRIAL MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
	Hunting Acreage	4	4	3	4	3	3	-	4	3	5	5	2	5	-	4	4	3	5	4	4	-
Campgrounds	4	4	3	4	3	4	-	5	1	5	3	2	3	-	5	4	5	5	4	5	-	69
Picnic Grounds	4	4	3	4	3	4	-	5	1	5	3	2	3	-	5	4	5	5	4	5	-	69
Off-Road Recreational Vehicles	4	2	1	3	2	4	2 AM	5	1	5	3	2	2	4	3	3	3	5	3	4	2	63
Animal Salt & Mineral Distribution	4	3	2	3	N/A	-	-	1	5	5	4	N/A	1	-	3	4	3	4	N/A	3	-	45
Pesticide Program	4	2	1	3	2	2	-	1	5	5	5	4	5	-	3	3	3	4	3	3	-	58
Structures for Animal Habitat	4	4	3	4	4	3	-	1	1	4	5	1	4	-	3	4	3	4	4	4	-	60
Excavation Sites	4	4	5	4	3	4	4 AM	1	2	3	3	4	5	5	5	3	5	5	4	4	2	79
Trails																						
Hiking	4	-	3	4	3	4	2 AM	5	-	4	3	1	4	3	3	-	3	4	3	5	2	60
Motorcycle	4	-	3	4	3	4	2 AM	5	-	4	2	1	3	4	3	-	3	4	3	5	2	59
Cross-country Skiing	4	-	3	4	2	4	-	5	-	4	2	1	4	-	3	-	3	4	1	5	-	49
Horseback	4	-	3	4	3	4	2 AM	5	-	4	2	1	4	3	3	-	3	4	3	5	2	59
Bicycle	4	-	3	4	N/A	4	-	5	-	5	2	N/A	4	-	3	-	3	4	N/A	5	-	46
Nature	4	-	3	4	3	4	-	5	-	5	4	1	4	-	3	-	3	4	3	5	-	52
Stock Trails & Walkways	4	3	3	4	3	4	- AH AM	3	5	4	2	1	3	-	3	3	3	4	3	4	-	59
Tactical Vehicle	4	2	3	4	2	4	2 AM	3	4	4	2	5	4	4	4	3	3	4	3	5	2	71
Herbicide Program	3	3	1	3	3	2	-	1	5	5	5	3	5	-	3	4	4	4	4	4	-	52
Firebreaks and Fire Control	3	1	3	3	3	2	5 AM	1	4	5	4	5	5	4	4	4	5	4	4	4	2	75
Integrated Pest Management System	3	4	1	4	4	1	-	1	5	5	5	3	5	-	2	4	5	4	3	4	-	63
Noise Levels and Derivation	3	2	3	3	3	-	-	1	1	5	4	5	1	-	3	1	3	3	3	3	-	45
Burying Personnel Waste Materials	4	-	1	3	3	-	5 AM	3	-	5	3	4	1	5	3	-	3	4	2	5	2	56



TERRESTRIAL MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	
Excavating Trenches, Gun Explosives, Foxholes, Fill, Road Surfacing, Earthworks	4	-	3	3	3	-	5	AM	1	-	5	2	5	1	5	4	-	3	4	3	5	2	58
Protected Areas	3	3	3	3	3	4	5	AM	1	2	5	3	5	5	5	3	3	3	4	5	5	2	75
Impact Areas	3	3	3	3	3	4	5	1	2	5	3	5	5	5	3	3	3	4	5	5	2	75	
Range Areas	3	3	3	3	3	4	5	1	2	5	3	5	5	5	3	3	3	4	5	5	2	75	
Coordination of Military Activities with Other Land Uses	3	3	3	3	2	2	-	5	5	5	5	5	5	-	3	4	3	4	4	3	-	67	
Forestry/Mil Coordination	3	3	3	3	2	2	-	5	5	5	5	5	5	-	3	4	3	4	4	3	-	67	
Hunting/Mil Coordination	3	3	3	3	2	2	-	5	5	5	5	5	5	-	3	4	3	4	4	3	-	67	
Agricult/Mil Coordination	3	3	3	3	2	2	-	5	5	5	5	5	5	-	3	4	3	4	4	3	-	67	
Rec/Mil Coordination	3	3	3	3	2	2	-	5	5	5	5	5	5	-	3	4	3	4	4	3	-	67	
Areas Restricted by Access or Noise	3	-	3	4	4	1	-	5	-	4	2	5	5	-	4	-	3	4	4	5	-	56	
Snow Removal	5	2	3	4	2	3	-	1	3	5	1	2	5	-	5	3	5	5	3	4	-	61	
Restoring Storm-Damaged Facilities	3	-	1	5	3	-	-	1	-	5	1	3	1	-	3	-	3	5	2	3	-	39	
Total																						2041	
Mean																						51.15	

MILITARY PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL			
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASERS	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES
Weapons System	3	-	1	4	3	-	-	1	-	5	1	5	1	-	5	-	3	5	5	-	-	42
Electronic Combat	3	-	1	4	3	-	-	1	-	5	1	5	1	-	5	-	3	5	4	-	-	41
Types of Training Units	3	-	1	4	2	-	-	1	-	4	1	5	4	-	5	-	3	4	5	-	-	42
Tracked Vehicles	3	-	2	4	2	5	-	1	-	5	1	5	5	-	5	-	3	4	5	-	-	50
Wheeled Vehicles	3	-	2	4	2	5	-	1	-	5	1	5	5	-	5	-	3	4	5	-	-	50
Fixed Wing Aircraft	3	-	2	4	2	-	-	1	-	4	1	5	1	-	5	-	3	4	5	-	-	40
Amphibious Vehicles	3	-	2	4	2	-	-	1	-	5	1	5	1	-	5	-	3	4	5	-	-	41
Water Craft	3	-	2	4	2	-	-	1	-	4	1	5	1	-	5	-	3	4	5	-	-	40
Cross-Country Movement	3	-	1	4	2	4	-	1	-	5	2	5	5	-	5	-	3	4	5	-	-	49
Training Area Land Requirements	3	-	1	4	2	2	-	1	-	5	2	5	5	-	4	-	3	4	3	-	-	44
Other Training Unit Requirements	3	-	1	4	2	-	-	1	-	5	1	5	5	-	5	-	3	4	4	-	-	43
Engineering Restrictions to Excavations	3	-	4	4	4	4	-	1	-	5	2	5	5	-	5	-	3	4	3	-	-	48
Maneuver Areas	3	3	3	3	3	4	-	1	2	5	3	5	5	-	3	3	3	4	5	5	-	63
Total																						633
Mean																						45.21

TERRESTRIAL ANIMAL PARAMETERS	DURATION								NEED								AVAILABILITY								TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Game Animal Populations	4	3	2	3	3	3	4	AH	5	3	5	5	1	4	4		3	3	3	3	3	4	3	71	
Non-Game Animal Populations	4	3	3	3	3	3	4	AH	5	3	4	5	1	3	4		2	1	3	3	1	3	3	64	
Populations (Specific)																									
Size	4	2	2	2	-	3	4	AH	4	3	5	5	-	4	4		2	2	3	2	-	4	3	58	
Reproduction	4	3	3	2	-	3	-		2	2	4	5	-	3	-		2	2	3	2	-	4	-	44	
Sex Ratios	4	2	3	2	-	3	-		1	2	4	5	-	3	-		2	2	3	2	-	4	-	42	
Movement	4	3	3	3	3	3	4	AH	2	2	4	5	3	3	4		2	2	3	3	2	3	2	63	
Mortality	4	2	3	2	-	3	-		1	2	4	5	-	3	-		2	2	3	3	-	3	-	42	
Migration	4	3	3	3	3	4	4	AH	2	4	4	5	3	3	4		2	2	3	3	2	3	3	67	
Diet	4	3	2	3	-	4	-		1	4	5	5	-	5	-		2	3	3	2	-	4	-	50	
Browse and Forage	4	3	2	3	-	2	-		1	4	5	5	-	5	-		2	3	3	2	-	4	-	48	
Scat Exams	4	2	3	3	-	-	-		1	2	4	5	-	1	-		2	2	3	2	-	3	-	37	
Pellet Exams	4	2	3	3	-	-	-		1	2	4	5	-	1	-		2	2	3	4	-	3	-	39	
Economic Value	4	2	3	4	-	4	4	AH	1	3	4	5	-	5	4		2	3	3	2	-	3	4	60	
Winter Stress	4	2	3	3	-	2	-		1	2	4	5	-	3	-		2	2	3	3	-	3	-	42	
Carrying Capacity	4	2	1	3	-	2	4	AH	1	5	5	5	-	4	3		2	2	3	4	-	3	2	55	
Breeding Habitat	4	3	1	3	3	2	4	AH	1	4	5	5	3	4	3		2	2	3	3	2	4	2	63	
Critical Area	4	3	1	4	3	-	-		3	5	5	5	5	-	-		2	3	3	3	3	-	-	52	
Predator-Prey Interactions	4	4	2	4	-	4	-		1	5	4	5	-	3	-		2	2	3	3	-	4	-	51	
Avian Fauna	4	4	3	3	-	2	4	AH	1	1	4	5	-	4	4		2	3	3	3	-	3	4	57	
Migratory Species (Waterfowl)	4	4	3	3	-	3	4	AH	2	1	4	5	-	2	4		3	3	3	3	-	4	4	57	
Mammal Fauna	4	4	3	3	-	3	4	AH	3	4	4	5	-	4	4		3	2	3	3	-	4	4	64	

TERRESTRIAL ANIMAL PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Herpetological Fauna	4	4	3	4	-	3	4	AH	1	1	4	5	-	3	4	2	1	3	3	-	4	4	57
Invertebrate Fauna	4	4	3	4	-	3	4	AH	1	1	4	5	-	3	4	2	1	3	3	-	3	4	56
Threatened or Endangered Species	3	3	1	2	3	2	-		5	5	5	5	5	5	-	3	3	5	3	3	4	-	65
Parasites	4	2	3	3	-	-	-		1	5	4	5	-	1	-	1	2	3	2	-	3	-	39
Pathogens	4	2	3	3	2	-	-		1	5	4	5	4	1	-	1	2	3	2	2	3	-	47
Nesting Sites/Density	4	2	3	3	-	2	-		1	3	4	5	-	4	-	1	2	3	2	-	3	-	42
Total																						1432	
Mean																						53.04	

TERRESTRIAL PLANT PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	
Critical Area	3	3	1	4	3	3	-	4	5	5	5	4	4	-	3	2	5	3	2	4	-	63	
Vegetative Pattern Diversity	5	4	3	4	4	2	-	4	4	4	4	3	3	-	1	3	3	4	3	4	-	62	
Vegetation Type	5	4	3	4	4	2	4	AH	4	5	4	4	5	4	4	4	3	3	4	3	5	4	82
Tree Size Class	4	4	4	3	3	1	-	4	2	4	4	3	5	-	3	4	3	3	3	4	-	61	
Overstory Density	4	4	3	3	4	2	-	4	4	4	4	5	5	-	3	3	3	3	3	3	-	64	
Forest Reproduction	4	4	3	3	3	2	-	4	3	4	4	2	5	-	2	3	3	3	3	4	-	59	
Ground Cover Density	4	2	3	3	3	3	4	AM	4	4	4	5	4	4	5	2	3	3	3	3	3	4	73
Pest/Poisonous Plants	4	3	4	3	3	3	-	4	4	5	5	3	3	-	1	3	3	3	2	3	-	59	
Pest/Weed Species	4	3	4	4	3	3	-	2	4	5	5	2	4	-	1	3	3	3	3	4	-	60	
Potential Natural Vegetation	5	5	5	4	-	3	-	2	5	4	4	-	4	-	3	3	3	3	-	4	-	57	
Species Composition	4	2	3	4	-	3	-	2	5	5	4	-	5	-	2	2	3	3	-	4	-	51	
Species Value	4	4	3	4	4	4	-	2	5	5	5	1	5	-	2	3	3	4	3	5	-	66	
Height Diversities	4	2	3	3	2	3	-	2	2	4	3	4	5	-	3	3	4	3	3	3	-	56	
Distribution of Vegetation	5	4	3	4	4	3	-	2	5	5	4	5	5	-	3	3	4	4	3	5	-	71	
Successional Stage	5	3	5	4	3	3	-	2	5	4	5	1	2	-	2	2	3	3	2	4	-	58	
Tree Growth/Yield	5	3	3	3	3	1	-	2	2	4	4	1	5	-	3	2	4	3	2	4	-	54	
Shrub Growth	5	3	3	3	3	3	-	1	4	4	4	1	4	-	2	2	4	3	2	2	-	53	
Grass Growth	5	3	3	3	3	3	-	1	5	4	4	3	3	-	2	3	4	3	3	2	-	57	
Moist Production	5	3	3	3	-	3	-	1	1	4	5	-	3	-	2	3	4	2	-	1	-	43	
Cavities	5	3	3	3	-	-	-	1	1	4	5	-	-	-	2	1	4	2	-	-	-	34	
Seasonal Variations in Vegetation	5	4	3	3	2	2	4	AH	1	2	4	4	5	4	4	2	3	3	3	2	4	4	68
Susceptibility to Fire	4	2	5	3	2	1	-	3	4	5	4	5	5	-	4	3	4	3	3	5	-	65	

TERRESTRIAL PLANT PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES		
Disturbance Tolerance	5	3	3	4	3	4	-	3	5	5	4	4	4	-	3	1	3	3	1	4	-	62	
Protected Plant Species	4	4	1	3	4	4	-	5	5	5	5	5	5	-	3	3	5	5	3	4	-	69	
Vegetative Concealment	4	-	3	4	3	-	-	1	-	5	2	5	1	-	3	-	5	3	3	2	-	44	
Forest Resource Maps	5	4	3	4	-	1	-	3	1	5	2	-	5	-	3	4	5	5	-	4	-	54	
Forest Classification	5	-	3	4	-	1	-	4	-	5	4	-	5	-	3	-	5	5	-	4	-	48	
Forest Climate	4	3	3	3	2	1	-	1	2	5	3	2	4	-	2	3	5	3	2	3	-	51	
Plant Associations	4	3	4	4	3	4	-	1	2	4	5	1	4	-	3	3	5	4	3	4	-	61	
Temperature Survival Data	5	4	4	4	-	2	-	1	2	4	2	-	5	-	4	2	3	4	-	5	-	51	
Light Tolerance	5	4	5	4	-	5	-	1	2	4	2	-	5	-	4	3	3	4	-	5	-	56	
Moisture Tolerance	5	4	5	4	-	4	-	1	2	4	3	-	5	-	4	4	3	4	-	5	-	57	
Species Natural Range	5	5	5	4	-	5	4	AH	1	2	5	4	-	5	3	5	4	5	4	-	5	4	75
Species Population Data	5	3	3	3	-	3	4	AH	1	2	4	4	-	5	3	3	3	5	3	-	3	3	60
Natural Regeneration Potential	5	4	3	4	4	4	-	1	2	4	4	2	5	-	3	3	3	3	3	4	-	57	
Artificial Regeneration Potential Methods	4	4	5	4	-	2	-	1	3	4	4	-	5	-	3	4	3	3	-	4	-	53	
Total																						2114	
Mean																						58.72	

TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Human Use of Range & Habitat	4	3	3	3	3	2	4	AH AM	1	2	5	5	4	5	5	2	4	3	4	3	3	5	73
Impacts from Hunting & Trapping	4	2	3	3	2	-	4	AH	1	3	5	5	3	4	4	2	2	3	3	2	4	2	61
Vehicular Damage	4	2	1	3	2	2	-		3	2	5	5	5	3	-	3	2	3	2	2	3	-	52
Wildlife Management Sites	3	4	3	4	4	3	-		2	3	5	5	4	5	-	5	4	5	5	4	4	-	72
Managed Forests	3	4	3	4	4	1	-		2	2	5	4	4	5	-	5	4	5	5	4	5	-	65
Seeding	4	2	3	4	3	3	-		1	5	5	4	2	4	-	5	4	5	4	3	5	-	65
Controlled Burning	3	2	3	3	2	4	-		1	5	5	5	4	4	-	5	3	3	4	3	4	-	63
Brush Control	3	2	3	4	2	4	-		1	5	5	5	3	5	-	5	3	5	4	3	4	-	66
Mowing	3	2	3	4	2	-	-		1	5	5	4	2	-	-	5	3	5	4	3	-	-	51
Fertilization	3	-	3	4	-	4	-		1	-	5	3	-	4	-	5	-	3	4	-	4	-	43
Cultivation	3	-	3	4	-	2	3	AM	1	-	5	3	-	3	4	5	-	3	4	-	3	2	48
Pruning	3	-	3	4	-	4	-		1	-	5	2	-	4	-	5	-	3	4	-	4	-	42
Agricultural Components																							
Agricultural/Recreation Coordination	3	3	2	4	-	-	-		5	3	5	5	-	-	-	3	4	5	5	-	-	-	47
Accessibility to Leased Lands	3	4	5	4	4	4	-		3	5	5	4	2	5	-	4	4	5	5	4	5	-	75
Range Suitability	3	3	5	3	-	-	-		1	5	5	3	-	5	-	3	3	5	4	-	5	-	53
Type of Grazing Land	5	4	5	4	-	-	-		1	5	5	5	-	3	-	5	4	5	4	-	4	-	59
Range Site Delineation	5	4	5	5	-	-	-		1	5	5	4	-	3	-	3	3	5	5	-	3	-	56
Potential Range-land Climax Plant Community	5	5	5	4	-	-	-		1	5	3	4	-	2	-	3	4	3	3	-	5	-	52
Range Composition	4	2	3	4	-	-	-		1	5	5	4	-	2	-	3	2	5	4	-	3	-	47

TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	
Retrospection Patterns	4	5	5	4	-	-	-	1	5	3	4	-	1	-	3	4	3	4	-	3	-	-	40
Range Trend	4	3	3	4	3	-	-	1	5	5	4	2	1	-	3	2	5	4	3	4	-	-	55
Total Annual Production	4	3	3	3	-	-	-	1	5	5	5	-	4	-	3	2	5	4	-	4	-	-	51
Forage Plants, Physiological Need	4	4	5	4	-	-	-	1	5	3	4	-	1	-	3	3	3	4	-	4	-	-	48
Proper Use Factor (PUF)	4	2	5	4	-	-	-	1	5	5	3	-	1	-	3	3	5	5	-	3	-	-	49
Key Species On Rangelands	4	4	5	3	-	-	-	1	5	5	5	-	1	-	3	4	5	4	-	4	-	-	53
Key Areas On Rangelands	4	3	5	3	-	-	-	1	5	5	5	-	1	-	3	3	5	4	-	3	-	-	50
Animal Unit Equivalent	4	5	3	4	-	-	-	1	5	5	5	-	4	-	3	5	5	4	-	4	-	-	57
Carrying Capacity	4	2	3	3	-	-	-	1	5	5	5	-	4	-	3	2	5	4	-	4	-	-	50
Insect Pests/ Damage & Control	2	2	3	3	2	2	-	4	5	5	5	3	4	-	3	3	5	3	2	4	-	-	60
Pests/Other	3	2	3	3	2	2	-	4	5	5	5	3	4	-	3	3	3	3	2	4	-	-	53
Predators	3	2	3	3	2	3	-	1	5	5	5	1	2	-	2	3	5	4	3	4	-	-	56
Poison Levels in Animals	3	2	3	3	2	-	-	1	5	5	5	1	1	-	2	1	3	2	1	2	-	-	41
Feral Dogs/Cats	3	2	1	3	2	-	-	1	2	5	4	1	1	-	2	2	3	2	2	4	-	-	40
Windbreaks	4	4	3	4	4	-	-	1	3	5	4	2	1	-	3	4	5	4	4	4	-	-	55
Impact of Browsing/Grazing	4	3	3	3	-	2	-	1	5	5	5	-	5	-	2	1	5	2	-	4	-	-	50
Forest Fire Protection	3	3	3	3	3	1	5	AM	1	3	5	4	5	5	4	3	3	5	4	4	4	2	73
Trespass Data	2	1	3	3	2	1	-	1	4	5	3	4	5	-	3	1	5	5	2	4	-	-	54
Silvicultural Practices																							
Thinning	4	3	3	3	3	4	-	1	3	5	4	3	5	-	3	4	5	4	4	4	-	-	61
Mortality or Sanitation Cuts	4	3	3	3	3	4	-	1	3	5	4	1	5	-	3	3	5	4	3	4	-	-	61



TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION							SEED							AVAILABILITY							TOTAL	
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Rehabilitation Plan	4	3	4	4	4	2	-	1	3	5	3	2	5	-	3	4	5	4	4	3	-	63	
Tree Improvement Plan	4	3	5	4	4	2	-	1	3	5	3	1	5	-	3	4	5	4	4	3	-	63	
Pruning	4	3	3	3	3	4	-	1	3	5	3	3	3	-	3	4	5	4	4	3	-	61	
Forest Disease Protection Plan	3	3	2	4	3	2	-	1	2	5	4	1	5	-	3	4	5	4	3	4	-	52	
Timber Contracts																							
Selected Area	4	3	5	5	3	2	-	1	2	5	4	1	5	-	3	4	5	4	4	5	-	60	
Type of Cutting	4	3	5	5	-	4	-	1	2	5	5	-	5	-	4	4	5	4	-	5	-	61	
Type of Logging	4	3	5	5	-	4	-	1	2	5	5	-	5	-	4	4	5	4	-	5	-	61	
Tree Marking	4	3	5	5	3	1	-	1	2	5	2	1	4	-	3	4	5	4	4	5	-	61	
Access Routes	4	3	5	5	3	4	-	AM	1	2	5	3	2	5	-	3	4	5	4	4	4	-	66
Timber Volume	4	3	5	5	-	1	-	1	2	5	3	-	5	-	3	4	5	4	-	4	-	54	
Description of Timber to be cut	4	3	5	5	-	2	-	1	2	5	4	-	5	-	3	4	5	4	-	2	-	54	
Period of Contract	4	3	5	5	3	4	-	1	2	5	4	2	5	-	3	4	5	4	4	5	-	69	
Cutting Schedule	4	3	5	5	3	4	-	1	2	5	5	2	4	-	3	4	5	5	4	4	-	68	
Scaling Procedures	5	3	5	5	-	4	-	1	2	5	2	-	5	-	5	4	5	5	-	4	-	60	
Environmental Protection Measures	3	3	5	5	-	4	5	AM	1	2	5	5	-	5	5	3	4	5	5	-	4	2	71
Slash Disposal/Treatments	4	3	5	5	-	2	-	1	2	5	5	-	4	-	3	4	5	5	-	5	-	58	
Snag Provisions	4	3	5	5	-	3	-	1	2	5	5	-	5	-	3	4	5	5	-	4	-	59	
Fire Programs	3	3	5	5	3	1	-	1	2	5	5	5	5	-	3	4	5	5	4	5	-	59	
Road Maintenance/Repair	3	3	5	5	3	1	-	1	2	5	2	4	5	-	3	4	5	5	4	4	-	64	
Total																						8387	
Mean																						57.41	

TERRESTRIAL GENERAL BIOTIC PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
	Habitat Composition	4	3	5	4	3	3	-	1	5	5	5	4	4	-	3	2	5	3	2	4	
Special Features	4	3	5	4	3	3	-	1	5	5	5	2	4	-	3	2	5	3	2	3	-	62
Habitat Use (General)	4	3	4	3	4	3	-	2	3	5	5	1	5	-	2	2	5	2	2	4	-	59
Habitat Use (Ruminants)	4	3	4	3	-	3	-	2	5	5	5	-	5	-	2	2	5	3	-	4	-	55
Habitat Use (Birds)	4	3	4	3	-	3	-	2	1	5	5	-	4	-	2	2	5	2	-	4	-	49
Shoreline Habitat	4	3	5	3	-	3	-	2	1	5	5	-	3	-	2	2	5	3	-	4	-	50
Habitat Interface	4	3	3	3	-	3	-	1	2	5	5	-	4	-	2	2	3	2	-	4	-	46
Open Field/Grass Habitat	4	3	3	3	-	3	-	1	5	5	5	-	2	-	2	2	5	2	-	4	-	49
Edge Habitat	4	3	3	3	-	2	-	1	2	5	5	-	4	-	2	2	3	2	-	4	-	45
Total																						480
Mean																						53.33

POPULATION/ PEOPLE PARAMETERS	DURATION							NEED							AVAILABILITY							TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Total Family Income	4	3	3	4	-	-	-	4	1	1	2	-	1	-	5	3	3	4	-	2	-	40
Educational Level of Household	4	-	3	4	-	-	-	4	-	2	1	-	1	-	5	-	3	4	-	1	-	32
Place of Residence	4	-	5	4	-	-	-	4	-	3	1	-	3	-	5	-	3	4	-	1	-	37
Census Region	4	-	5	4	-	-	-	4	-	3	1	-	2	-	5	-	3	4	-	3	-	38
Age	4	-	3	4	-	-	-	5	-	3	1	-	1	-	5	-	3	4	-	1	-	34
Race	4	-	3	4	-	-	-	3	-	3	1	-	1	-	5	-	3	4	-	1	-	34
Sex	4	-	5	4	-	-	-	5	-	4	1	-	1	-	5	-	3	4	-	1	-	37
Marital Status	4	-	5	4	-	-	-	4	-	4	1	-	1	-	5	-	3	4	-	1	-	36
Family Size	4	-	5	4	-	-	-	4	-	4	1	-	1	-	5	-	3	4	-	1	-	36
Handicapped	4	-	3	4	-	-	-	4	-	5	1	-	1	-	3	-	3	4	-	1	-	33
Days Worked per Week	4	-	3	4	-	-	-	4	-	4	1	-	1	-	3	-	3	4	-	1	-	32
Vacation	4	-	3	4	-	-	-	5	-	4	3	-	3	-	3	-	3	4	-	1	-	37
Agricultural Demand for Land	4	3	3	4	3	4	-	2	5	5	5	2	4	-	3	3	5	4	3	2	-	64
Agricultural Cost and Benefits	4	3	3	4	3	4	-	1	5	5	4	3	5	-	3	2	5	4	2	4	-	64
Agricultural Leasing Agreements	3	4	3	4	4	4	-	1	5	5	5	3	1	-	5	5	5	5	4	5	-	71
Army-Induced Demands	3	-	4	4	-	-	-	3	-	5	1	-	1	-	5	-	3	4	-	5	-	38
Cantonment Facilities	4	-	5	4	3	-	-	1	-	4	1	2	1	-	5	-	3	4	4	-	-	42
Restricted Areas	3	-	5	4	3	4	-	1	-	5	3	3	5	-	5	-	3	4	4	5	-	57
Religion	3	-	4	4	-	-	-	1	-	4	1	-	1	-	5	-	4	4	-	2	-	33
Life Style	3	-	4	4	-	-	-	3	-	4	1	-	1	-	5	-	3	4	-	-	-	32
Permanent/Transient	3	-	4	4	-	4	-	3	-	4	1	-	1	-	5	-	4	4	-	-	-	37
Recreational Activities	3	-	4	4	-	4	-	5	-	4	5	-	4	-	5	-	4	4	-	4	-	46

POPULATION/ PEOPLE PARAMETERS	DURATION						NEED						AVAILABILITY						TOTAL			
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE		TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES
Displacement of Previous Users	4	5	5	5	5	-	-	2	4	4	1	1	1	-	3	4	3	5	4	-	-	56
Employment Statistics	3	-	3	4	3	-	-	4	-	4	1	1	1	-	5	-	3	4	3	-	-	39
Hunter/Trapper/Fisherman Attitudes	4	3	4	4	3	4	-	4	1	4	5	2	4	-	3	2	3	3	3	3	-	59
Hunter/Trapper/Fisherman Economic Values	4	3	4	4	-	4	-	4	1	4	5	-	5	-	3	2	3	3	-	2	-	54
Hunter/Trapper/Fishing Quotas	3	-	3	3	-	4	-	1	-	5	5	-	2	-	3	-	5	4	-	5	-	43
Storm Warning Procedures	2	4	5	5	4	-	-	1	3	5	2	4	4	-	3	5	5	5	3	5	-	65
Training for Storm Preparation	2	-	5	4	4	-	-	1	-	5	1	5	4	-	3	-	5	4	4	3	-	50
Land Area Ownership	4	4	5	4	4	5	-	3	2	5	5	2	5	-	5	4	5	5	4	5	-	76
Land Area Control	3	4	5	5	4	4	-	1	2	5	5	4	5	-	5	4	5	5	4	5	-	75
Original Land Survey & Corner Data	5	4	5	5	5	5	-	1	2	5	3	2	5	-	3	4	5	5	3	5	-	72
Plat Books	5	3	5	5	3	5	-	1	3	5	5	1	5	-	5	4	5	5	4	5	-	74
Land Use/Zoning Data	4	4	5	5	4	3	-	1	2	5	4	5	5	-	3	4	5	5	4	4	-	72
Legal Description Forestry	5	4	5	5	-	4	-	1	4	5	3	-	5	-	5	4	5	5	-	3	-	63
Aims/Goals of Land Owner	3	4	4	5	3	4	-	1	4	5	4	2	5	-	3	4	3	1	3	2	-	63
Total																						1771
Mean																						49.11

SURROUNDING AREA PARAMETERS	DURATION							NEED						AVAILABILITY						TOTAL			
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASHES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASHES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASHES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING		FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	
Substitute Area Parameters	4	-	4	4	-	-	-	5	-	4	4	-	1	-	5	-	4	4	-	4	-	-	43
Travel Cost	4	-	4	4	-	-	-	4	-	4	3	-	1	-	3	-	3	5	-	1	-	-	36
Travel Time	4	-	4	4	-	-	-	4	-	4	3	-	1	-	3	-	3	5	-	2	-	-	37
Fee Schedule	4	-	4	4	-	-	-	4	-	4	3	-	1	-	5	-	3	5	-	4	-	-	41
Quality	4	-	4	4	-	-	-	4	-	4	3	-	4	-	1	-	3	4	-	3	-	-	38
Off-Post Agricultural Land Use	4	4	4	4	4	-	-	1	5	4	2	3	3	-	4	4	3	4	4	3	-	-	56
Off-Post Resources	4	-	3	3	-	-	-	1	-	5	2	-	2	-	3	-	3	4	-	2	-	-	32
Off-Post Land Use	4	-	4	4	4	-	-	1	-	4	3	4	1	-	3	-	3	3	4	2	-	-	40
Off-Post Fire Protection	3	4	3	4	4	-	-	1	4	5	3	5	4	-	5	4	5	3	4	1	-	-	62
Impact of Installation Noise on Off-Post Communities	3	-	3	4	4	-	-	1	-	5	2	5	1	-	3	-	4	5	4	-	-	-	44
Total																						429	
Mean																						12.90	

APPENDIX C  
SPECIFIC TABLES FOR ESTABLISHING PRIORITIES

SOIL PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL								
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION		AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Fertility																								
Stability																								
Depth to Parental Material/Bedrock																								
Series and Type Classification																								
Soil Horizon/Profile																								
Texture																								
Structure																								
Consistence																								
Color																								
Reaction																								
Chemical Composition																								
Organic Matter or Content																								
Exchangeable Sodium Fraction																								
Permeability																								
Available Water Capacity																								
Depth to Seasonally High Water Table																								
Soil Capability Class, Subclass, Unit																								
Soil Productivity																								
Susceptibility to Sheet and Rill Erosion																								
Susceptibility to Gully Erosion																								

SOIL PARAMETERS	DURATION						NEED						AVAILABILITY										
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
The Universal Soil Loss Equation (USLE)																							
Soil Loss Tolerance																							
Rainfall and Run-off Factor																							
Slope Length and Steepness Factor																							
Soil Erodibility Factor (K)																							
Cover and Management Factor																							
Support Practice Factor (P)																							
Susceptibility to Wind Erosion																							
The Wind Erosion Equation																							
Conventional Agricultural Practices																							
Soil Fertility Improvement																							
Erosion Control																							
Erosion Control Facilities																							
Shrink - Swell Potential																							
Presumptive Bearing Value																							
Corrosion Potential																							
Trafficability/ Bearing Strength of Subsurface Strata																							
Overflow/Flooding Hazard																							
AASHTO (Unified Classification) Engineering Data Properties																							
Soil Analysis																							



SOIL PARAMETERS	DURATION					NEED					AVAILABILITY												
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Soil Maps																							
Water Seepage and Retaining Properties																							
Erosion from Human Activity																							
Rocks, Bedrock Composition																							
Soil Nutrient Deficiencies																							
Soil Toxicities																							

CLIMATIC PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Air Temperature															
Snowfall (Monthly)															
Snow Accumulation															
Thunderstorm Patterns (Frequency)															
Sunlight Duration															
Solar Radiation															
Precipitation (Amount)															
Precipitation (Distribution)															
Precipitation (Type)															
Frost Free Period															
Winds															
Evaporation and Transpiration															
Storms															
Length of Growing Season															
Degree Days Heating															
Degree Days Cooling															
Mean Number Days Cloud Cover/Mth.															
Snowfall (Number of Days)															
Per Month Freeze/Thaw Transitions															
Wind Chill Factor															
Effect of Temperature Extremes on Equipment															
Effect of Temperature Extremes on Transportation															

CLIMATIC PARAMETERS	DURATION					NEED					AVAILABILITY											
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Effect of Storms on Equipment & Transportation																						
Visibility Conditions																						
Altitude of Clouds																						
Humidity (Seasonal Patterns)																						
Humidity (Daily Patterns)																						

EXISTING STRUCTURAL FACILITIES	DURATION					NEED					AVAILABILITY												
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Corrals																							
Fencing & Gates (Perm & Temp)																							
Protective Barricades																							
Magazines/ Igloos																							
Piers/Docks																							
Recreational Structures																							
Open Loading Docks																							
Flag Poles																							
Military Features																							
Radio Towers																							
Mock Villages																							
Bunkers																							
Grandstands																							
Targets																							
Observation Towers																							
Abandoned Airstrips																							
Revetments																							
Pits																							
Concrete Pillboxes																							
Launcher Sites																							
Ammunition Dumps																							
Radar Facilities																							
Dams																							

EXISTING STRUCTURAL FACILITIES	DURATION						NEED						AVAILABILITY										
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Airfields																							
Helicopter Land Zones																							
Railroads																							
Walks																							
Sanitary Landfills																							
Telephone Network																							
Radio Network																							
Cemeteries																							
Roads																							
Location																							
Shoulders																							
Bridges																							
Culverts																							
Signs																							
Easements/ Ownership																							
Fords																							
Length																							
Mile Load Classification																							
Width																							
Surface Condition																							
Drainage Improvements																							
Drainage Problems																							

EXISTING STRUCTURAL FACILITIES	DURATION					NEED					AVAILABILITY					TOTAL								
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION		AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Traffic																								
Reg Facilities																								
Maintenance																								
Responsibility																								
Surface																								
Strength																								
Usage																								
Rates																								
Commercial																								
Traffic																								
Parking Areas																								
Construction																								
Class																								
Length																								
Width																								
Grade																								
Specification																								
Required																								
Structures																								
Volume of																								
Cut & Fill																								
Speed																								
Specification																								
Blasting																								
Steep																								
Grades																								
Buildings																								
Location																								
Wall Type																								
Roof Type																								
Window and																								
Door Type																								
Floor Type																								

EXISTING STRUCTURAL FACILITIES	DURATION					NEED					AVAILABILITY													
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	TOTAL		
Foundation & Footing Type																								
Paint (Interior)																								
Paint (Exterior)																								
Electrical Systems																								
Elec Distribution System																								
Water System (Pot & Non)																								
Sewer System, Industrial																								
Heating System																								
Air Conditioning System																								
Ventilation System																								
Installed Equipment																								
Lightning Protect System																								
Fire Protect System																								
Permits/Restrictions																								
Water System																								
Steam System																								
Compressed Air System																								
Natural Gas System																								
Coal Storage Facilities																								
Fuel Oil Storage System																								
On-Post Structural Resources																								
Housing																								

EXISTING STRUCTURAL FACILITIES	DURATION					NEED					AVAILABILITY											
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Recreation																						
Religion																						
Schools																						
Shops, Stores																						
Artificial Waterways																						
Archeological Sites																						
Windmills & Windpumps																						
Pipeline Pumping Stations																						
Transmission Lines & Substation																						
Cattleguards																						
Cultural & Historic Sites																						
Storm Safety Facilities																						
Transportation Fuel Store Area																						



AQUATIC BIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY													
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL		
Aquatic Plants																								
Phytoplankton Productivity																								
Aquatic Pest Plants																								
Fish (Economic Value)																								
Fish (Undesirable)																								
Fish Growth																								
Fish Parasites																								
Fish Populations																								
Size																								
Reproduction																								
Movement																								
Mortality																								
Diet																								
Sex Ratios																								
Migration																								
Stress Periods																								
Impact of Fishing Activities																								
Vehicular Damage																								
Invertebrate Fauna																								

AQUATIC NATURAL ABIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY													
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL		
Lakes																								
Drop-off to 5-Ft Depth																								
Drop-off to 4-Ft Depth																								
Lake Shoreline																								
Streams (Location Size, Flow)																								
Characteristics of Lakes & Streams																								
Temperature																								
Shoreline Fluctuation																								
Shoreline Material																								
Color and Turbidity																								
Groundwater Resources																								
Watershed/Drainage/Discharge																								
Marsh/Swamp																								
Eutrophication																								
Suspended Solids																								
Use by Fish and Wildlife																								
Tides																								
Inland Waterways																								
Coastal Waterways																								
Water Bodies Bordering Lands																								
Salt Water Types																								

AQUATIC MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION				NEED				AVAILABILITY				TOTAL		
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING		FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES
Fishing Area															
Boat Launch															
Swimming Area															
Maintained Shore- line/Beaches															
Reservoir															
Accessibility From Roads															
Water Sites Shared W/Non-wild Users															
Streams (Impound- ments Upon)															
Livestock Water Needs and Uses															
Surface Water Contributions															
Surface Water Withdrawal															
Water Quality															
Pollut. Levels															
Impact of Grazing on Water Resources															
Domestic Water Avail. for Rec- reation Areas															
Irrigation & its Effects on Water Vegetation															
Amphibious Move- ment and Suit- ability															
Water Rights															
Range and Man- euver Sites															
Mtl/Agricul. Land Use Coordination															
Impact Areas															
Restricted Areas															

AQUATIC MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Mil/Outdoor Rec Coordination															
Parameters Affected by Training:															
Water Quality															
Sediment Load															
Turbidity															

TERRESTRIAL NATURAL ABIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASAGES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASAGES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Topographic Maps															
Terrain Analysis Maps															
Elevation															
Slope Length															
Slope Orientation															
Landform Variety															
Rock Form Features															
Air Quality															
Topographic Feature Refer.															
Subsurface Vibra- tion Transmission															
Mass Wastage															
Tectonic Activity															
Atmosphere Impacts															
Aerial Photographs															
Sites Having Valuable Sub- surface Materials															

TERRESTRIAL MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY													
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL		
Hunting Acreage																								
Campgrounds																								
Picnic Grounds																								
Off-Road Recreational Vehicles																								
Animal Salt & Mineral Distribution																								
Pesticide Program																								
Structures for Animal Habitat																								
Excavation Sites																								
Trails																								
Hiking																								
Motorcycle																								
Cross-Country Skiing																								
Horseback																								
Bicycle																								
Nature																								
Stock Trails & Walkways																								
Tactical Vehicle																								
Herbicide Program																								
Firebreaks and Fire Control																								
Integrated Pest Management System																								
Noise Levels and Derivation																								
Burying Personnel Waste Materials																								

TERRESTRIAL MAN-INFLUENCED ABIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY												
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Excavating Trenches, Gun Emplacement, Foxholes, Fill, Road Surfacing Earthworks																							
Protected Areas																							
Impact Areas																							
Range Areas																							
Coordination of Military Activities with Other Land Uses																							
Forestry/Mil Coordination																							
Hunting/Mil Coordination																							
Agricult/Mil Coordination																							
Rec/Mil Coordination																							
Areas Restricted by Access or Noise																							
Snow Removal																							
Restoring Storm-Damaged Facilities																							

MILITARY PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Weapons System															
Electronic Combat															
Types of Training Units															
Tracked Vehicles															
Wheeled Vehicles															
Fixed Wing Aircraft															
Amphibious Vehicles															
Water Craft															
Cross Country Movement															
Training Area Land Requirements															
Other Training Unit Requirements															
Engineering Restrictions to Excavations															
Maneuver Areas															



TERRESTRIAL ANIMAL PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL								
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION		AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Game Animal Populations																								
Non-Game Animal Populations																								
Populations (Specific)																								
Size																								
Reproduction																								
Sex Ratios																								
Movement																								
Mortality																								
Migration																								
Diet																								
Browse and Forage																								
Scat Exams																								
Pellet Exams																								
Economic Value																								
Winter Stress																								
Carrying Capacity																								
Breeding Habitat																								
Critical Area																								
Predator-Prey Interactions																								
Avian Fauna																								
Migratory Species (Waterfowl)																								
Mammal Fauna																								

TERRESTRIAL ANIMAL PARAMETERS	DURATION						NEED						AVAILABILITY										
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHAEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Herpetological Fauna																							
Invertebrate Fauna																							
Threatened or Endangered Species																							
Parasites																							
Pathogens																							
Nesting Sites/ Density																							

TERRESTRIAL PLANT PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASHES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASHES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Critical Area															
Vegetative Pat- tern Diversity															
Vegetation Type															
Tree Size Class															
Overstory Density															
Forest Reproduction															
Ground Cover Density															
Pest/Poisonous Plants															
Pest/Weed Species															
Potential Natural Vegetation															
Species Composition															
Species Value															
Height Diversities															
Distribution of Vegetation															
Successional Stage															
Tree Growth/ Yield															
Shrub Growth															
Grass Growth															
Mast Production															
Cavities															
Seasonal Varia- tions in Vegetation															
Susceptibility to Fire															

TERRESTRIAL PLANT PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL		
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS		FISH AND WILDLIFE	TRAINING FORESTRY
Disturbance Tolerance																		
Protected Plant Species																		
Vegetative Concealment																		
Forest Resource Maps																		
Forest Classification																		
Forest Climate																		
Plant Associations																		
Temperature Survival Data																		
Light Tolerance																		
Moisture Tolerance																		
Species Natural Range																		
Species Population Data																		
Natural Regeneration Potential																		
Artificial Regeneration Potential/ Methods																		

TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION						NEED						AVAILABILITY										
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL	
Human Use of Range and Habitat																							
Impacts from Hunting & Trapping																							
Vehicular Damage																							
Wildlife Management Sites																							
Managed Forests																							
Seeding																							
Controlled Burning																							
Brush Control																							
Mowing																							
Fertilization																							
Cultivation																							
Pruning																							
Agricultural Components																							
Agricultural/Recreation Coordination																							
Accessibility to Leased Lands																							
Range Suitability																							
Type of Grazing Land																							
Range Site Delineation																							
Potential Rangeland																							
Climax Plant Community																							
Range Composition																							

TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY													
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL		
Range Condition Class																								
Retgression Patterns																								
Range Trend																								
Total Annual Production																								
Forage Plants, Physiological Need																								
Proper Use Factor (PUF)																								
Key Species On Rangelands																								
Key Areas On Rangelands																								
Animal Unit Equivalent Carrying Capacity																								
Insect Pests/ Damage & Control																								
Pests/Other																								
Predators																								
Poison Levels in Animals																								
Feral Dogs/ Cats																								
Windbreaks																								
Impact of Browsing/ Grazing																								
Forest Fire Protection																								
Trespass Data																								
Silvicultural Practices																								
Thinning																								

TERRESTRIAL MAN-INFLUENCED BIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL								
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION		AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Mortality or Sanitation Cuts																								
Rehabilitation Plan																								
Tree Improvement Plan																								
Pruning																								
Forest Disease Protection Plan																								
Timber Contracts																								
Selected Area																								
Type of Cutting																								
Type of Logging																								
Tree Marking																								
Access Routes																								
Timber Volume																								
Description of Timber to be Cut																								
Period of Contract																								
Cutting Schedule																								
Scaling Procedures																								
Environmental Protection Measures																								
Slash Disposal/Treatments																								
Snag Provisions																								
Fire Programs																								
Road Maintenance/Repair																								

TERRESTRIAL GENERAL BIOTIC PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Habitat Composition																
Special Features																
Habitat Use (General)																
Habitat Use (Ruminants)																
Habitat Use (Birds)																
Shoreline Habitat																
Habitat Interface																
Open Field/Grass Habitat																
Edge Habitat																



POPULATION/ PEOPLE PARAMETERS	DURATION					NEED					AVAILABILITY					TOTAL
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES		
Total Family Income																
Educational Level of Household																
Place of Residence																
Census Region																
Age																
Race																
Sex																
Marital Status																
Family Size																
Handicapped																
Days Worked per Week																
Vacation																
Agricultural Demand for Land																
Agricultural Cost and Benefits																
Agricultural Leasing Agreements																
Army Induced Demands																
Cantonment Facilities																
Restricted Areas																
Religion																
Life Style																
Permanent/Transient																
Recreational Activities																

POPULATION/ PEOPLE PARAMETERS	DURATION				NEED				AVAILABILITY						
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Displacement of Previous Users															
Employment Statistics															
Hunter/Trapper/Fisherman Attitudes															
Hunter/Trapper/Fisherman Economic Values															
Hunter/Trapper/Fishing Quotas															
Storm Warning Procedures															
Training for Storm Preparation															
Land Area Ownership															
Land Area Control															
Original Land Survey & Corner Data															
Plat Books															
Land Use/Zoning Data															
Legal Description Forestry															
Aims/Goals of Land Owner															

SURROUNDING AREA PARAMETERS	DURATION					NEED					AVAILABILITY				
	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL
Substitute Area Parameters															
Travel Cost															
Travel Time															
Fee Schedule															
Quality															
Off-Post Agricultural Land Use															
Off-Post Resources															
Off-Post Land Use															
Off-Post Fire Protection															
Impact of Installation Noise on Off-Post Communities															

												DURATION			NEED			AVAILABILITY			
OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	OUTDOOR RECREATION	AGRICULTURAL OUTLEASURES	BUILDING AND GROUNDS	FISH AND WILDLIFE	TRAINING	FORESTRY	ARCHEOLOGICAL AND CULTURAL RESOURCES	TOTAL

## APPENDIX D:

### ARCHEOLOGICAL AND CULTURAL RESOURCES MANAGEMENT

#### Introduction

The management of archeological resources on Federally owned or administered properties is primarily a matter of conserving prehistoric and historic archeological sites and the information about the past that they contain. Management is conducted at three distinct phases: (1) inventory, (2) assessment, and (3) mitigation of adverse effects. A fourth phase, interpretive development, may be appropriate for some specific archeological sites. Procedures for managing cultural resources to comply with relevant Federal preservation statutes are outlined below. For a glossary of key terms in this appendix, see pp 183, 185, 190. References on archeological parameters are provided at the end of this appendix.

#### Phase I: Inventory

Effective resource management requires that the significant archeological resources on a particular property be known to the land or resource manager. That is the rationale for Executive Order 11593, issued in 1971, which mandates complete inventories of cultural resources (i.e., archeological and historical sites) on all Federally administered properties. These surveys are to determine which sites are eligible for nomination to the National Register of Historic Places. A deadline of 1 July 1980 for completion of all surveys was impossible to meet, but the original order is still in effect, and systematic searches for archeological sites on Federal properties all over the country are continuing.

The standard way of inventorying the archeological resources of a property is to conduct an archeological survey or reconnaissance. The surveyor, who should be a qualified archeologist familiar with the cultural traits typical of archeological sites in the region, examines the property. A survey design may provide for either a complete survey of a property or a sample survey. On every survey, the archeologist examines the ground surface visually for evidence of former human activity, and usually tests the sub-surface by digging small, shallow holes with a shovel or posthole digger, or by probing with a soil corer, or by other appropriate means. On a complete survey, the entire ground surface of the property being surveyed is examined visually, and shovel or posthole probes are made at selected intervals where the ground surface is not visible owing to vegetation cover. A sample survey looks at only part of the entire surface area of a property, after the area has been stratified statistically on the basis of topography and physiography. From sample data, a predictive model is developed of expected archeological resources in unsurveyed areas of the property.

Whenever an archeological site is found during a survey, its location, physical description, dimensions, cultural affiliation (identified through artifacts at the site), and other pertinent data are recorded. Usually, a collection of artifacts is made from the surface of the site; the artifacts are retained permanently as reference samples of the site's material culture.

Preliminary assessment of a site's significance is made at Phase I. Sometimes it can clearly be seen from an inspection of the area's surface that a site contains too little cultural information, or is too similar to other sites that have been thoroughly studied, to warrant conservation. The manager need worry no further about such sites (except in the unlikely event that the effects of erosion or purposeful land modification in the future expose unsuspected, significant archeological remains). But usually an appreciable number of the sites found during Phase I (generally 20 percent to 80 percent, depending on circumstances) cannot adequately be assessed with only survey data, and their significance will have to be determined by test excavations in Phase II.

#### Phase II: Assessment

Along with Executive Order 11593, a series of Congressional enactments (mainly the Antiquities Act of 1906 [16 USC 431 et seq.], the Historic Sites Act of 1935 [16 USC 461 et seq.], the Historic Preservation Act of 1966 [16 USC 470 et seq.], the National Environmental Policy Act of 1969,<sup>5</sup> and the Archeological and Historical Conservation Act of 1974 [16 USC 469 et seq.]) provide that every significant archeological site on Federally administered property be preserved. However, when damage or destruction is unavoidable, an adequate set of scientific data must be recovered by excavation and preserved before the site is destroyed. The site's significance is determined in Phase II (except for those obviously insignificant sites identified during Phase I).

Phase II assessment of the prehistoric and historic significance of an archeological site is done by exploratory excavation. An acceptance testing design provides for judicious probing of the site at appropriate places both to determine its overall structure and size, and to sample the cultural features and artifacts present.

Most testing is done by digging squares of trenches into the site's matrix -- usually with shovels or other hand tools, but sometimes with earth-moving machinery. In most instances, these tests expose soil profiles which reveal the gross morphology of the site, intersect cultural features (architectural remains, postmolds, trash pits, burials, etc.), and produce samples of small artifacts, food remains, and other items of archeological interest. Testing techniques also include soil probing with corers and sub-surface remote sensing of anomalies with electronic equipment (e.g., proton magnetometers and devices that measure differences in the soil's electrical resistivity).

When a site has been adequately tested, there should be enough data to estimate its age, recognize the past culture or cultures that occupied it, define its size and general structure, and estimate the quantity and kind of cultural features, artifacts, and other archeological remains present. These data become the bases for making full determination of the site's significance.

If Phase II testing indicates that a site is eligible for nomination to the National Register of Historic Places, it becomes the responsibility of the

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<sup>5</sup> National Environmental Policy Act (P.L. 91-190; 83 Stat. 851).

land manager or the resource manager to see that the site is not adversely affected by any construction project or other human activity, or by erosion or other natural process. If a site eligible for nomination to the National Register should become threatened, appropriate steps must be taken to conserve the site and the significant archeological information there. This is done in Phase III.

### Phase III: Mitigation of Adverse Effects

When any archeological site eligible for nomination to the National Register is threatened by human activity (e.g., new construction, Army training activities, recreational activities, relic collection) or by natural process (e.g., erosion, inundation) the impact of such activities or processes must be controlled acceptably. Mitigation can take different forms; for example, a construction project may be redesigned so that it does not affect the archeological site at all; revetments may be installed to protect the site from erosion; or a site may be extensively excavated to recover comprehensive data before destruction or serious damage.

When it is not practical to preserve an endangered, significant archeological site and data recovery by extensive excavation is necessary, then a full-scale archeological dig must be planned and carried out under the direction of a qualified field archeologist. The site will be painstakingly dissected, component by component, a process which destroys the area. But because the archeologist has recorded the location and a full description of each structural component (soil strata, cultural features, etc.), a complete record of the site's structure, cultural content, geological associations, and biological referents is preserved, even though the site itself is gone. Artifacts are collected from the various components, along with samples of pollen, soils, food remains, snails, and other items valuable to understanding former peoples, climate, biota, and geological processes.

State Historic Preservation Officers, who are responsible for the preservation archeology that takes place in their respective states, invariably demand that excavation follow a well-conceived research design in keeping both with the tenets of scientific archeology, and with archeology's ultimate goal of interpreting and explaining cultural process.

Archeological excavation takes a lot of time, and the resource or land manager should plan far enough ahead to allow archeological data recovery before construction or other planned activities that may affect significant archeological resources.

### Archeological Site Development

Occasionally an archeological site on Federal property is so important historically or prehistorically that it might be developed for visits by the public. Examples include Cliff Palace (the prehistoric ruin at Mesa Verde National Park) and fortifications dating from the American Revolution at the U.S. Military Academy, West Point. Land and resource managers may decide to develop such sites, but there is no statutory requirement to do so.

## Archeological Parameters

The natural resource parameters in Appendix B are not suited to archeological quantification according to duration of usefulness, need, and availability. Of more use to land and resource managers are eight data parameters which relate specifically to archeological resources. These parameters are defined on pp 183, 185. In Table D1, the eight parameters are placed in a matrix similar to that used for the natural resource parameters, and numerical rankings are given for the expected state of knowledge about archeological resources at each of the management phases.

## Definitions of Archeological Data Parameters

**Significance:** The critical quality of an archeological resource that determines its eligibility for nomination to the National Register of Historic Places. An archeological site's significance, which in the end must be a value judgment, is a function of several factors, including the site's uniqueness, the extent of current knowledge about the past culture or cultures associated with the site, its relationships with other archeological sites, the quantity of cultural remains present, and the state of preservation of those remains. Only archeologists who are thoroughly familiar with a region are qualified to judge the significance of sites there.

**Location:** The geographical locus of a site, including its situation with respect to topographical features, physiographic divisions, and natural resources.

**Dimensions:** The size of an archeological site, horizontally and vertically. At Phase I (survey), only superficial dimensions can be observed, even though buried components may extend far beyond surface indications. One objective of Phase II testing is to determine the full sub-surface dimensions of the tested site.

**Content:** An essential factor in a site's potential for yielding significant data is the kind and quantity of archeological remains that it contains. A site's probable content can be estimated during Phase II, or in a much more limited way during Phase I; but full disclosure of a site's content can be achieved only through Phase II excavation.

**Cultural affiliation:** Archeologists reconstruct past cultures -- and give them names (e.g., Mississippian, Archaic, and Woodland) -- by synthesizing data from many sites. A site is identified with specific cultures through recognition of their distinct forms of tools, architecture, burial practices, dietary habits, and the like -- all revealed by archeological study. The ease with which a site can confidently be identified with a specific culture depends in large part on how well the culture is known from previous studies at other sites.

**Function:** The purpose of the archeological site to the people who occupied it. Functional categories include village sites, farmsteads, religious centers, base camps, kill sites, cemeteries, quarries, and many others.



Table D1

## Ranking of Data Parameters for Archeological Resources

Parameters	Before Phase I			After Phase I			After Phase II			After Phase III					
				Sample Survey			Full Survey			Mitigation By Preservation			Mitigation By Excavation		
	D*	N	A	D	N	A	D	N	A	D	N	A	D	N	A
<u>Applicable to Individual Sites</u>															
Significance	3	5	1	3	5	3	3	5	3	3	5	5	3	5	5
Location	5	5	1	5	5	3	5	5	5	5	5	5	5	5	5
Dimensions	5	5	1	5	5	3	5	5	4	5	5	5	5	5	5
Content	5	4	1	5	4	1	5	4	1	5	4	4	5	4	4
Cultural Affiliation	5	4	1	5	4	2	5	4	2	5	4	4	5	4	4
Function	5	4	1	5	4	2	5	4	2	5	4	4	5	4	4
Condition	3	5	1	3	5	4	3	5	4	3	5	5	3	5	5
<u>Applicable to Entire Populations of Site</u>															
Site Distribution	5	4	1	5	4	4	5	4	5	5	4	5	5	5	5

\*D = Duration of usefulness

N = Need

A = Availability

**Condition:** The site's state of preservation. Some sites retain much more of their original content of cultural items than do other sites because their environments and post-occupational histories have been conducive to good physical preservation. Obviously, condition is an important consideration when a site's significance is being determined.

**Site distribution:** The geographical pattern in which the sites representing a particular culture are distributed is of great interpretive value. Site distribution studies can suggest preferred environmental settings for different kinds of functional sites. Such studies also may lead to conclusions about the efficiency of a culture's exploitation of available natural resources, its trade networks, its social structure, its relationships with neighboring cultures, and the like.

### Parameters of Archeological Significance

In Appendix B, the natural resource parameters considered archeologically or historically significant are ranked for duration of usefulness, need, and availability, following the ranking criteria described in Chapter 2. Each parameter having potential intrinsic archeological or historical significance is marked with the symbol AH. Each parameter which is a potential threat to archeological or historical resources -- and therefore, of current management importance -- is marked with the symbol AM. Parameters marked AH and AM in Appendix B and needing explanation are discussed below.

#### *Soil Parameters*

Fertility (AH). Soil fertility was an important factor in the selection of farmsites by both prehistoric and early historic peoples. Therefore, the distribution of fertile soils during the past 2000 to 3000 years should correlate with archeological farmsites.

Texture (AH). Only relatively friable soils could be cultivated with the simple tools of prehistoric and early historic peoples. So soil texture, along with fertility, can help identify high-potential areas for archeological farmsites.

Susceptibility to Sheet and Rill Erosion (AM). May damage archeological resources.

Susceptibility to Gully Erosion (AM). Erosion may damage archeological resources.

Susceptibility to Wind Erosion (AM). May damage archeological resources.

Erosion Control (AM). Erosion that is adversely affecting an archeological resource should be brought under control.

Soil Maps (AM). These can be important sources of information on possible locations of archeological sites, especially sites related to farming activities.

### *Climatic Parameters*

Precipitation (Amount, Distribution, and Type) (AM). The amount, distribution, and type of precipitation largely determines the rate of sheet, rill, and gully erosion, which may endanger archeological resources.

Winds (AM). Wind velocity and direction determine the rate of wind erosion.

Storms (AM). Storms may damage archeological resources.

### *Existing Structural Facilities (AH, AM)*

Some structural facilities, especially buildings, are old enough and of enough architectural, engineering, or historical significance to fall under the protection of the preservation statutes. Installation of new structural facilities may threaten archeological resources.

Sanitary Landfills (AH, AM). If over 50 years old, a sanitary landfill is an archeological site. Active landfilling may affect archeological resources.

Cemeteries (AM, AH). Digging graves at active cemeteries may affect archeological resources. Some cemeteries may be archeologically or historically significant in themselves.

Road Construction (AM). Road construction may have an impact on archeological resources.

### *Aquatic Biotic Parameters*

Fish (Economic Value, Populations, and Impact of Fishing Activities) (AH). Fish were a staple food for many Native American peoples, as well as for post-Columbian Americans of European origin.

Invertebrate Fauna (AH). Shellfish, both freshwater and marine, were an important resource for both prehistoric and early historic cultures, not only for food, but also for their shells. Widely traded among Native Americans, shells were used for decorating and also as money. Pearls and mother-of-pearl were valuable to both Native Americans and European-Americans, so rich sources of shellfish frequently have archeological or historical sites nearby.

### *Aquatic Natural Abiotic Parameters (AH)*

Water resources -- lakes, lake shoreline, streams, and marshes -- for drinking, technological processing, and as sources of plant and animal foods were important factors in determining the settlement patterns of both Native Americans and Americans of European origin.

*Aquatic Man-Influenced Abiotic Parameters*

Boat Launch (AM). Building boat launches may affect archeological resources.

Maintained Shoreline/Beaches (AM). Maintenance activities may have an impact on archeological resources.

Reservoir (AM). Installation of reservoirs may affect archeological resources.

*Terrestrial Natural Abiotic Parameters*

Topographic Maps (AM). High-potential locations for possible archeological sites frequently can be identified on topographic and other surface-feature maps because there are correlations between favored surficial features (e.g., bluff crests bordering stream valleys, lake shores, caves) and the presence or absence of archeological sites.

Terrain Analysis Maps (AM). Same as Topographic Maps.

Rock Form Features (AM). Same as Topographic Maps.

Tectonic Activity (AM). Tectonic activities may affect archeological resources.

Aerial Photographs (AM). Useful for visually identifying archeological sites and areas where there is high probability that archeological sites are present.

Sites Having Valuable Subsurface Materials (AH, AM). Subsurface mineral resources (e.g., flint and chert for making chipped-stone tools, clay for making pottery, building stone, metals) attracted peoples at all periods of the past. Current mining of subsurface materials -- especially strip mining -- may have an impact on archeological sites.

*Terrestrial Man-Influenced Abiotic Parameters*

Off-Road Recreational Vehicles (AM). Such vehicles may damage archeological resources.

Excavation Sites (AM). Excavations may affect archeological resources.

Hiking Trails (AM). Heavily used hiking trails often are subject to erosion, which may damage archeological resources.

Motorcycle Trails (AM). Motorcycle traffic on unpaved trails may damage archeological resources.

Horseback Trails (AM). Horseback trails often are subject to erosion, which may damage archeological resources.

Stock Trails and Walkways (AH, AM). Modern stock trails may damage archeological resources. Historic or prehistoric stock or animal trails may

have historical significance in themselves, or may be associated with archeological sites where people were attracted to the animals that followed the trails.

Tactical Vehicle Trails (AM). Tank traffic may damage archeological resources.

Firebreaks and Fire Control (AM). Firebreaks or other fire control measures that disturb the earth may affect archeological resources.

Burying Personnel Waste Materials (AM). Excavation of burial pits may damage archeological resources.

Excavating Trenches, Gun Emplacements, Foxholes, Fill, Road Surfacing, Earthworks (AM). Such earthmoving activities as these may affect archeological resources.

Protected/Impact/Range Areas (AM). Range impacts may damage archeological resources.

#### *Military Parameters*

Except for cross-country movement, the parameters listed under this heading probably will not affect archeological resources.

#### *Terrestrial Plant Parameters (A/H)*

Quantitative and distributional data on past faunal populations, both prehistoric and early historic, are of great importance to archeology. All human cultures have relied on animal resources both for food and for raw materials used to make artifacts. Thus most parameters are marked with the symbol AH.

#### *Terrestrial Plant Parameters*

Vegetation Type (AH). Since plants were used both for food and as sources of raw materials for housing and artifact manufacture, knowledge of the types of vegetation that formerly existed in a particular area is a significant parameter for archeology.

Ground Cover Density (AM). The amount of ground surface masked by vegetation is an important factor in estimating the time and cost of conducting archeological surveys. The more ground surface that is visible, the easier it is to locate and evaluate surficial archeological sites.

Seasonal Variations in Vegetation (AH). Availability of plant foods and materials often dictated the seasonal travel of Native American peoples, especially those who foraged for most of their food.

Species Natural Range (AH). Same as Environmental Protection Measures.

Species Population Data (AH). Same as Environmental Protection Measures.

### *Terrestrial Man-Influenced Biotic Parameters*

Human Use of Range and Habitat (AH, AM). Former human use of range and habitat affected biotic populations, which, in turn, affected the cultural patterns of the people who were exploiting the biotic resources. Some kinds of current human use of range and habitat may have an impact on archeological resources.

Impacts from Hunting and Trapping (AH). Former human use of range and habitat affected biotic populations which, in turn, affected the cultural patterns of the people who were exploiting the biotic resources.

Cultivation (AM).

Forest Fire Protection (AM). Firebreaks may damage archeological resources.

Access Routes (AM). Dirt roads through forests often damage archeological resources.

Environmental Protection Measures (AM). Measures to protect cultural resources, including archeological sites, sometimes are necessary.

### *Terrestrial General Biotic Parameters*

Terrestrial general biotic parameters appear to have no effect on archeological resources.

### *Population/People Parameters*

Since population/people parameters refer only to characteristics of modern populations, they have no reference to archeological resources.

### *Surrounding Area Parameters*

Although some off-post land use may have an impact on archeological resources, the effects are not usually the responsibility of land or resource managers of military properties.

### Parameters That May Correlate With Archeological Site Locations

The following parameters may suggest the presence of archeological sites.

1. Physiographic parameters:
  - a. General land forms (e.g., plains, mountains, river valleys, littoral)
  - b. Climate (annual rainfall, temperature, growing season)
  - c. Local topography (habitation sites tend to be at well-drained locations)

- d. Travel avenues (e.g., streams, lakes, seas, divides, passes, corridors).
2. Resource availability parameters:
    - a. Potable water
    - b. Food (vegetable and animal)
    - c. Arable soils (for farming peoples)
    - d. Pasturage (for stock-raising peoples)
    - e. Fuel (for cooking, heating, and technological processing)
    - f. Minerals (stone, metal, clay, salt, etc., for manufacturing)
    - g. Plant raw materials (wood, fiber for manufacturing)
    - h. Animal raw materials (hides, furs, bone, antler, ivory, horn, shell, for manufacturing).

All these parameters have changed in much of North America during the period of human occupancy -- except for most mineral deposits.

Different kinds of archeological sites affiliated with the same culture will usually be correlated with different sets of the above parameters. For example, quarry or mining sites will be found where a people searched for mineral resources, regardless of the other variables; and hunting kill sites may be at places unsuitable for permanent habitation. Knowledge of the particular cultures that inhabited a region is essential to the accurate development of archeological parameter rankings for that area.

### Glossary of Key Terms

- archeological site: Any site at least 50 years old where cultural resources are present -- whether dating from prehistoric (i.e., pre-literate) or historic times. The 50-year criterion is an arbitrary statutory definition; only sites at least 50 years old are eligible for nomination to the National Register of Historic Places.
- archeological survey: An organized search to locate, examine, and make preliminary assessments of archeological sites on a designated property or in a specific geographic area.
- cultural resource: Any tangible evidence of past human activity. A particular resource may be conspicuous (e.g., a standing building or ruins of a building), indistinct (e.g., an Indian burial mound that has been nearly leveled by plowing), or hidden entirely (e.g., artifacts or cultural features buried beneath the ground).

#### References on Methods for Obtaining Archeological Data Parameters

- Deetz, James J. F., Invitation to Archeology (Doubleday, 1967).
- Fagan, Brian M., Archeology: A Brief Introduction (Little, Brown and Co., 1978).
- Guidelines for Local Surveys: A Basis for Preservation Planning (Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, 1977).
- In the Beginning: An Introduction to Archeology (Little, Brown and Co., 1978).
- Hole, Frank and Robert H. Heizer, An Introduction to Prehistoric Archeology, 3rd ed. (Holt, Rinehart, and Winston, Inc., 1973).
- King, Thomas F., The Archeological Survey: Methods and Uses (Heritage Conservation and Recreation Service, U.S. Department of the Interior, 1978).
- Smith, Jason W., Foundations of Archeology (Glencoe Press, 1976).
- Smith, Landon D., Archeological Sampling Procedures for Large Land Areas: A Statistically Based Approach (USDA, Forest Service, 1977).
- Willey, Gordon R. and Jeremy A. Sabloff, A History of American Archeology (W. H. Freeman and Co., 1973).

#### References on Proper Management Plans for Archeological Sites

- Glassow, Michael A., "Issues in Evaluating the Significance of Archeological Resources," American Antiquity, Vol 42 (1977), pp 413-420.
- King, Thomas F., Patricia P. Hickman, and Gary Berg, Anthropology in Historic Preservation: Caring for Culture's Clutter (Academic Press, 1977).
- Lipe, William D., "A Conservation Model for American Archeology," The Kiva, Vol 39 (1974), pp 213-245.
- Lipe, William D. and Alexander J. Lindsay, Jr., eds., Proceedings of the 1974 Cultural Resource Management Conference, Museum of Northern Arizona Technical Series, No. 14 (1974).
- Lynott, Mark J., "The Dynamics of Significance," American Antiquity, Vol 45 (1980), pp 117-120.
- Matheny, Ray T. and Dale L. Berge, Symposium on the Dynamics of Cultural Resource Management, Archeological Report No. 10 (USDA, Forest Service, 1976).
- McGimsey, Charles R., III, Public Archeology (Seminar Press, 1972).



McGimsey, Charles R., III and Hester A. Davis, eds., The Airlie House Report (Society for American Archeology, 1977).

Schiffer, Michael B. and George J. Gumerman, eds., Conservation Archeology: A Guide for Cultural Resource Management Studies (Academic Press, 1977).

Scovill, Douglas H., Garland J. Gordon, and Keith M. Anderson, Guidelines for the Preparation of Statements of Environmental Impact on Archeological Resources (Arizona Archeological Center, National Park Service, 1972).