The Generation of Criteria for Selecting Analytical Tools for Landscape Management[1]

By Marilyn Duffey-Armstrong[2/]

Abstract: This paper presents an approach to generating criteria for selecting the analytical tools used to assess visual resources for various landscape management tasks. The approach begins by first establishing the overall parameters for the visual assessment task, and follows by defining the primary requirements of the various sets of analytical tools to be used. Finally, the paper reviews and critiques a number of existing techniques available for assessing visual (aesthetic) resources by applying the criteria developed.

"There are almost always trade-offs to be made to sub optimize all objectives."[3/]

INTRODUCTION

A statement of objectives implies that an understanding of how well a system should work, and for what purpose, is clearly understood. Since every action and every policy has, or should have, a statement of objectives, those involving landscape management are no exception. The difficulty arises when the objectives of one set of policies and practices within one institutional system must meld with those of others.

During the past decade we have seen a growing concern for environmental quality manifest itself in a multitude of legislated standards and public agency guidelines directed to protecting the environment. The next decade is likely to evidence a similar trend focused on resource development and energy conservation.[4/] Melding the issues surrounding these two separate, but related, national concerns will not be an easy task, particularly for agencies caught up in trying to manage the resources germane to both areas of concern.

The need to locate and develop new energy resources in the United States promises to place ever-growing pressures on landscape managers to compromise visual resources. For example--the siting of a 200-foot wind generating turbine, or acres of solar collectors, or nuclear power plants with their cooling towers and plumes, or even the dedication of vast amounts of land for silviculture to feed a biomass facility--all represent problems for visual resource management.

The immediacy of the energy situation in the United States has created an atmosphere of urgency in planning decisions. Proposals for development have been initiated in many geographical areas of the country. Professionals in the area of landscape management must interact with the decision process *now* in a systematic way, or we will not have the wide range of visual resources to manage in the future that we have available today.

Since visual resources in a narrow sense and aesthetic resources in the broader sense are inherently a part of both environmental quality and resource development, it is essential that public agencies attempting to manage these resources have tools available that will allow them to make an objective assessment of the trade-offs between development (and preservation) options and still include the various interests of the stakeholders associated with each area of concern. The tools are available, though some may need refinement. The key to a successful assessment lies in the selection of the appropriate tools for the management task, and not in how elaborate the individual technique might be.

This paper presents an approach to generating the criteria used for selecting the analytical tools for a variety of landscape management tasks, including:

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[2/]Senior Analyst, SRI International (formerly Stanford Research Institute, Menlo Park, California; and private consultant.

[3/]U.S. Forest Service, Landscape Management Handbook #483.

[4/]These trends are, in part, directly tied to the passage of the National Environmental Policy (1969) and the National Energy Act (1978).

- Environmental impact assessments of alternative energy developments.
- Scenic and open-space preservation.
- Development of land-use plans and overall master plans.
- Plans for special activities, such as recreation development, roadway development, utility corridors, and so on.

The approach to criteria generation focuses on defining the primary requirements of the various sets of analytical tools used for visual assessment, and on matching these with the overall objectives, stakeholders, and ultimate decision makers using the information generated.

The paper will, first, identify and discuss the basic categories of criteria which apply to most landscape management decisions, and then will discuss how individual criteria within each category might differ depending on the task at hand. The paper concludes with a brief review of a number of visual assessment tools, and discusses how each satisfies the different sets of criteria within both resource development and environmental protection issue areas.

CRITERIA GENERATION

Criteria are a set of standards that can be used to evaluate how well various options satisfy an overall objective. The generation of criteria usually accomplishes two purposes: first, it encourages the user, or decision maker, to articulate the important factors in the task; and second, it provides a mechanism for making an objective assessment of the options. It is particularly useful if each criterion, within a set of criteria, can be ranked according to degree of importance to the user and the stakeholders, thus allowing priorities to be established early in the assessment process.

The need for a visual assessment is sometimes an independent task (e.g., the visual quality inventory of land owned by a single agency), but more often is part of a much larger task (e.g., the environmental impacts of a proposed geothermal power plant or a new roadway); thus, the criteria used for the visual assessment must reflect the overall scope and objective of the entire study task. If the visual assessment task is a part of a larger assessment study, the criteria should be compatible with that used for the overall study. For example, the indirect or induced impacts, such as economic impacts, number of persons or activities affected, effect on growth or development, and finally, the degree of resistance to the proposed activity (or project) should be accounted for so that those impacts directly and indirectly associated with visual impacts might be evaluated along with those associated with the technical aspects of the project. This is not to say that visual assessments must be quantitative rather than qualitative, but they must at least address similar categories of concern in order to become a part of the overall evaluation scheme. All too often, the visual assessment component of a study is given a "footnote status" simply because it does not directly relate to the factors discussed under the more technical categories of assessment. And yet, the visual assessment factors are typically the ones underlying the ultimate reasons for support or opposition to the proposed action.

The approach to criteria generation follows a logical progression of steps (Figure 1) beginning with a definition and understanding of the landscape management task. Landscape management tasks can range from the development of policies for the preservation of visual resources, for example, to the actual design phase of a new development, such as the siting of a utility transmission line. Once the objective for the overall study task is defined, a statement of the role that the visual, or

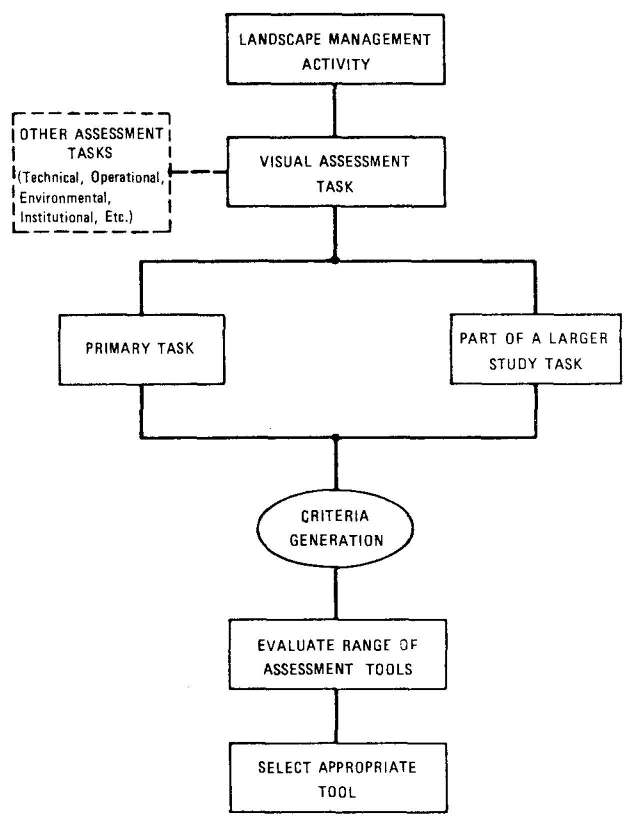

Figure 1--Approach to Criteria Generation

aesthetic, assessment task plays should be prepared. For example, the development of a policy to "preserve the unique bodies of water on public lands" would require a visual assessment task to inventory all bodies of water and then assign a visual resource quality rating to each. In this example, the visual assessment task would be the primary task in the study and would therefore have criteria specific to its own statement of objectives.

If, for example, the visual assessment task is only a part of a larger study task, such as the environmental impact assessment of a geothermal development, the objectives and criteria for the visual task must reflect the overall study objectives (such as to select options that minimize disruption to the natural setting while still maximizing the efficiency of the geothermal resource).

Typical categories of criteria used for evaluation schemes in overall study tasks include the following:

- Long-term versus short-term tradeoffs.
- Assessment of the irreversible commitment of resources.
- Impacts to the human environment such as economic, social and institutional impacts--the number and categories of stakeholders affected.
- Impacts to the natural environment.
- The technical difficulty and the costs involved with implementing the proposed action.
- Openness to public input.

Criteria within each of the above categories tend to vary somewhat depending on the scope of the management task being addressed. For example, in the siting of a utility substation and transmission lines, the criteria in the last four categories would be most important because the primary concern is to minimize the direct impacts of the new development. If, on the other hand, the project is a geothermal development, the emphasis would be on the first two categories of criteria because the visual impacts of the development induced by the availability of geothermal power (presuming it will be lower cost than conventional sources such as oil) would be far greater than those of the actual physical plant. Similarly, master plan development and policy development that influences growth and the form of development in future years would emphasize criteria within the first two categories. (A move to dispersed rather than central energy systems such as solar heating and cooling is an example of a policy in this category.)

In order to illustrate further the importance of criteria generation for visual resource management, a recent policy evaluation process on the Island of Hawaii is described. The policy under consideration was a statement by both the state and county governments for a move to energy self-sufficiency by the year 1990.[5/] The assessment process had to do with identifying all renewable energy options available on the island and making an assessment of the economic, social, and environmental impacts of each of the options.[6/] The visual assessment part of the task was clearly directed to identifying and assessing the magnitude of the impacts directly resulting from the development of the physical facilities associated with each energy option.

Using the approach outlined in Figure 1 of this paper, it became evident that the visual assessment task must also address the longer-term impacts induced by each of these options (or combinations of options) in order to be consistent with the criteria of the broader study task. The differences had to do with looking at the change to the visual and aesthetic character of the island that could occur given an inexpensive energy source (such development as manganese nodule processing plants to extract aluminum from ores from the sea, extensive hotel and tourism growth, general population influx, and so on). The result was that in addition to the straightforward assessment of the visual impacts of each of the energy options, a more complete assessment would allow for an assessment of the tradeoffs with conservation options, stronger regulatory and environmental controls, and the longer-term development objectives for the island. For example, one of the energy options was further use of the existing biomass facility (located in conjunction with the sugar cane processing plant). This facility produces low-cost energy by burning the waste product from the sugar cane processing, thus eliminating a waste disposal problem. The same operation, however, also generates visual impacts from excess emissions (particulates) and effluents (sedimentation in discharge to the ocean). The cost of controlling these impacts is over $1.5 million per year in environmental control technology. A continued expense of this magnitude will eventually run the plant out of business and thus eliminate one of the most efficient renewable energy sources on the island. The tradeoffs between the visual impacts resulting from this biomass activity

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[5/] Self-sufficiency in this case meant a reduction in the amount of imported oil to the island.

[6/] Options included wind energy machines, hydropower from waterfalls, biomass conversion using sugar cane residue, geothermal development in the volcanic region, and solar hot water.

(which are ultimately controllable and focused on one location) and those resulting from massive industrial and commercial development, such as that which would accompany geothermal and ocean thermal, turned out to be of primary interest to decision makers and the general public in Hawaii. This assessment would not have happened without the careful review of criteria for the overall study task and a structuring of the visual assessment task which looked beyond the immediate, more obvious impacts.

Once criteria have been defined for the visual assessment task, the user is ready to consider how various analytical tools might help provide the information needed. Visual assessment tools include:

- Manual graphic techniques--such as artist renderings of the landscape.
- Photographic techniques--sometimes with photo retouch images superimposed in the scene, and photomontages.
- Descriptive techniques--such as matrices and checklists.
- Mapping techniques--such as overlays and color coded maps.
- Computer graphic simulations--in some cases combined with photographs.

Each of these techniques is described in detail in the accompanying papers in this publication. The remaining section of this paper is a brief review of each categorical area and a discussion of how well techniques within each category satisfy the various sets of criteria described above. Examples of specific techniques are identified for each categorical area; however, for a more complete selection of analytical tools the reader should refer to a report by the author entitled "Aesthetics in Environmental Planning" (Bagley, 1973) and "Measuring Scenic Beauty: A Selected Annotated Bibliography," The USDA Forest Service (1976).

REVIEW OF VISUAL ASSESSMENT TOOLS

Visual assessment tools are designed both to provide an illustrative description of the existing characteristics of the landscape and to enable a user to simulate the changes to the landscape that would result from a planned development or management activity. The information generated by these tools is merely input to the ultimate assessment tasks. The success of the tasks lies in the creative and systematic application of the tools to the overall problem.

A few general criteria apply to all categories of visual assessment techniques; these include:

(1) The technique should provide information generated from public experience, as free as possible of the developer's biases. The method should be as objective as possible and should at least reflect knowledge of information generated from studies developed for assessing user preferences.

(2) The technique should cover the full range of attributes in the environment including natural and man-made (built) characteristics, unique features, and misfits (intrusions which detract from the setting).

(3) The factors and variables used should be appropriate to the scale and purpose of the ranking system. Thus, a ranking system designed to evaluate a large region for the purpose of formulating a land-use policy may necessitate an entirely different set of factors and variables than a system prepared to evaluate a camping site.

(4) A good technique will be straightforward and easily reproduced by others (planners), and relatively inexpensive to employ. Persons having skills and training similar to those who develop a technique should be able to reproduce and evaluate it. Likewise, the complexity of the technique and sophistication of the tools used in the system should reflect the resources typically available to the intended users (including manpower, budget and hardware resources).

(5) The output from the technique (information generated) should be easily translated and useful as a communicative tool between planner and decision maker; and between decision maker and the relevant public.

(6) Values assigned to visual impacts or simulated changes should indicate especially sensitive aspects that influenced evaluation (special interest groups, trends in established values, culturally diverse groups).

Manual Graphic Techniques

Hand-rendered plans, perspective sketches, sections and elevations have a long history as useful tools for design analysis of changes and for public presentation. These artist renderings offer particular advantages in that they present a visual image based solely on human perception. A skilled artist can thus portray the important characteristics in a manner that helps generate particular responses in the observer. Depending on the number and complexity of images desired, and with limited data available, this technique remains among the lowest-cost presentation tools.

The disadvantages of the manual graphic techniques are that: the accuracy of the image is dependent on the artist's perception and interpretation of the scene, thus making objectivity difficult; high-quality drawings are time-consuming to produce and difficult to change once completed; and, finally, some persons have difficulty understanding the image presented by line drawings, such as sections and elevations.[7/]

Photographic Techniques

Photographic techniques include: a straight snapshot of a particular view of a landscape, or portions of the landscape; a photo retouch with a proposed change to the scene air brushed or spliced in; or a photographs with an artist's sketch or computer graphics printout superimposed on the scene. Photographs offer the advantage of allowing realistic reproductions of the existing image. They are usually cost-effective, given that a skilled photographer and photographic equipment are available, and they provide familiar presentation images to the general public and decision maker (unlike trying to "read" line drawings).

The disadvantages of this technique are: it is sometimes difficult to highlight characteristics of particular significance for soliciting response from the public, and it requires extra time to superimpose changes to the existing landscape scene.

Additional limitations include the difficulty of covering a large expanse of space (without the use of costly aerial photographs) or hard-to-get-at perspectives, thus making large-scale evaluation schemes difficult. Examples of photographic techniques are described in studies completed by Shafer and Mitz (1970); Burke et al. (1968); and by Jones and Jones et al (1975).

Descriptive Techniques

Visual assessment tools under this category include: inventory-type checklists of characteristic attributes in the landscape (e.g., a grove of redwoods, a pond, a flowering tree, a mountainous horizon, and so on); matrix checklists attributing an evaluation factor to each attribute; and narrative description of relevant landscape characteristics. Examples of techniques which fall within this category have been developed by Handley (1973); Leopold (1969); and Litton (1972).

Descriptive techniques lend themselves to environmental impact assessment projects because they produce information compatible with the format of other environmental characteristics (e.g., air quality, water resources, vegetation, social and economic characteristics, etc.); however, without the use of other visual presentation tools (maps, photos, drawings) they can have limited impact on decision makers because it is extremely difficult to articulate physical changes to the landscape effectively without the use of a graphical image of some type. It is also very difficult to treat detail adequately without extensive text, or an extremely talented writer.

Mapping Techniques

This approach can include combinations of aerial photographs or geological survey maps with manually prepared overlays describing landscape characteristics. Two examples of this technique include: the one described in Design with Nature by Ian McHarg (1969), and "How to Rate and Rank Landscapes," by Hart and Graham (1967).

This approach offers the opportunity for a comprehensive analysis of visual resources as they are related to other environmental factors (landform, vegetation, ecosystems stability, and so on). Additionally, because it combines graphic illustrations (maps) it is visually informative as well. The major disadvantage is that the data collection necessary to develop this technique is labor-intensive and thus time-consuming and costly.

Computer Graphics

During the past several years a number of public agencies, universities and private firms have developed computer-generated graphic assessment tools. Once the descriptive information is input to the computer (detailed data

[7/] "Creating Land for Tomorrow," Landscape Architecture Technical information Series, Volume 1, Forest Service, 1978, p. 38.

describing height of terrain, height and density of surface patterns coded in grid cell structures) the computer can output a three-dimensional line drawing on plotted paper or 35 mm film. It is possible to produce computer-generated plans, perspective sketches, and pro-files of existing and proposed landforms and surface patterns. Once the extensive input data task is complete, the computer can generate views of a project from many different heights and locations in a very short period of time.

Disadvantages are similar to those mentioned above under mapping techniques--extensive data collection which can be time consuming and costly (plus the cost of computer time), in addition to the problem that software is difficult to analyze for built-in assumptions and not always easily reproducible by a lay person. Further, unless combined with photos, the graphic printout may be unfamiliar to the public and thus difficult to understand.

Examples of computer-aided visual assessment techniques include those described in reports by Bunde (1972); Feeser (1971); and Fabos (1974).

In summary, each of the analytical tools described above has specific advantages and limitations, which further illustrates the point that it is the selection process that is critical to the assessment. In some cases a combination of these tools provide a more complete understanding of the situation than the use of any one tool alone.

The usefulness of the visual assessment tools does not lie in the fact that they may be the latest creation available, or the most glamorous portfolio of illustrations to show the decision makers, but rather, how well they satisfy the need for information that feeds into addressing the overall objective of the assessment project. The assessment tools, properly used, offer an opportunity to do a more objective and systematic job of including the visual tradeoffs with other impact areas in the overall landscape management task. The critical step in the evaluation process is the generation of the criteria for the task itself, thus enabling the selection of the appropriate tools. If we, as professionals, expect to influence the visual quality of our future landscape, we must move beyond focusing on the tools and reassess our understanding of their application and usefulness in the decision process.

LITERATURE CITED

American Society of Landscape Architects.
1978. Creating land for tomorrow. USDA Forest Serv. Landscape Arch. Tech. Infor. Ser., Vol. 1, No. 3, Surface Envir. and Min. Pro., Billings, Mont., 45 p., illus.

Anonymous.
1977. National forest landscape management handbook, #483, Vol. 2, Chap. 4, Roads. USDA Forest Serv., 62p., illus.

Arthur, Louise M., and Ron S. Boster.
1976. Measuring scenic beauty: a selected annotated bibliography. USDA Forest Serv. Tech. Report RM-25, Rocky Mountain Forest and Range Exp. Sta., Ft. Collins. Colo., 34 p.

Bagley, Marilyn, and Cynthia Kroll.
1973. Aesthetics in environmental planning. EPA report 600/5-73-009, 187 p.

Burke, Hubert D., et al.
1968. Method for classifying scenery from a roadway. Pract. Dev. Guidl. 22(1):125-141.

Jones, Grant R., and Ilze Jones, et al.
1975. A method for quantification of aesthetic values for environmental decision making, Nuclear Tech., 25:682-713.

Feeser, Larry.
1971. Computer-generated perspective plots for highway design evaluation. Fed. Hwy. Admin. Report No. FHWA-RD-72-3, Wash. D.C.

Ferris, Kimball H., and Julius Fabos.
1974. The utility of computers in landscape planning: the selection and application of a computer mapping and assessment system for the Metropolitan Landscape Planning Model (METLAND). Mass. Agric. Exp. Stn. Res. Bull. No. 617, Coll. Food and Nat. Resources, Univ. Mass., Amhurst, 116 p.

Handley, Rolland B., T. R. Jordan, and William Patterson.
1973. An environmental quality rating system. U.S. Dept. Int., Our. Outdoor Recreat., Northeast Reg. Off., Phila., Pa., 45 p.

Hart, William, and William Graham.
1967. How to rate and rank landscapes. Landscape Archit. 57(2): p. 121-123.

Kramskopf, Thomas, and Dennis Bunde.
1972. Evaluation of environmental impact through computer modeling process. Univ. of Wis., Madison, Wis., 29 p.

Leopold, Luna B.
1969. Quantitative comparison of some aesthetic factors among rivers. Geol. Surv. Circ. 620, p. 1-16, U.S. Dept. Int. Geol. Surv., Wash., D.C.

Litton, Burton R., Jr.
1972. Aesthetic dimensions in the landscape. In Natural Environments: Studies in Theoretical and Applied Analysis, p. 262-291. John V. Krutilla, ed., Johns Hopkins Univ. Press, Baltimore, Md.

McHarg, Ian.
1966. Design with nature, National Hist. Press, Doubleday and Co., N.Y., 198 p.

Shafer, Elwood, and James Mitz.
1970. It seems possible to quantify scenic beauty in photographs, USDA For. Serv. Res. Pap. NE-162, Northeast For. Exp. Stn., Upper Darby, Pa., 12 p.