Appraising the Reliability of Visual Impact Assessment Methods[1]

Nickolaus R. Feimer,[2] Kenneth H. Craik,[3]

Richard C. Smardon[4] and Stephen R. J. Sheppard[4]

Abstract: This paper presents the research approach and selected results of an empirical investigation aimed at the evaluation of selected observer-based visual impact assessment (VIA) methods. The VIA methods under examination were chosen to cover a range of VIA methods currently in use in both applied and research settings. Variation in three facets of VIA methods were investigated: (1) the descriptive landscape attributes which serve as the basis for ratings; (2) the rating procedure employed; and (3) the mode of landuse activity simulation. Research participants consisted of USDI Bureau of Land Management (BLM) staff and university environmental planning and management students with prior VIA training. Research participants were assigned to one of three experimental groups, with each group rating 35 mm photo slide representations of 4 scenes using some combination of the various rating procedures. The scenes employed are representative of typical landscapes and landuse activities in BLM's administrative jurisdiction. Reliability coefficients for the various rating methods are presented. Observed trends in the reliability coefficients indicate that reliabilities are: (1) low for ratings based on small numbers of observers; (2) higher for ratings of scenes before the imposition of landuse activity impacts than for ratings of scenes after the imposition of impacts; (3) higher for direct ratings of landscape attributes than for ratings of the degree of contrast, or change, imposed upon landscape attributes by landuse activities, and (4) higher for BLM's visual contrast rating method when the visual impact is simulated by photographic representation rather than brief verbal descriptions and artists' sketches.

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[2] At the time of this report, Assistant Research Specialist at the Institute of Personality Assessment and Research (IPAR), University of California at Berkeley; currently, Assistant Professor of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

[3] Professor of Psychology and Research Psychologist, Institute of Personality Assessment and Research (IPAR), University of California at Berkeley.

[4] Post-graduate Landscape Architect, Department of Landscape Architecture, University of California at Berkeley.

The goal of Visual Resource and Impact Assessment (VRIA) is the provision of systematic and objective information concerning the visual quality of landscapes and the visual impacts of landuse activities pertinent to decisionmakers charged with land resource management (Brush 1976; Craik 1970, 1971, 1972; Craik and Feimer 1979; Craik and Zube 1976; Litton 1968; Zube, Brush and Fabos 1975). A fundamental assumption underlying the inclusion of such methods in the decision-making process is that more effective and judicious management practices will result. However, that assumption can be correct only if the quality of information generated by VRIA methods is acceptably high. Effective decisions are possible to the degree that the information upon which they are based is both accurate and appropriate to the issues at hand.

The nature and quality of information generated by VRIA methods can be appraised by standard psychometric indices (Craik and Feimer 1979, Daniel 1976). Although a number of measurement issues are of fundamental importance in that regard, none is more basic than the question of reliability. Most simply, the reliability of measurement provides an index of the consistency and precision with which a measurement instrument performs. A reliable instrument will yield consistent results upon repeated attempts to measure a particular attribute under relatively equivalent conditions and will accurately reflect systematic variation of the attribute in question under varying conditions.

In the context of observer-based VRIA's, the issue of reliability concerns the degree of agreement attainable from independent judgments of specified landscape attributes (Craik and Feimer 1979, Daniel and Boster 1976). These independent judgments may be made by the same individuals rendering their judgments at two different times, in which case a measure of intra-observer reliability is obtained, or they may be judgments made by persons independently and subsequently compared to one another, in which case a measure of inter-observer reliability is obtained. Estimates of both intra-observer and inter-observer reliability are desirable, but an estimate of inter-observer reliability is especially important in evaluating observer-based VRIA methods since the scope of comparability in judgments among individuals defines the attainable level of objectivity of the measures in question.

The empirical evidence concerning inter-observer agreement indicates that relatively high reliability (e.g., reliability coefficients as high as .7 - .9 on a 1.0 scale) is obtained when (1) the coefficients are based upon the degree of agreement between composite ratings of 2 or more panels with 10 or more judges per panels (Brush 1976; Craik 1972a; Shafer and Tooby 1973; Zube 1973, 1974; Zube, Pitt and Anderson 1975), or (2) when multiple scenes representative of target areas are rated by every observer and the composites for each area are employed in obtaining the reliability estimates (Daniel and Boster 1976).

Although it is reassuring to know that the reliability of scenic quality and related descriptive attributes can be relatively high when multiple composite ratings are obtained, the plausibility of obtaining such composite ratings is somewhat limited in the day-to-day context of VRIAs. The manpower allocation of 5 or more observers to evaluate the same area from multiple perspectives is normally reserved for major developments, such as the siting of nuclear power plants, large-scale oil exploration and major utility corridors. For more frequently occurring and mundane VRIA problems, such as pipeline and tank siting, small scale mining, and brush to range conversion, one or two field technicians may have the task of carrying out the pertinent VRIA procedures from the vantage point of the nearest access road. Under these conditions the reliability of the obtained indices cannot be expected to be as high as it is under conditions permitting a large number of raters to evaluate an area from numerous perspectives. The reliability of indices based upon multi-rating composites will almost inevitably result in reliabilities far in excess of unitary ratings (Guilford 1954; Nunnally 1978). Nonetheless, the need for the establishment of psychometric standards under non-optimal assessment conditions must also be of concern. Although the landuse activities being evaluated under those conditions may not singly constitute major landscape intrusions, by virtue of their more frequent occurence they have the potential for compounding their effect on the landscape over time and thus, in the long-run, can be just as detrimental to scenic quality as the initially more attention-getting single large-scale impacts.

The research to be reported here appraises the reliability of selected Visual Impact Assessment (VIA) methods which can be applied under site specific conditions with varying numbers of observers. It is part of a more comprehensive research project being carried out in cooperation with the U. S. Department of Agriculture's Forest Service and the U. S. Department of the Interior's Bureau of Land Management to evaluate VIA methods relevant to use within those agencies.[5] A technical

5/This research was supported by the U.S.D.I.,

evaluation of the U.S.D.I. Bureau of Land Management's (BLM) Visual Contrast Rating (VCRM; U.S.D.I., Bureau of Land Management 1975) has been a primary goal of the undertaking.

METHOD

Selection of VIA Methods

A review of the literature on observer-based VIA methods reveals considerable variation in three facets: (1) the descriptive landscape attributes which serve as the basis of ratings; (2) the rating procedure enlisted, including instructional sets for attending to the landscape representation and recording responses; and (3) the form of simulation employed to depict changes in the landscape. Variations in each of those VIA system facets were selected for study in the current research project based on their prevalence in either application or the research literature, and their promise for ease of incorporation into active VRIA programs dealing with a wide range of both large and small scale landuse applications.

Descriptive Attributes

Thirteen environmental descriptors applicable to general evaluation of landscapes and 2 descriptors applicable directly to impact evaluation were examined. The general landscape descriptors include: ambiguity, color, compatability, complexity, congruity, form, intactness, line, novelty, scenic beauty, texture, unity and vividness. The impact evaluation descriptors were importance (of an element) and severity (of visual impact). Color, form, line and texture were included because of their use in BLM's VCRM (USDI, Bureau of Land Management 1975), as well as in other VRIA systems (e.g., Litton 1968, 1972; USDA, Forest Service 1974, 1975, 1977). Importance, intactness, unity and vividness were abstracted from the work of Jones and his colleague's (Jones et al.1975). Scenic beauty, as a general index of visual quality, was drawn from the work of Daniel and his colleague's (Daniel and Boster 1976; Daniel et al.1977; Schroeder and Daniel in press). Ambiguity, compatability, complexity, congruity and novelty were drawn from concepts developed primarily in the experimental aesthetics literature (Wohlwill 1976). Severity was added as a general dimension intended to assess the degree of visual impacts.

Rating Methods

A four-point 0 to 3 scale analagous to the one employed in BLM's VCRM (1975) was employed for all ratings. An ordinal scale of measurement was presumed, with the numeric values representing the strength of the qualities rated. The verbal labels none, weak, moderate and strong were associated with the numeric values 0, 1, 2, and 3 respectively, in conformance with BLM's VCRM (1975).

Two rating procedures were employed. One of these entailed a direct rating of the visual representation of scenes with respect to the descriptive attributes previously enumerated. The use of these direct ratings in VIA requires independent ratings of a particular scene (a) in its unaffected state, and (b) after presentation of a landuse activity by visual or other means.

The other rating procedure entailed a rating of the degree of change, or contrast, in all of the descriptive attributes, except importance and severity, following a visual presentation of each scene both before and after the imposition of a landuse activity. Importance and severity ratings imply the rating of some element of change by definition, and thus required no additional procedural modification.

Landscape and Impact Stimuli

Scene Selection. Three primary criteria were employed in the selection of landscape scenes: (1) the representativeness of scenes with respect to general landscape types within the BLM's management domain; (2) the scenes' suitability for landuse activities that bear upon BLM's visual management concerns; and (3) the availability of photographs of suitable quality for reproduction and simulation.

BLM's land holdings are located primarily in the western portion of the United States and are quite extensive and diverse. To select representative scenes, it was necessary to develop an appropriate landscape classification. The area in question extends from the Pacific coastline, to the eastern border of North Dakota, Nebraska, Kansas, Oklahoma and Texas.

The landscape classification was based on the system developed by Litton et al.(1978) for the Northern Great Plains. Continuities

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Bureau of Land Management (USDA Pacific Southwest Range and Experiment Station interagency agreement nos. PSW-46 and PSW-62) and the USDA Forest Service (USDA Pacific Southwest Range and Experiment Station interagency agreement no. 36).

and provinces were identified by consulting references on physiographic and vegetative features, supplemented by color slides from a number of areas. Hammond's (1964) land-surface form classification and Kuchler's (1969) vegetation maps were the primary sources used. Thirty-six landscape continuities were identified and subsequently grouped into 10 landscape types, based upon similarities in topography and vegetation. The land-form and vegetation combinations which constitute the ten types are: rugged mountain with forest; rugged mountain with a mosaic vegetative pattern (combination of vegetation of vegetative types); combined plain and mountain with forest; combined plain and mountain with open vegetation (sparse vegetation which forms no visual mass); tableland (plateau) with forest; tableland with mosaic; tableland with open vegetation; subdued landform (flat, gentle) with forest; subdued landform with open vegetation; and, coastal continuities.

Landuse activities relevant to BLM visual management were identified through interviews with landscape architects in all BLM state offices. The most pertinent landuse activities can be characterized by nine general classes: range and agriculture; timber; water; surface mining; oil and gas exploration; power plants; utilities; roads; and, recreation. An "other" category for assorted minor landuse activities was also formed.

Nineteen scenes that characterize landscapes and landuse activities relevant to BLM and for which appropriate photographs were available were selected. However, the data to be reported here are based only upon the four scenes in Figure 1. Scenes 1 and 2 represent the landscape class consisting of subdued landform with open vegetation. The landuse activities for those two scenes are surface mining and utilities, respectively. Scenes 3 and 4 represent the landscape class comprised of plain and mountain landform with open vegetation. The landuse activities for those two scenes are water (tank and pipeline in this case) and roads.

Simulation. To evaluate the effectiveness of the various VIA methods, two visual alternatives of each scene were required, one depicting the scene before the imposition of a landuse activity (pre-impact) and one depicting the scene subsequently (post-impact). However, pre-impact and post-impact photographs of scenes controlled for observer position, lighting, time of day, season, and other variables were not available. Thus it was necessary to employ some form of simulation.

The photographs used in this study are 35 mm color slides, which were obtained from BLM state and district offices, the USDA's Forest Service, the California Coastal Zone Commission, and the files of one of the authors. Of the nineteen original photos, four depicted scenes before intrusion of a landuse activity, and the others depicted the scene after the intrusion of a landuse activity.

Simulation of pre-impact scenes was accomplished by a 3-stage retouching process. Two 7"X10" high quality color prints were made from the original slide. One of the reprints was retouched to remove the activity, using retouch dyes to darken and alter light color, and opaque water color to lighten dark areas or objects. An airbrush was used to apply water color to mask structures seen against the sky. The appearance of the landscape obscured by the landuse activity was inferred from unaffected portions of the landscape in the scene. Both the altered (pre-impact) and unaltered (post-impact) prints were then rephotographed to produce the slides used in this study.

Simulation of post-impact scenes was accomplished by painting in the landuse activity. The first and third steps of this process were the same as in pre-impact simulation. In the second step, the addition of the landuse activity was accomplished by outlining the proposed development based upon the locations of the viewpoint and activity (in one case this was done using the mosaic photomontage program), the dimensions of the proposed development, and the construction material specifications. The activity was then painted in using opaque and retouch colors.

Scenes 1 to 4, employed in the portion of the study reported here, are displayed in Figure 1.*

Research Design

To assess the psychometric attributes of the direct and contrast rating procedures under the three rating conditions (direct pre-impact rating, direct post-impact rating, and pre-impact versus post-impact contrast), two experimental conditions were employed.

Pre-Impact and Post-Impact Treatment (PRE-POST)

Research participants in this treatment condition are shown pre-impact versions of the scenes, and immediately after viewing each scene are asked to rate all of the landscape attributes previously enumerated (see Appendix A), except importance and severity.

*See color illustration on page 391.

Next they complete part 1 of the BLM VCRM, which entails a description of the scene in terms of form, line, color, and texture, for each of three segments of the landscape: (1) land-water bodies, (2) vegetation, and (3) structure.

The pertinent landuse activity for the scene is then presented in one of two forms: (1) A single 8 1/2"x 11" sheet of paper containing an artist's black and white sketch of the site with the impacting activity added, along with a one paragraph statement concerning dimensions and construction features (e.g., composition, color and texture of building materials) of the activity; or, (2) the post-impact photo slide. Immediately after the presentation of the pertinent impacting activity for each scene, participants complete three additional procedures. First, using the four point scale previously described, respondents rate the degree of contrast the landuse activity imposes upon all of the landscape elements, except importance and severity, and then rate the importance of the landuse activity with respect to scenic quality and severity of visual impact. Second, participants complete Part 2 of the BLM VCRM, which entails a description of the landuse activity in terms of the same descriptive dimensions and landscape components previously noted for the landscape description required in Part 1 of the VCRM. Finally, participants complete Part 3 of the BLM VCRM, which entails a rating of the degree of contrast the activity generates for the dimensions of form, line, color and texture (separately for the landscape components of land-water bodies, vegetation, and structure).

Post-Impact Only Treatment (POST)

Research participants in this treatment condition are shown only the post-impact versions of the scenes. Immediately after viewing each scene participants rate it on all landscape attributes (see Appendix A) (except Importance and Severity). After completing these ratings the relevant landuse activity is pointed out, and participants are asked to rate the importance of the element in determining the scenic quality of the scene and the severity of visual impact caused by that element.

STUDY: PART 1

Participants

Research participants in this portion of the study consisted of 60 BLM staff members whose agency duties included VIA. All participants had received some training in BLM's VCRM. The professional specialties of participants in this sample are: landscape architecture, recreation planning, and various technical areas (e.g., range, minerals, forestry).

Procedure

Data were collected at three BLM agency meetings and at one special session arranged for the study. At the three BLM agency meetings, participants were randomly assigned to one of the two experimental conditions. At the special data collection session, facility limitations and the small number of BLM staff in attendence made group sub-division unfeasible. In that instance all participants were assigned to the PRE-POST experimental condition.

Each experimental session was directed by one of two male research staff members, who read standardized instructions explaining the rating procedures. Each session followed the sequence previously described for the appropriate experimental treatment. For the current study photo-slides 1 to 4 were employed, and were shown in serial order. A one-page sketch and verbal description were used to present the landuse impacts to participants in the PRE-POST treatment condition.

Results

To provide reliability estimates pertinent to a range of field conditions where a small number of independent observers carry out the rating task, two reliability estimates have been calculated for each rating scale under each condition. One is the average reliability for a single observer, and the other is the average composite reliability for a panel of five observers. The average reliability estimates for single observers consist of the intra-class correlation (Ebel 1951) coefficients derived from a one-way analysis of variance (ANOVA), where scenes are the main effect and the residual variance is the error term. For each rating the composite reliability for a panel of five observers was obtained by an application of the Spearman-Brown correction, which is based upon the single observer reliability and gives a reasonably accurate estimate of composite reliabilities for any number of observers (Guilford 1954).

Reliabilities for the direct ratings of pre- and post-impact versions of the scenes by BLM staff are given in the second two and last two respective columns of numbers in

Table 2. Reliability Coefficients for Contrast and Impact Ratings[a]

Scale	STUDENT PRE-POST (PRE- AND POST-IMPACT) r_1	r_5	BLM PRE-POST (PRE- AND POST-IMPACT) r_1	r_5
AMBIGUITY	.04	.17	.07	.27
COLOR:				
Overall	.34*	.72	.06	.24
Land-Water Bod.	.49*	.83	.20*	.56
Begetation	.13*	.43	.05	.21
Structure	.05	.21	.19*	.54
COMPATABILITY	.01	.05	.06	.24
COMPLEXITY	.01	.05	.04	.17
CONGRUITY	.02	.09	.00	.00
FORM:				
Overall	.11*	.38	.04	.17
Land-Water Bod.	.18*	.52	.08*	.30
Vegetation	.04	.17	.12*	.41
Structure	.49*	.83	.06	.24
IMPORTANCE	.00	.00	.00	.00
INTACTNESS	.08*	.30	.00	.00
LINE:				
Overall	.01	.05	.09*	.33
Land-Water Bod.	.16*	.49	.10*	.36
Vegetation	.41*	.78	.17*	.51
Structure	.25*	.63	.00	.00
NOVELTY	.00	.00	.03	.13
SCENIC BEAUTY	.02	.09	.14*	.45
SEVERITY	.05	.21	.00	.00
TEXTURE:				
Overall	.14*	.45	.08*	.30
Land-Water Bod.	.10*	.36	.04	.17
Vegetation	.00	.00	.03	.13
Structure	.39*	.76	.03	.13
UNITY	.00	.00	.12*	.41
VIVIDNESS	.01	.05	.05	.21
n (Raters	22		22	

[a]The average single observer reliability is r_1, and the average five observer composite (based upon a Spearman-Brown correction of r_1) is r_5.

*$p < .05$ (probabilities are based upon intraclass correlation and significance is given only for r_1).

STUDY: PART 2

Participants

Participants in this portion of the study consisted of 23 upper division students in the Environmental Planning and Management Program at the University of California, Davis.[9] Participation in the research project was part of a laboratory to a course on visual analysis and planning in which all students were enrolled.

Procedure

Participants were first given an abbreviated three hour version of the standard BLM VCR training procedure by a trained BLM staff member.[10] This training consisted of familiarization with the appropriate sections of the BLM VCRM manual (USDI, BLM 1975), an explanation and discussion of conceptual and practical underpinnings of the VCR system, and the presentation of visual examples with illustrations of VCR use.

One week later students participated in the same PRE-POST experimental condition previously described for BLM staff participants. The procedure was identical except that after completing the direct pre-impact ratings the color photo-slide post-impact version of the scene was presented (rather than the verbal description and sketch presented to the BLM PRE-POST group in the previous study). Because three of the four post-impact scenes were photographic representations of the actual activity, this treatment condition was virtually equivalent to perfect knowledge of the actual visual impacts associated with each landuse activity, subject to the accuracy of the pre-impact simulation.

Results

Reliabilities for direct and contrast-impact ratings are presented under the first two columns in Tables 1 and 2, respectively.[11] A comparison of the BLM and student PRE-POST groups with respect to the PRE-IMPACT direct ratings, the general contrast ratings and the BLM contrast ratings reveals some differences on a scale by scale basis, but in general the level of reliabilities is similar. The

9/We would like to thank Dr. Ronald Hodgson, Ms. Sheila Brady and Mr. Ron Thayer of the Environmental Planning and Management Program of the University of California, Davis, for making available the facilities of their institution and for encouraging student participation in this research project.

10/We would like to thank Mr. Alex Young of BLM's California State Office for conducting the student training session.

11/One protocol was discarded because of excessive missing data.

Table 1. Reliability Coefficients for Direct Ratings[a]

Scale	STUDENT PRE-POST (PRE-IMPACT)		BLM PRE-POST (PRE-IMPACT)		BLM POST (POST-IMPACT)	
	r_1	r_5	r_1	r_5	r_1	r_5
AMBIGUITY	.02	.09	.09*	.33	.10*	.36
COLOR	.12*	.41	.02	.09	.02	.09
COMPATABILITY	.06	.24	.04	.17	.20*	.56
COMPLEXITY	.68*	.91	.44*	.80	.13*	.43
CONGRUITY	.07	.27	.24*	.61	.02	.09
FORM	.52*	.84	.38*	.75	.10*	.36
INTACTNESS	.20*	.56	.44*	.80	.00	.00
LINE	.34*	.72	.00	.00	.14*	.45
NOVELTY	.60*	.88	.47*	.82	.17*	.51
SCENIC BEAUTY	.10*	.36	.39*	.76	.17*	.51
TEXTURE	.47*	.82	.50*	.83	.14*	.45
UNITY	.00	.00	.26*	.64	.08*	.30
VIVIDNESS	.44*	.80	.56*	.86	.23*	.60
n (Raters)	22		22		33	

[a]The average single observer reliability is r_1, and the average five observer composite (based upon a Spearman-Brown correction of r_1) is r_5.

*$p < .05$ (probabilities are based upon intraclass correlation and significance is given only for r_1).

Table 1.[6] A perusal of these reliability coefficients yields three observations.[7]

First, the general level of the reliabilities is quite low for both the pre-impact and post-impact conditions. The single rater reliabilities for the pre-impact condition range from .00 to .56, with an average[8] of .24 (the possible range for reliability coefficients is .0 to 1.0, with .0 indicating complete lack of agreement and 1.0 indicating complete agreement). For the post-impact condition, single rater reliabilities are even lower, ranging from .00 to .23, with an average of .10. Standards for psychological rating procedures lead to an expectation of reliabilities of .7 or higher.

Second, the average reliability in the post-impact condition was lower than that in the pre-impact condition. That may indicate that the presence of obvious landuse activities in scenes that were previously in relatively natural states may elicit differential judgments that reduce the reliability of ratings.

Third, five-observer composites do show increased reliabilities for direct ratings to a reasonable degree. However, the average five-observer reliability for pre-impact ratings (.61) is still only moderate in strength, and the average reliability for the post-impact ratings (.36) must be considered low.

A perusal of the reliabilities for contrast and direct impact ratings (importance and severity) indicates an even more problematic state of affairs (see Table 2). The importance and severity ratings for both treatment conditions are in each case .05 or less, indicating virtually no agreement. The state of affairs for general contrast ratings (contrast ratings not including importance, severity and the BLM contrast ratings) or BLM contrast ratings alone improves very little: Average single rater reliabilities for those sets of ratings are .05 and .08 respectively, with predicted five-observer composite averages of .21 and .30 respectively.

Thus, it appears that the rating of the degree of change to be imposed upon the landscape by landuse activities is characterized by very little agreement when the number of raters is relatively small (as is often the case in field settings).

The low level of reliabilities for contrast ratings is particularly distressing since such ratings are frequently used in application. To determine whether the reliabilities for both the general contrast and BLM contrast ratings are related to the typical quality of visual impact simulation (i.e., a one-paragraph description plus a one page black and white artist's sketch), another study was conducted using simulation of a notably high quality.

[6]When more than 10% of the ratings were incomplete, the protocol was considered unusable. Five protocols in the PRE-POST condition were discarded for excessive missing responses. For protocols with less than 10% of the total set of ratings missing, random normal deviates converted to the current scale of measurement using the appropriate distributional parameters were substituted for missing values.

[7]Only general trends are reported in the interpretation of differences between reliability coefficients obtained under the various rating conditions. The usual standard error term for the evaluation of intraclass correlations is not applicable because the number of rated stimuli is not extremely high and all ratings are not completely independent of one another. A statistical procedure is currently under development to permit such comparisons.

[8]Average reliabilities for subsets of rating scales under alternative treatment conditions were obtained by transforming the intra-class correlations into standard, or z-scores, according to the method described by Fisher (1954), averaging the z-scores, and reversing the transformation.

average single rater reliability of the pre-impact direct ratings is .24 and .22 for the BLM and Student samples respectively, with five-observer composite reliability estimates of .61 and .59 for the same respective groups. The average reliabilities for general contrast ratings are virtually identical in the BLM and Student samples (.05 and .04 respectively for single observer composites, and .21 and .17 respectively for five-observer composite). As with both BLM samples, the importance and severity reliabilities are negligible for the Student sample. The most notable difference between the Student sample and the BLM sample is in the BLM contrast ratings, but even so, the difference is small and the reliabilities remain low. The BLM contrast single rater reliabilities for the Student sample and the BLM PRE-POST sample are .18 and .08 respectively. Those reliabilities corrected for a five-observer composite yield reliabilities of .30 and .52 respectively. Thus, some modest improvement in inter-rater reliabilities is gained through use of visual simulation, but the level still falls below usual standards of measurement.

DISCUSSION

The main purpose of this report has been to describe our on-going research program and the VIA measurement issues it is addressing. Only early selective results are now available. They suggest in general that the reliability of component ratings of observer-based VIA's tend to be low when, as is the case for many current field applications, the numbers of observers and their visual samples of each environment are small. Ratings of visual contrast, or changes imposed by introduced landuse activities tend to be particularly unreliable under these conditions.

However, a cautionary note on interpreting the findings to date is in order. The reliability estimates reported here are based upon ratings of only four scenes. Confidence in obtained reliability coefficients depends upon the degree to which these scenes and their visual impacts characterize the true distribution of landscape scenes and landuses. To the degree that variation is restricted, the possibility of underestimated reliability coefficients is increased. Subsequent reports will present better estimates of reliability based upon a larger sample of scenes (N: 19) and a broader range of impacting activities. The likelihood is that these results will indicate somewhat higher levels of reliability, but whether adequate levels are attained cannot be forecast at this time.

Until the full array of findings from the research project is at hand, recommendations for possible ameliorative changes in the VIA systems under study are somewhat premature. However, possible courses of action include: (1) use of larger panels of observers yielding composite ratings based upon independent judgments by members (Tables 1 and 2, for example, indicate that reliabilities can increase appreciably for larger, in this case five-member, panels); (2) use of marker scenes, reliably scaled along a continuum of scenic quality that embodies variations in activity uses within given landscape types and provides a comparative standard for judging pre- and post-impact conditions for specific cases being considered within the context of field applications; and (3) for contrast ratings especially, more extensive experimentation with the use of various color photographic and related modes of visual simulation. Final reports on the current research program will treat these matters of procedural adjustment and innovation more fully and offer appropriate recommendations.

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Evaluation and Recommendations Concerning the Visual Resource Inventory and Evaluation Systems Used Within the Forest Service and the Bureau of Land Management[1]

Blaise George Grden 2/

Abstract: This paper is an investigation of the Visual Management System (VMS) and the Visual Resource Inventory and Evaluation Process (VRIEP). Questionnaires were developed and sent to persons who were experienced with VMS and/or VRIEP. VMS has been found easier to understand and apply than VRIEP. The methodology of VRIEP has been found to be a more complete approach than that of VMS. Sensitivity levels in both manuals were found to be the sections most difficult to understand, apply, and in need of most improvement and research. Recommended are changes to methodology and criteria as well as the development of a system national in scope with regionally adjustable criteria.

INTRODUCTION

Two methodologies were investigated in this paper;3/ the Visual Management System (VMS) used within the Forest Service and the Visual Resource Inventory and Evaluation Process (VRIEP) used within the Bureau of Land Management (BLM).4/ This study was conducted during 1977.

1/Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

2/Landscape Architect, Walla Walla District, Corps of Engineers, Walla Walla, Washington.

3/Based on Grden, Blaise G. 1978. Evaluation and Recommendations Concerning the Visual Resource Inventory and Evaluation Systems Used Within the United States Forest Service and the Bureau of Land Management. Unpublished MLA thesis, Landscape Architecture and Environmental Planning Department, Utah State University, Logan, Utah.

METHODS AND PROCEDURES

The primary objective of this project was to discover both the merits and problems of VMS and VRIEP and to make recommendations for clarification and improvement of the methodologies. VMS and VRIEP have had wide use in USFS and BLM. The writer contacted persons with knowledge of and experience with either VMS or VRIEP in USFS and BLM, and other professional institutions such as private firms and universities.

Separate questionnaires were developed for VMS and VRIEP. Respondents were asked to rate the methodologies as well as the manual. Questions were organized so that comparative analysis of the sections and the methodologies would be possible. The forms of the questions were of four types: yes, no, and don't know; a 5-point scale of 0-2-4-6-8 with adjectives that

4/BLM has since revised VRIEP which is now called Upland Visual Resource Inventory and Evaluation (UVRIE). The author has eliminated any comments or results which no longer apply to VRIEP due to the update.

corresponded to the numbers, rank order; and open-ended questions.

A SUMMARY OF DIFFERENCES AND SIMILARITIES OF VMS AND VRIEP QUESTIONNAIRE RESULTS

The problems of VMS and VRIEP/UVRIE are many and complex. There are general problems in understanding the methodologies and resistance from persons not experienced in evaluating visual resources. Landscape architects tended to evaluate the systems higher than other professionals. However, all respondents tended to agree on the hierarchy of problems. VMS manual was considered to be biased in terms of mountainous west examples and experiences, while VRIEP (UVRIE) manual was considered to be biased toward Colorado Plateau examples and experiences. Neither was considered to be national in scope.

Nearly all of the VMS questionnaire respondents were landscape architects, while the VRIEP respondents were approximately one-third landscape architects and two-thirds other professionals. VMS respondents applied the system more frequently, but to less acreage than VRIEP respondents. Landscape architects applied VRIEP on an average to larger sites than other professionals. The total average area in which landscape architects applied VRIEP was 3.6 times greater than other professionals (see Table 1).

Table I - Respondents and their application of VMS and VRIEP.

Respondents	VMS	VRIEP	
	60 landscape architect 1 forester	11 landscape architects	18 other professionals
Average times applied	5	2.5	2.8
Average hectares (acres) each application	116,000 (286,600)	424,929 (1,050,000)	105,498 (260,700)
Total application hectares (acres)	591,000 (1,460,700)	1,052,320 (2,625,000)	295,394 (730,000)

Sensitivity Levels

Sensitivity levels in both manuals were found to be the sections most difficult to understand, apply, and in need of most improvement and research.

In prescribing visual resource management classes, this study and research by Burns[5] both found that sensitivity levels were essential.

A higher percent of VRIEP respondents indicated that the sensitivity level section met the objective. The higher rating by VRIEP respondents may be due to the more complex criteria resulting in a more complete approach.

VMS respondents rated the clarity of sensitivity levels higher than VRIEP respondents. This shows the difference of manuals as well as more complex VRIEP sensitivity levels.[6]

VMS respondents had a greater mean range than the VRIEP respondents concerning the ease of application of sensitivity level criteria. This indicates that some of the sensitivity levels of VRIEP are easier to apply and some are harder to apply than VMS criteria.

The respondents indicated that sensitivity level produces more unwanted bias than any other section of the systems, with VRIEP being more biased than VMS. The writer's opinion is that VRIEP criteria are more complicated and the data used in the criteria are difficult to obtain, resulting in more subjective decisions.

Visual-Distance Zones

Research by Burns[5] indicated a concern for the value placed on unseen areas. The respondents to this study agreed and rated unseen area treatment as fair.

According to 75 percent of the respondents, distance-visual zones were valid criteria in determining sensitivity levels. The clarity of the manual in defining and explaining distance-visual zones was rated higher by VMS respondents. This may be due to the fact that VMS manual is more elaborate.

Applying the concepts of visual-distance zones was considered easier by VMS respondents. This may be due to the fact that the VMS respondents applied the system more times and VMS manual was considered clearer.

Scenic Quality

The respondents of VRIEP and VMS questionnaires stated that the scenic quality or variety class section measures variety or diversity. VRIEP respondents rated the "scenery units" higher than the VMS respondents rated character types. This may be because scenery units are easier to understand and to apply.

VMS respondents stated that the variety in the landscape was an accurate factor in measuring scenic quality while the VRIEP respondents stated it was between moderately accurate and accurate. This difference may be due to the fact that VRIEP also includes the factors of intrusions and uniqueness in the rating of scenic quality.

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[5] Burns, Jim. 1976. Summarization of activities, findings, and recommendations of the workshop on sensitivity level determinations for the BLM's visual resource program, Tahoe, Nevada, 16 November. (Mimeographed.)

[6] Sensitivity level criteria in UVRIE have been simplified.

VRIEP landscape architect respondents stated that the concepts used for rating the scenery units were easier to apply and more clearly defined in the manual than VMS respondents rating of the features and classifying them into ABC classes. This could be due to the use of a numerical rating system in VRIEP which is easier to understand and carry out.

Approximately 25 percent more of the VMS respondents than VRIEP respondents stated that the methodology of the scenic quality section produced no unwanted bias. The differences of the scenic quality rating may be due to the complex methodological additions made by VRIEP over the VMS. In other words, VRIEP respondents felt their system was more biased.

Visual Resource Management Classes (Goals)

A greater percent of VMS respondents agreed with the matrix which determines the appropriate visual resource management classes than did VRIEP respondents.

The clarity of the manual in which the management classes was explained was rather higher by VMS respondents than by VRIEP respondents. This may be explained by the quantity of examples contained with VMS manual and the amount of text explaining the classes.

General

VMS and VRIEP respondents rated "applying the system" as the most used and the most helpful method in understanding the systems. The respondents rated reading the manual as the second most used method in understanding the systems. VMS respondents rated reading the manual as the second most helpful method while the VRIEP respondents rated it as the least helpful method.

The comprehensibility, format, and text of the VMS manual were rated higher than the VRIEP manual was rated by VRIEP respondents.

The above differences can be understood by reference to the manuals. VMS manual is more elaborate, with color photographs, illustrations, and examples. VRIEP manual was in "draft" form with fewer illustrations and no photographs.[7/]

Approximately 44 percent of the respondents indicated that additional background would be helpful to bring more credibility to the systems.

VMS respondents' professional judgment agreed more with the final results of VMS than VRIEP respondents' professional judgment with the final results of VRIEP. This may be due to the fact that VMS respondents have used the system more often over a long period of time and have become used to it.

7/The UVRIEP manual presently used has more illustrations but still lacks photographic examples.

ISSUES AND RECOMMENDATIONS

Introduction

The following recommendations are based on the results of the questionnaire and current research.

Why two different systems? Now that each has been tested in the field, USFS, BLM and other land management agencies should collaborate and design an integrated system. The systems should contain the same methodology and terminology. The integrated system which is national in scope could be used as a core with allowance for variations, as the system is tested in the different physiographic regions. One national core system would eliminate problems arising when a project crosses more than one agency's land and areas where agencies' boundaries are adjacent. One system would insure equal treatment of the visual resources.

One of the frequent comments of respondents from non-western, mountain regions was that the manual should be more national in scope, concepts, and examples. Each region is composed of different natural features. Different historical events influenced attitudes toward the land and structures such as agricultural fields, buildings, cities, and travel routes. The inhabitants vary in number, character, culture, personality, experience, and economics. (Starkey and Robinson 1969, Sonnefeld 1966). The new manual should include an explanation explaining to the user that the criteria must be "fine tuned" for each physiographic region. What is used in the Rocky Mountains cannot be applied in the Gulf Coastal Plain. Some areas of USFS and BLM have adjusted the criteria to fit their needs better, such as in Kootenai National Forest, Arizona, New Mexico, and in the Colorado BLM offices.

The new manual should integrate supplemental references, appendices, bibliographies, and other source materials to help support the methodology. The methodology would then be more helpful to professionals and the general public.

A numerical rating system as in VRIEP/UVRIE would simplify the scenic quality and sensitivity evaluating process and render the system adaptable to computers. The weight of the criteria should be regionally adjustable in range and value. UVRIE manual gives examples of the adaptability of their system for computer use.

Figure 1 shows the flow diagram for the recommended system.

Scenic Quality

The term scenic quality as used in VRIEP/UVRIE describes the process used to measure the scenic quality of the visual resource. Variety classes used in VMS would be appropriate if scenic quality were based only on the concept of variety. There are additional concepts which might be better used to determine scenic quality which will be discussed later in this section.

Landscape Divisions

One of the initial impressions from reading either VMS or VRIEP/UVRIE manual is that the Great Plains or the Central Lowlands, physiographic provinces of the United States, would be entirely rated "C" class scenery and that need not be true.

Each physiographic province has relative levels of scenery with different visual resource characteristics. Both scale and relationship of objects are also relative in each province.

Scenic quality of the landscape can be determined by dividing the landscape into areas of similar visual resource characteristics and rating each area for scenic quality based on its inherent characteristics. Both VMS and UVRIE incorporate physiographic divisions based on Fenneman (1931, 1938).

Components of the Visual Landscape

Within VMS and VRIEP/UVRIE it is stated that landform, vegetation, and water are basic components of the visual landscape. However, VRIEP/UVRIE also includes manmade components ("cultural features"). Neither VMS or VRIEP/UVRIE take directly into account animal life, an important component in the visual landscape. The components of the visual landscape should include landform, vegetation, water, animal life, and man-made objects and processes. The arrangement of the components of the visual landscape serves to create variety, vividness, and harmony, and will be investigated later in this section.

Design Elements

VMS and VRIEP/UVRIE, as well as some other visual analysis methodologies used the design elements of form, line, color, and texture to describe the components of the visual landscape. The relative importance of each element tends to vary with each physiographic region and subregion, due to atmospheric conditions and available light and other inherent landscape characteristics (Harman *et al.*, 1973; USDA 1972, 1973; USDI 1976).

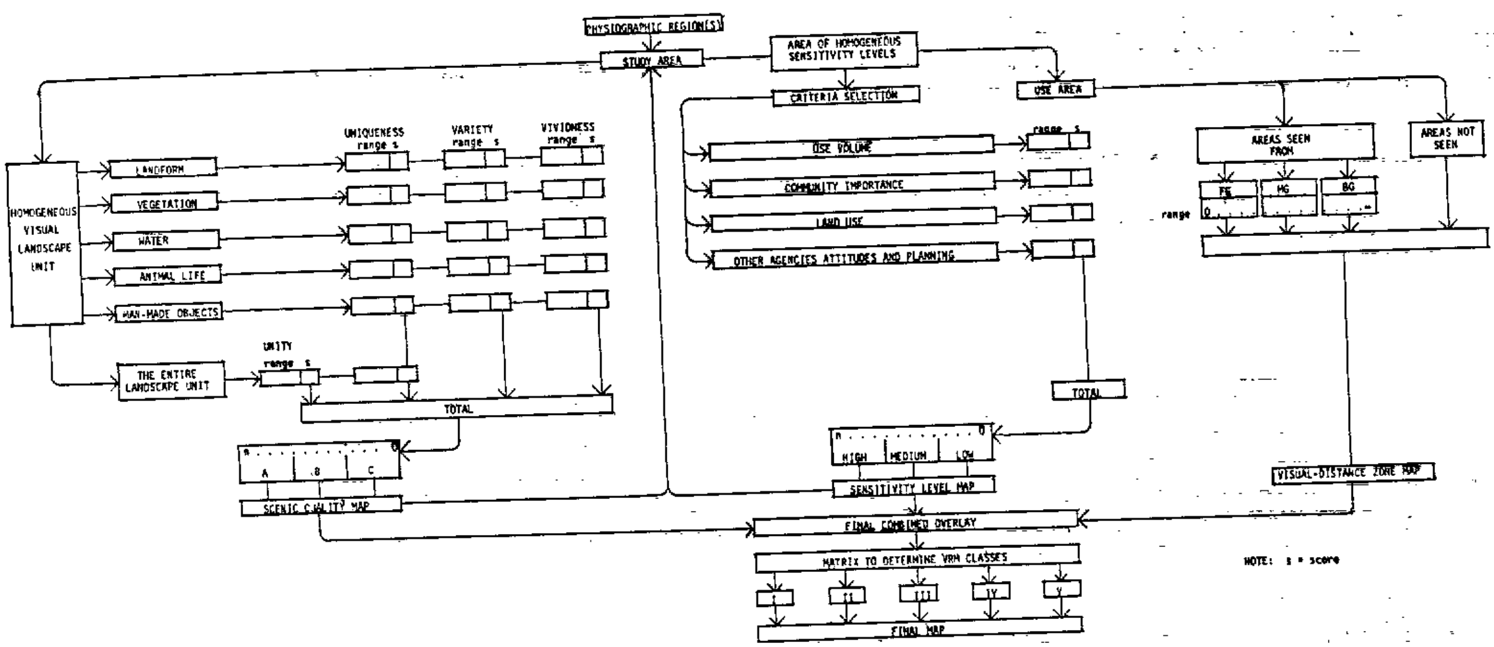


FIGURE 1 - Recommended visual resource inventory and evaluation system flow diagram.

terminology

Variety--includes the number of objects, the distribution, and the relationship in terms of scale between them. Variety is in opposition to monotony where repetition of objects is uninteresting and implies low level scenic quality. Landscapes with the greatest variety or diversity have the potential of possessing higher levels of scenic quality (Sargent 1966; Zube 1971; Litton 1971, 1972; USDA 1973, 1974; Laurie 1975;)8/

Vividness--is that quality in the visual landscape which is strong enough to make a lasting impression. Lynch (1960) uses the word "imageability," Jones (1975) "vividness or memorability," and Litton (1971, 1972) "vividness." "Contrast is the most obvious source of vividness, if it avoids confusion." (Litton 1972, p. 285).

Unity--is a single harmonious visual unit in terms of the combined quality of the landscape components. The unified landscape is not the arithmetic sum of its components, but the unity of components interacting holistically with each other. (Ocvirk et al. 1968; Handley et al. 1970; Litton 1972; USDA 1972; Jones and Jones 1974, 1975, 1976; Jones 1976; and Laurie 1975).

Uniqueness--is the scarcity of an object or landscape in a physiographic region. The object can be physical, biological, and/or of human interest (Leopold, 1969; Leopold et al. 1971 Leopold, 1966, McHarg 1969; Handley et al., 1970; Leopold, et al., 1971; Jones 1975; Iverson 1975; 8/)

Criteria

The methodology of VMS is based upon the criterion of variety as a measurement of scenic quality while the methodology of VRIEP is based upon the criteria of variety, uniqueness, and harmony, which are not explicitly explained. Most respondents stated that variety was an important criterion in assessing scenic quality, which it is, but other criteria exist. Research has shown that variety, vividness, unity or harmony, and uniqueness are factors which assess scenic quality.

The four criteria of variety, vividness, unity, and uniqueness are generally recognized as basic in determining the artistic quality of music, painting, and landscapes. The criteria exist not only as entities but also in interaction (Ocvirk et al. 1968; Litton 1972 Ocvirk and Litton do not mention uniqueness).

Methodology

VMS and VRIEP scenic quality methodologies should be modified to include the recommended criteria. The visual landscape unit can be divided into the components of the landscape: landform, water, vegetation, animal life, and manmade components. These components can be described by the design elements of form, line, color, and texture. The components and the landscape as a whole can be given a numerical rating of scenic quality determined by the criteria of variety, vividness, unity, and uniqueness. The weight and range of the components will depend on two factors: the characteristics of the components and the physiographic region in which they lie. In some regions components such as water or man-made components may be scarce or non-existent. The adjusted weight and range would have to be modified in these instances, however the criteria "uniqueness" would provide a means of compensation.

When rating the components of the visual landscape unit, they should first be rated for variety, vividness, and then uniqueness. Then the visual landscape unit as a whole can be rated for harmony, followed by rating the whole visual landscape unit for uniqueness relative to the defined physiographic region. Scenic quality classes can be determined by the sum of the scores (see table 2).

Sensitivity Levels

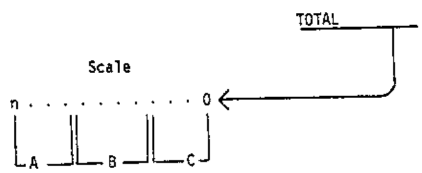
Analysis of sensitivity levels is a necessary factor for planners and managers dealing with visual resource management. Sensitivity levels serve to establish priorities as well as prescriptions for change in managing the visual environment. The concept of sensitivity level is not as easily understood or applied as scenic quality or visual-distance zones. This section will need the most research before a methodology is accepted by the majority of professionals.

In VMS, sensitivity levels are the measure of concern that a perceiver has for scenic

8/ Paulson, Merlyn J. 1975. Western coal strip-mines, related energy conversion structure, and transmission lines: A study of visual quality, visual change, and alleviating visual siting criteria. Unpublished MLA thesis, Landscape Architecture Research Office, Harvard University.

TABLE 2. -- Table to determine recommended scenic quality

measurement criteria	components of the visual landscape	verbal description and value range (varies with region)			score
variety (Y)	landform	verbal description & weight			Y V U
	vegetation				Y V U
vividness (V)	water				Y V U
	animal life				Y V U
uniqueness (U)	man-made objects				Y V U
harmony	the landscape as a whole				
uniqueness	uniqueness of the whole				



scenic quality class

quality, while in VRIEP sensitivity levels were ". . . an index of the relative importance or visual value of visual responses to an area in relation to others in the planning unit" and in UVRIE sensitivity levels are indications of user interest and concern for change in the visual resources. (USDI 1976, 6300.05).

Sensitivity levels should serve to measure the concern for the visual resource of persons viewing the area, persons having interest or "stock in the area" but who may never visit the area, and public agencies that have jurisdiction in the area.

Landscape Divisions

While the physiographic regions serve as a basis for division of the landscape into homogenous visual units that can be measured for scenic quality, physiographic regions can also serve as a basis for division of the landscape into homogenous sensitivity units that can be measured for sensitivity levels. There are:

> . . . differences between the people and their cultural traits in each of the physiographic provinces---differences in ethnology, dialects, educational levels, religions, wealth, industrial or agricultural pursuits and politics. (Hunt, 1974, p. 3)

Along with physiographic regions, regional geography and United States Office of Business Economics (USOBE) have criteria to divide the landscape into regions.

Regional geographers use five major criteria to delineate areas. Man's relationship with the land or geography can be used as a basis to divide the land into regional areas (Starkey 1969).

(1) The land: its extent and quality. (2) The historical events that have been significant in influencing later land use. (3) The accumulation of structures on the land, including fields, buildings, routes, cities, and monuments. (4) The inhabitants of the land: their numbers, character, culture and rates of increase. (5) The income that inhabitants earn and the economic structure within which they earn income.

The mapping procedure of USOBE is based on demography, ethnic, cultural, and social factors of the labor force.

These examples are suggestions, however, the concept might serve to produce a broader basis for determining the criteria used to measure sensitivity levels.

Criteria

New criteria should be developed to evaluate the use area and determine sensitivity levels. The criteria should be based on the defined region and a profile of public attitudes and the consultation of sociologists, economists, recreation specialists, and representatives of other appropriate fields.[9/]).

Use areas, use volume, community importance, land use, and other agencies' attitudes and planning are criteria that can be applied in most regions to determine sensitivity levels of use areas. The criteria have been used in some part either in VMS and/or VRIEP.

The criteria should be adjusted and/or new criteria developed for each region. The criteria weight or value will depend on the particular region. Each use area can then be rated on the established criteria and range, and the appropriate sensitivity level assigned by adding the assigned scores (Table 3).

[9/] Lee, Robert. 1976. Summarization of activities, findings, and recommendations of the workshop on sensitivity level determinations for the BLM's visual resource program, Tahoe, Nevada, 16 November. (Mimeographed.)

terminology

Use Areas -- within a region should be delineated and mapped. Use areas can be places where people live, work, play, and move about. They may include cities, towns, villages, summer home sites, commercial and industrial areas, campgrounds, visitor centers, picnic grounds, water bodies, beaches, roads, and trails. The boundaries of the areas of use are determined by what areas are viewed from the use area.

Use Volume -- is determined by the number of persons in an area or traveling through an area. Perception of the landscape varies with the amount of time it is seen and the speed of movement through it.

Community Importance -- is the significance placed on a use area by local, state, regional, and/or national communities.

Land Use -- is a general designation or proposed function which occurs above, on, or in the land.

Other Agencies Attitudes and Planning -- and social programs should be taken into account because different agencies represent different attitudes toward management of the visual resources. Lands administered by the National Park Service tend to generate higher values for the visual resources than most other agencies. There may be times when the function a use area may influence the viewshed of a nearby use area.

TABLE 3.--Table to determine recommended sensitivity levels

Criteria	High sensitivity level	Medium sensitivity level	Low sensitivity level	Score
	Verbal description and value range (varies with region)			
Use volume:	Verbal description & weight			
Community importance:				
Land use:				
Other agencies attitudes and planning:				
Other:				
			TOTAL	

n 0

high — medium — low

sensitivity levels

Visual-Distance Zones

Since the zones are based on distances of visual perception, it is recommended that the term visual-distance zones be used.

Visual-distance zones determine the viewed areas from use areas, and help to determine the visual sensitivity of the use area as well as the boundaries of the sensitivity area.

An observer can usually recognize that the closer one is to an object the clearer the details of the object are perceived. As distances increase away from the objects, the details become more uniform in color-value and less contrast is apparent between the objects. The other senses such as smell and touch are less acute (USDA 1972, 1973).

Criteria

There are three visual-distance zones used to describe distances in painting, photographs, and the observed landscape--foreground, middleground, and background, which are based on the details that can be perceived at a given distance.

Measurable distances such as meters and kilometers can be applied to each visual-distance zones. The measurable distances are used in VMS and VRIEP/UVRIE and are based on research conducted by Litton on national forests in the western United States (Litton 1972).

These distances are arbitrary and do not take into consideration the atmospheric conditions, seasonal or diurnal variations, or variable contextual settings (Litton 1972). These conditions can vary depending on the physiographic region. This results in possible changes in the length of each distance zone and in the weight given in the matrix to determine the visual resource management classes. The manual should contain explanations of these possible variations.

All three visual-distance zones should be used instead of the two in VRIEP/UVRIE. The foreground is different from the middleground. The background should end at infinity or at a point where the components such as landform or man-made features are not identifiable or visible. The background zone of VRIEP/UVRIE ends at 24.1 kilometers or 15 miles, but a huge structure may be viewed beyond 15 miles. The distances will vary from region to region. More than three zones may be needed in some instances such as the investigation of possible visual impacts.

Visual Resource Management Classes

Through a matrix scenic quality, sensitivity levels and visual-distance zones are brought together to determine visual resource management classes. The three major sections should be regionally adjusted as well as the matrix.

Many of the respondents stated that the terms retention and preservation were misleading and often confusing. This problem could be solved by assigning roman numerals as in VRIEP/UVRIE, instead of terms such as preservation or retention.

The management classes ". . . provide the land manager and supporting staff with objectives for the visual appearance of landscapes that vary with the lands intrinsic scenic quality and its sensitivity to public viewing pressure".10/

This is just the first step. The manager and others must know how difficult it may be to achieve the visual management classes in one unit of land as in another unit.

It may appear that it would be easier to meet the least restrictive class than a more restrictive class. But no such correlation is within the system. The opposite can be the case, where it is easier to meet a more restrictive class than a less restrictive class.10/

The manual should explain how the visual resource management classes fit into the whole process, and that the classes are not the final decision. The desire for integration of visual absorption capability (VAC) into the VMS was a major comment of the VMS responde respondents. This is now in progress and VAC will be a supplement to the VMS.11/

SUMMARY AND CONCLUSIONS

A problem of the methodologies of the management classes is that the higher scenic landscapes tend to receive the higher levels of protection. Protection of common landscapes may be just as important as the high scenic quality landscapes. It can be argued that the protection of common landscapes serves to enhance and heighten the scenic quality of the unique or precious areas.

10/ Iverson, Wayne D. 1975. Visual absorption capability. (rough draft). United States Department of Agriculture, Forest Service, California Region, San Francisco. (Mimeographed.)

11/ Iverson, Wayne D. 1977. Letter to Blaise Grden. San Francisco, California, 21 March.

It should be understood that high scenic quality can exist in unfashionable or inaccessible deserts and plains as well as in popular and accessible areas of craggy peaks, pine trees, and crystal clear lakes. It is only reasonable that each physiographic region be attributed with a full range of potential scenic quality. Since the visual landscape character varies from region to region, the scenic quality landscape features weight and ranges should be adjusted. Public attitudes, and accessibility also vary within regions and over time which is cause for the sensitivity level criteria to be adjusted and tested in each region.

Other problems exist in VMS and VRIEP/UVRIE that are inherent in inventory and analysis methodologies. Random as well as systematic errors occur in application of methodology. By educating the users to the complexity of the systems, these errors can eventually be controlled.12/

Improvements in the methodologies should be made as more research is available. The existing areas that the systems have been applied to should be periodically updated for continuing relevant management decisions. Public attitudes may critically affect the existing data in a relatively short time. The methodologies should be kept as simple as possible without sacrificing a complete approach.

We can ask, "Should the systems have been invented?" Because of the size and extent of USFS and BLM, a manual on visual resource management is necessary. Visual resource analysis provides the land manager with an understanding by sharpening one's sense of awareness and thus encouraging better decision in planning and management.

The systems do provide an integrative basis for collaborating land managers to act in concert while also enhancing accountability to the public. VMS and VRIEP should be considered a positive pioneering step in managing the visual resource.

In the future, public agencies can become more systematic and sensitive to the importance of visual resource and the effects of the visual resource policies and management on the feelings and actions of the public.

A committee, agency, or institution needs to coordinate a national visual management system, research, and information at all levels of government if we are going to manage our landscape's visual resource.

12/ Becker, Carlisle. 1977. Assistant Professor of Landscape Architecture, Utah State University, Logan, Utah. Personal interview, October.

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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 suboptimize 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 silvaculture 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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[1]Presented at the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

[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 compatable 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

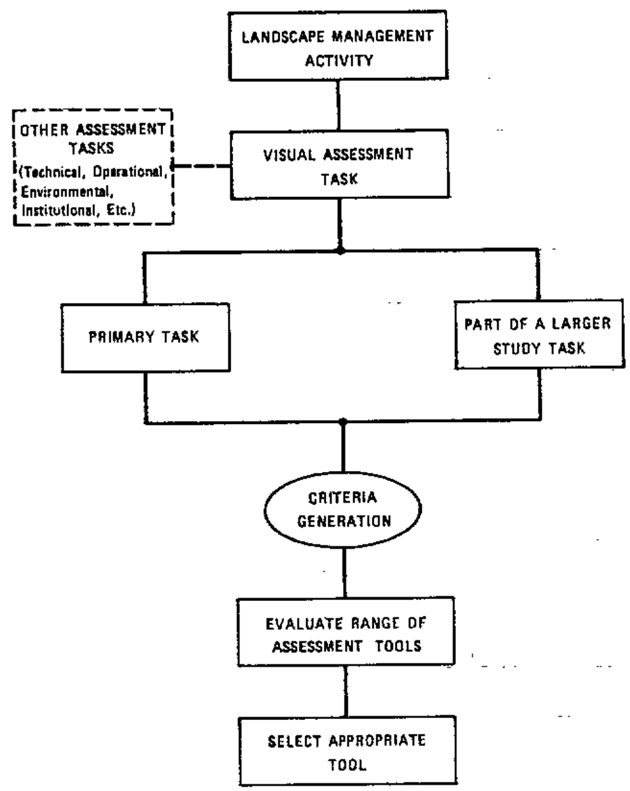

Figure 1--Approach to Criteria Generation

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 photograph 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

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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 profiles 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.

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