

Visual Unit Analysis: A Descriptive Approach to Landscape Assessment¹

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Abstract: Analysis of the visible attributes of landscapes is an important component of the planning process. When landscapes are at regional scale, economical and effective methodologies are critical. The Visual Unit concept appears to offer a logical and useful framework for description and evaluation. The concept subdivides landscape into coherent, spatially-defined units.

This study extends that concept by developing methods for consistent mapping and analysis based on available topographic data and aerial photographs, supplemented by field checks. This approach to describing scenic distinction, supplemented by graphic displays, permits comparison of visual attributes for the landscape units in a study area, supporting planning and design.

VISUAL ANALYSIS AND THE VISUAL UNIT

The aim of visual analysis is to ensure recognition and consideration of the visual qualities of the landscape in the process of environmental design and management.

Various methods of visual analysis have arisen in response to need. Some are based upon criteria related to the landscape in only a general or indirect way, including assessment of visibility from static viewpoints. Others modify results according to viewing distances from available roads or trails.

^{1/} Submitted to the National Conference on Applied Techniques for Analysis and Management of the Visual Resource, Incline Village, Nevada, April 23-25, 1979.

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Methods are needed which provide more flexible applications and a more comprehensive range of information, related to specific landscape tracts and their inherent landscape qualities. The visual unit concept (Litton, Shizowa, 1971; Tetlow, 1975)^{3/} appears to offer a logical and useful framework for evaluation of the landscape, proposing its division into units which are coherent for planning or analysis purposes. This paper extends the concept and defines a practical and economical procedure for routine use.

The Visual Unit is defined as a portion of the landscape enclosed and limited by topography, bounding an observer's field of view. That spatial enclosure enables the viewer to accumulate and form a unified impression of his surroundings (Tetlow and Sheppard 1976). Because each landscape is

^{3/} Tetlow, R.J., 1975. Scenic Units and their Interrelationship in the Forest Landscape. USDA, Forest Service, Pac SW Forest and Range Exp. Sta. (Manuscript).

inherently variable in appearance, as well as in spatial extent, each unit has its own distinct visual character and degree of unity; its specific scenic distinction is created by the combination of landscape elements within it and bounding it.

VISUAL UNIT MAPPING

For purposes of mapping, the concept of the visual unit as a bounded space requires that topography be the dominant criterion for delineating unit boundaries. These normally follow major ridge lines and enclosing spurs, or marked changes in topographic character (fig. 1).

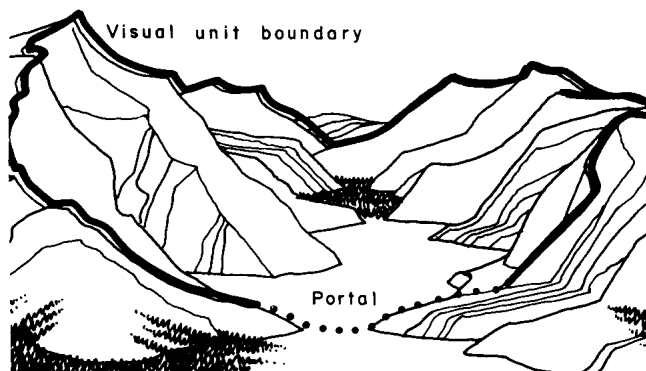


Figure 1 -- A Typical Visual Unit

Visual units are seldom completely enclosed. It is common to find at least one or more openings or portals where the skyline dips to provide a threshold for drainage, access or views outward (fig. 1). Portals are important for observer orientation and for potential movement into or through the unit. The stereopair and drawing in figure 2 illustrates how unit boundaries and portals may be located relative to topography.

Where a unit boundary coincides with a major ridgeline, this division is readily apparent and easily mapped. More commonly, unit boundaries follow complex high ground. In such cases, the unit appears less strikingly enclosed from most points on the ground. It is often possible to map a "false" enclosure or rim intervening between a valley floor and the unit boundary. Rims mark the extent of views from valley floors, upper slopes being foreshortened or invisible. In such cases there is no definite and

perceptible ridge-line, as in the example of a narrow flat-topped ridge separating adjacent valley units. Here, the boundary may be assumed to run down the center of the ridgetop above the rim. An example is shown in figure 3.

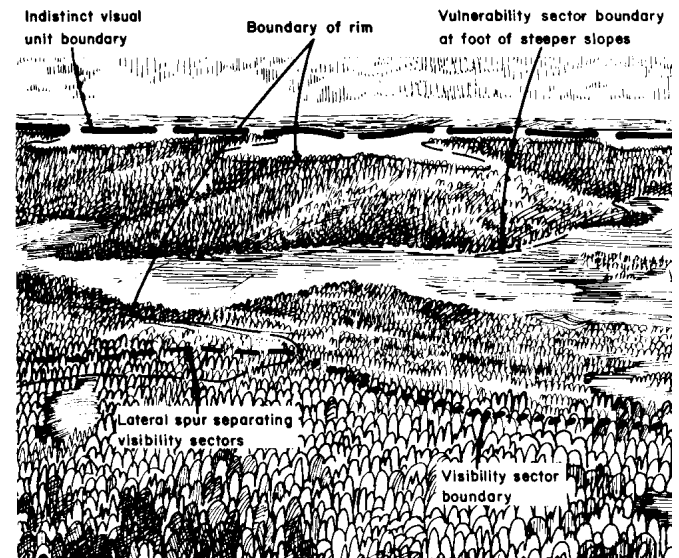


Figure 3 -- Fellers Heights: Oblique view showing rims, visibility sectors, and vulnerability sectors.

The mapped geographical arrangement of visual units and their portals indicates the sequence of differing landscapes to be seen along possible travel routes. Mapped visual units also convey much information on visibility. A unit boundary usually marks a distinct change in the extent and direction of views from the ground. However, a map of visual unit boundaries is not a visibility map per se, since no specific observer locations form the basis for boundary definition. Specific views and visibility will alter with change of observer position; within the unit boundary--wherever the observer is--a spatially defined impression of landscape character is likely to be obtained. Within or beyond a visual unit, individual features or scenic elements which contribute to scenic distinction may be identified.

Visual units may be subdivided to provide more specific information. Some extensive or complex visual units can be subdivided into visibility sectors. These are defined by minor differences in landscape character or by minor impediments to lines of sight (fig. 3).

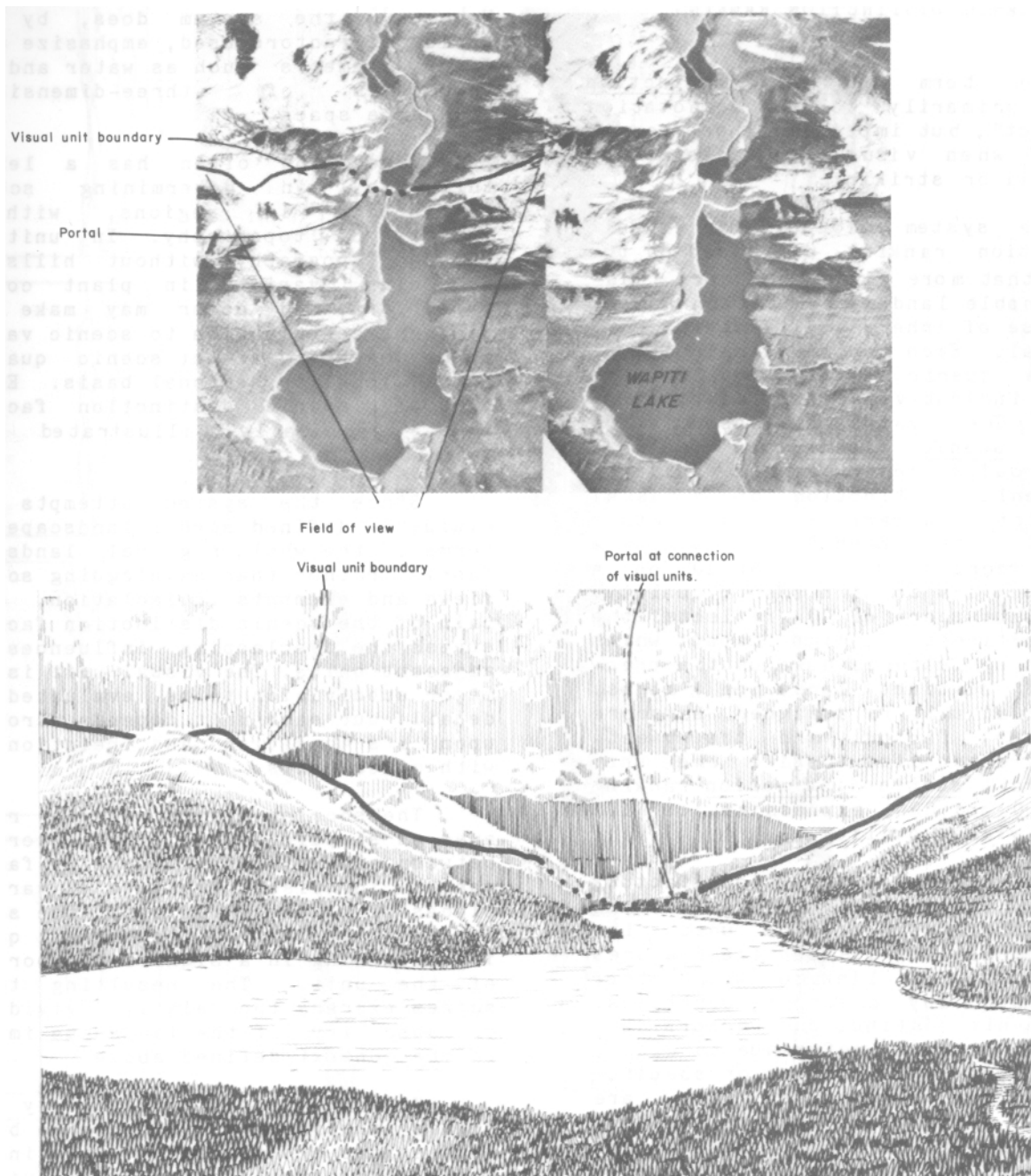


Figure 2 -- Wapiti Lake: Stereo-pair and oblique view showing visual unit boundaries.

If the visual unit is to remain a distinct entity, there must be limits to its complexity. For mapping purposes, it is important to discriminate between a valley as a visibility sector in a larger unit, and a valley as a separate unit. A major symmetrical fork in a valley is usually best

mapped as the convergence of three units, linked by portals. Large side-valleys, visually cut off from a unit by elevation difference or by narrow "pinching" of spurs, may form separate units, while side-valleys largely visible from, and contiguous with the main valley, form visibility sectors.

SCENIC DISTINCTION RANKING

The term scenic distinction refers primarily to the connotation "distinct", but implies higher scenic quality when visual characteristics are vivid or striking.

The system adopted for scenic distinction ranking is based on the thesis that more vivid or more distinguishable landscapes (Litton, 1968) are those of inherently greater scenic potential. Each mapped visual unit is given a scenic distinction ranking score, indicative of its distinctive values. The system is based upon twenty scenic distinction factors, which broadly describe and indicate the scenic distinction of a visual unit for comparison with other regional units. Each factor carries a ranking score of 0, 1, 2, 4, or 10, on a scale of low to high scenic quality. The maximum score of 10 reflects the disproportionately high impact which outstanding features have on the creation of distinct landscape images. Each visual unit is assigned a score for every factor, and the twenty scores are totalled to give the unit an overall scenic distinction ranking between 0 and 200, expressive of its general visual quality.

The scenic distinction factors describe the spatial dimensions and visual character of the unit, its water forms, its distinctive features and accents, its linkage with other units, and any degrading contrasts. These scenic distinction factors are assigned without reference to either existing access conditions or specific physical use potentials. Many are generally accepted in the literature as contributing to scenic quality, and have precedents in the work of Leopold (1969), Linton (1968), Shafer, Hamilton, and Schmidt, (1970), and the U.S. Forest Service (1973). The authors, however, have selected and defined the factors presented here.

In this system, the number of factors is limited to twenty in order to keep the work within reasonable limits. For simplicity, the ranking system attaches equal weight to all factors, since it is considered that a change in any one of them is sufficiently important to alter the scenic character of the unit noticeably.

However, the system does, by the choice of factors used, emphasize dominant elements such as water and the parameters of three-dimensional landscape space.

Vegetation often has a lesser influence in determining scenic distinction in regions, with a variety of topography. In units of subdued topography, without hills or mountains, variety in plant cover, type, form, and color may make the dominant contribution to scenic value, or may markedly affect scenic quality on a local or seasonal basis. Examples of scenic distinction factors are graphically illustrated and described in figure 4.

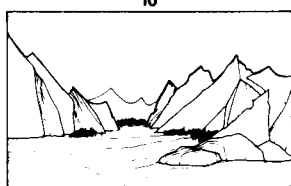
Since the system attempts to evaluate defined scenic landscapes in terms of the whole regional landscape fabric, rather than cataloguing scenic views and elements in isolation, certain of the scenic distinction factors stress the overlapping influences of adjacent units. The visual unit is the major subdivision to be evaluated in detail, but each unit depends strongly upon its position and relationship with other units.

The scoring system places reliance on simplicity and equal intervals between subdivisions. Where a factor varies in visual quality in various places within a single unit, the score assigned is that of the highest quality occurring in a significant portion of the unit. The resulting total scores express the relative vividness or obscurity of the landscape image, in the context defined above.

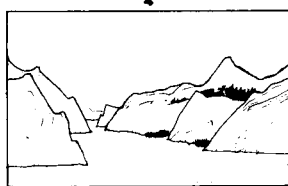
Visual units of relatively low scenic distinction tend to be broad depressions or plateaus with indistinct enclosure, having little visual variety in elevation, water forms, or striking features. Visual units of moderate scenic distinction may have definite topographic enclosure and clear orientation, but contain few visual features and characteristics of high contrast. Visual units of high scenic distinction are generally strongly oriented, containing bold contrasts in relief, skylines, water features, and vegetation. Units of very high or outstanding scenic distinction tend to exhibit a considerable number of vivid scenic elements, combined in a unified and

**Spatial Dimension
And Character**

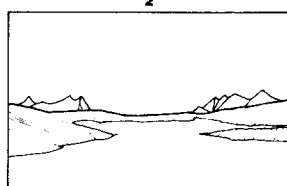
Skyline



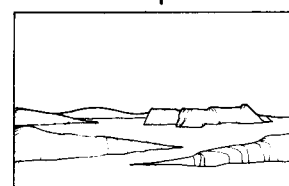
Sharp and vivid all around.



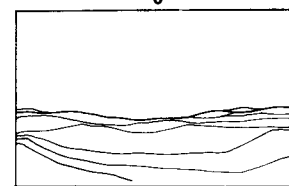
Mostly sharp and conspicuous; distinct all around.



Sharp and vivid accents; mostly distinct or regular.



Distinct or definite in parts.



Low, discontinuous, overlapping, or indistinct.

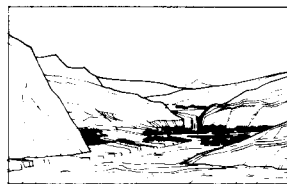
Profile



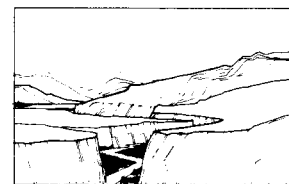
Vivid profile unifies and links terrain, water and scenic features.



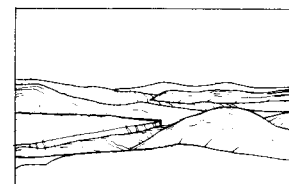
Conspicuous and extensive lake or stream-related profile.



Distinct profile; portions segmented or water-oriented; minor branches.

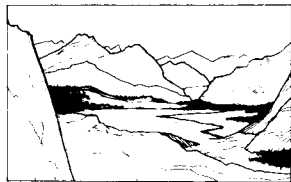


Complex profile; frequent changes in gradient, direction, or transverse tilt; often extensively branched.

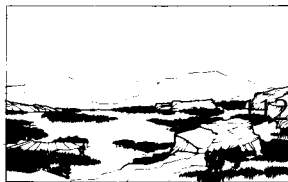


Discontinuous or inconspicuous; expansive, level, or undulating.

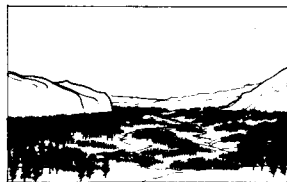
Floor



Vivid expanse of open terrain or water in midst of peaks and scenic features, with extensive panoramic views.



Conspicuous extent of contrasting enclosed and open terrain, framing distant views.
(or) Extensive water forms permit long or panoramic views.



Distinct opening or occasional water forms or forested or broken floor; distant views of higher enclosure only.
(or) Conspicuous extent of open but subdued terrain with no distant views; vegetation frames vistas.



Floor mostly forested, and restricted or broken, occasional glimpses of distant elements or elevations.



Heavily forested or closely confined floor, with foreground views only; on open areas or distant views.

Water Forms

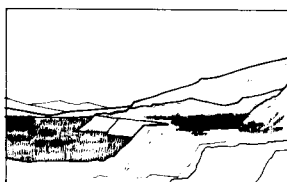
**Lakes:
Extent
and Character**



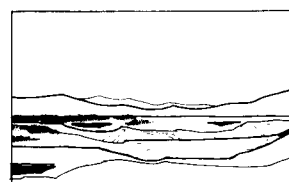
Major Lake(s).



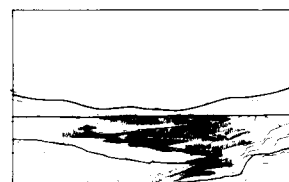
Numerous related or grouped lakes.
(or) Significant central lake(s).



Significant isolated or remote lake(s).

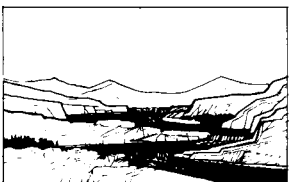


Scattered small lakes.
(or) Extensive marsh or weedy lakes.



Intermittent or seasonal water; no lakes.

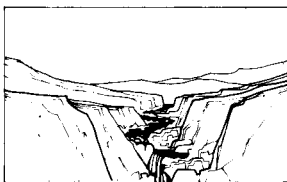
**Rivers and Streams:
Extent and Character**



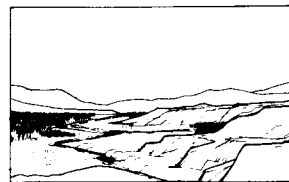
Extensive high volume stream; vivid visual flow and motion.



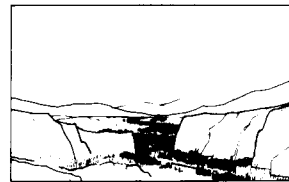
Extensive, high volume placid stream; minor active stretches.



Visually active low volume narrow stream.



Low volume open stream, placid or marshy.



Minor stream; inconspicuous or concealed; seasonal or intermittent.

Figure 4 -- Examples of the twenty scenic distinction factors

MAP REFERENCE UNIT NAME	SPATIAL DIMENSION & CHARACTER								WATER FORMS						DISTINCTIVE FEATURES & ACCENTS								RANKING SCORE
	SPATIAL VIDUENESS	CROSS-SECTION PROPORTION INDEX			LINEARITY CONTINUITY		PROFILE	EXTENT AND CHARACTER		SHORELINE FORM		WATER SETTING	FALLS AND RAPIDS		SNOW AND ICE		VISUAL UNIT LINEAGES	IMPACTS & DEGRADING CONTRASTS					
		CROSS-SECTION COMPLEXITY	CROSS-SECTION CONTRAST	SKYLINE	FLOOR	LAKES		RIVERS STREAMS	LAKES	RIVERS STREAMS	SETTING FREQUENCY		PEAKS, TOPOGRAPHIC ELEMENTS, GEOMORPHIC FEATURES	VEGETATION CONTRASTS									
MURRAY RIVER	4	10	10	4	4	2	10	4	2	10	2	10	4	10	4	2	4	4	2	112			
HOMINKA PASS	10	10	10	10	1	4	1	10	2	1	2	1	10	4	1	10	4	4	4	10	109		
UPPER HOMINKA	10	10	10	10	1	10	10	10	2	1	2	2	4	4	1	10	2	10	2	10	121		
HOMINKA RIVER	10	10	10	10	4	2	10	4	4	4	4	4	4	4	2	10	2	10	4	10	122		
MISSINKA RIVER	10	10	10	10	4	2	2	4	1	2	0	4	2	2	0	4	2	4	4	10	87		

Table 1 -- Scenic distinction factors and visual unit ranking examples .

unusually distinctive whole. Table 1 shows an array of such scores, as recorded for various visual units within the Canadian Rockies.

VISUAL VULNERABILITY ASSESSMENT

Visual Vulnerability is the potential of a landscape to absorb or be visually disturbed by man's activities (Litton, 1974). In many units, vulnerability sectors may be distinguished, differing in slope or, surface pattern (fig. 3).

Visual vulnerability is assessed for each vulnerability sector on the basis of slope and surface patterns. Generally, sectors of low vulnerability have gentler slopes and conspicuous irregular or horizontal patterns of bare ground and vegetation; this may allow landscape alterations to be absorbed almost unnoticed. Sectors of high visual vulnerability occur with steep slopes or with uniform or vertically-oriented surface pattern, where many impacts, notably those of transportation routes, would radically alter the appearance of the landscape. Figure 5 indicates how the various surface patterns may be categorized, and combines them with slope classes into a matrix for assessing visual vulnerability. This example deals primarily with vulnerability to any linear impact, oriented generally along the contour. However, the assessment also indicates vulnerability to point impacts and area impacts (Litton, Tetlow, Sorenson, and Beatty 1974),

INVENTORY TECHNIQUES

The methodology was first applied in an inaccessible tract of the Rocky Mountains and foothills in British

Columbia, Canada, during 1976. The study area encompassed over 19,000 square miles of virtually undeveloped landscape, containing scenery ranging from rolling prairie to rugged mountains. Ground access was severely limited. Proposed development alternatives for coal mining, road and rail transportation, and townsites penetrated much of the area. The visual unit method was used to evaluate the entire study area, and to assess proposed developments within particular landscapes.

Where study areas are large, most of the base data must be derived from aerial photographic interpretation. An Old Delft scanning stereoscope may be used to determine unit boundaries, scanning 111:80-chain vertical photographs, with parallel reference made to 1:100,000 topographic maps, on which boundaries may be recorded. 1":40-chain and 111:20-chain photographs are used for the detailed sector mapping and for analysis of any proposed developments.

Extensive photographic coverage on 35mm film, using both color and black and white film, serves to corroborate preliminary findings on unit boundaries and features and to provide information on both scenic distinction and visual vulnerability. A combination of fixed-wing and low level helicopter flights, with limited ground access, provides a considerable amount of data simply and quickly. Final evaluation costs depend largely upon the extent of field-checking required from aircraft or vehicles. The methodology has subsequently been used in several studies undertaken by the Resource Analysis Branch of the British Columbia Ministry of Environment.^{4/}

^{4/} Adams River, Bowen Island, NECoal 1977, (In-house studies).

Inconspicuous Surface Pattern

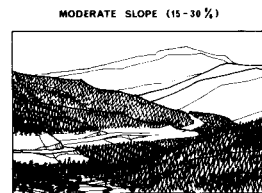
Patterns generally absent or of low contrast

Indefinite pattern (uniform)

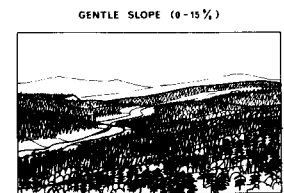
Form: subdued surface expression.
Colour/Texture: extensive or continuous forest canopy with conifers only, deciduous trees only, or mixed and scattered conifers/deciduous.
Ground: extensive open.



HIGH visual vulnerability



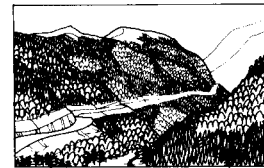
HIGH visual vulnerability



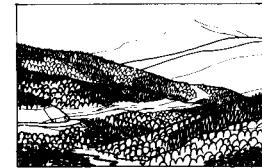
MODERATE visual vulnerability

Definite pattern (low contrast)

Form: subdued or weak surface expression.
Colour/Texture: extensive or continuous forest canopy with discrete irregular groups of conifers and deciduous trees.



HIGH visual vulnerability



MODERATE visual vulnerability



MODERATE visual vulnerability

Conspicuous Surface Pattern

Exposure patterns of high contrast

Vertical pattern (oriented into vertical lineaments running across contours)

Form: gullied slopes, colluvial fans.
Colour/Texture: avalanche chutes, riparian vegetation strips.



HIGH visual vulnerability



MODERATE visual vulnerability



Not distinguishable

Irregular pattern (no markedly linear orientation)

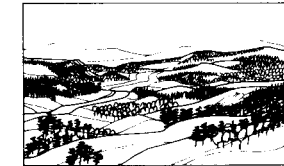
Form: hummock-terrace, scattered rock outcrops and erosional slopes.
Colour/Texture: broken forest canopy with numerous or extensive marsh openings, meadows, burnt areas, or clearings.



MODERATE visual vulnerability



LOW visual vulnerability



LOW visual vulnerability

Horizontal pattern (oriented along the contour)

Form: terraced or benched slopes, ridge-saddle theory, prominent horizontal rock exposures.
Colour/Texture: horizontal strata exposing bare rock or supporting bands of vegetation.



MODERATE visual vulnerability



LOW visual vulnerability



LOW visual vulnerability

Figure 5 -- Criteria for visual vulnerability assessment.

DISCUSSION OF THE METHOD

The method permits coordinated analyses at a range of scales. Visual units may be: 1) compared on a measure of inherent scenic value; and 2) grouped to display regional patterns of scenic value. At the site scale, derivation of visibility sectors, vulnerability assessment, and identification of scenic features provide detailed information for landscape management and design.

The concept assumes that observers are not limited to specific viewpoints. However, certain developments (e.g. townsites, overlooks) may require more precise visibility data than can be drawn from the visual unit maps. This demands considerable field-plotting or the use of computer

programs to produce visibility maps (Travis, Eisner 1975). A recent study using VIEWIT, on a test portion of the Northeast Coal Study area, confirmed the general validity of the visual unit maps^{5/} in terms of general visibility.

With respect to scenic distinction ranking, an assumption which may be questioned is that of representation of scenic value by a single number, located on an ordinal (rank-

^{5/} Fujioka, M., and S. R. J. Sheppard, 1979. 'An application of Computer Graphics to Visual Unit Analysis. Unpublished paper, Department of Landscape Architecture, Univ. of California, Berkeley.

ing) scale, and derived by summing the scores of contributing factors. However, the summing of scores is the most direct method of taking into account all factors which are significant in forming a cumulative visual experience within a visual unit. It would be useful to establish index scores for regional landscapes against which the scores for particular units might be compared.

The factors are scored by comparative evaluation from a qualitative graphic scale, and, hence no absolute quantitative relationship exists between the ranking scores of different visual units. The ranking system does not assert, for example, that a unit with ranking score of 100 is ten times as scenic as a unit with a score of 10. It aims instead to provide a relative scale on which regional scenic values may be ordered and compared, unit by unit.

Adverse visual impacts are considered only in one out of twenty scenic distinction factors, whereas their effects on the landscape may, in the extreme, be dominant. Future studies may require more complex assessment.

Visual vulnerability assessment, as presented here, addresses only two of the factors likely to influence visual impact. Ideally, technical information on soils, terrain, vegetation, regeneration rates, and climate should be included.

It is expected that extension of the methodology may be necessary to meet the demands of new studies. It must be emphasized, however, that the visual unit concept remains useful regardless of the evaluation system employed.

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Sketches and drawings by the authors. Graphics presentation; Presentation Section, Resource Analysis Branch, Ministry of Environment, Province of British Columbia.