J. ENVIRONMENTAL SYSTEMS, Vol. 9(2), 1979-80

THE USE OF CRITERIA IN A CORRIDOR SELECTION ANALYSIS

R. W. HUFSTADER
VTN Environmental Sciences
Portland, Oregon

ABSTRACT

The use of criteria to determine an environmentally acceptable corridor for a power transmission line is discussed. The method involves 1) development of criteria, 2) compatibility rating of alternative routes on the basis of the criteria selected, and 3) ranking the alternative corridors in a quantitative manner. Criteria were developed within the resource categories of Ecology, Land Use, Aesthetics, Land Economics and Engineering. The method provides a concise, useable ranking of alternate corridors.

INTRODUCTION

Recently, efforts have been made in developing and applying systematic approaches to environmental impact analysis [1-7]. One approach is to determine and develop criteria and assess the impacts to them [7]. A basic intent of the "criteria analysis" process is to allow comparison of different environmental components. This paper will describe an application of "criteria analysis" used in a corridor selection process.

The selection process was designed to determine a corridor that does not include unsuitable or non-compatible areas within its boundaries. Depending on the particular use intended for the corridor, these unsuitable areas may change, for instance one area may be determined non-compatible for a transmission line but compatible for a highway. With the intended use in mind, a selection of criteria must be made. When criteria have been developed for each category, the attributes of the study area can be determined. Those parts of the study area found non-compatible are indicated on a map of suitable scale. When this has

© 1979, Baywood Publishing Co., Inc.

doi: 10.2190/C1FA-9U9P-NTQC-CNM7
http://baywood.com

been completed a constraints map will have been developed. This map indicates those areas that are non-compatible with the intended use of the corridor. Alternative corridors can now be located on the constraints map to avoid the maximum amount of non-compatible areas. Lineal or areal measurement of non-compatible areas crossed by each alternative corridor provides the basis for comparison among alternatives. The following discussion will describe the methodology for route selection involving a power transmission line.

CORRIDOR ANALYSIS METHOLOGY

In order to determine the requisite criteria for analysis, two factors were considered:

1. the constituents of each resource category (e.g., land resources include topography, landforms, faults, seismicity, geology, soils, minerals and geothermal areas among others); and
2. the relative importance of each constituent or group of constituents.

Since several categories and sub-categories were possible the resources were divided into Ecology, Land Use, Aesthetics, Land Economics and Engineering. The criteria determined for each is shown in Table 1.

The criteria shown can be effectively subdivided in different ways, however, this particular division provided a reasonable separation of work efforts within the five major categories.

Compatibility Analysis

The listing of criteria in Table 1 includes compatibility ratings, which were used to score alternative routes. A compatible ranking indicates that the criterion either has low or no sensitivity, conflict is minimal, and no constraint is imposed on the location of the route. Either physical disturbance of the environment has already occurred along the route, or the environmental element being considered has a low value.

Marginal compatibility indicates that there would be some conflict or impairment of sensitivity that would have to be minimized. Either some degree of environmental disturbance has occurred, or the land use or environment is moderately valuable.

A criterion that is incompatible would have a high sensitivity, and should be avoided if possible. If the area could not be bypassed, definite mitigating measures would have to be applied to minimize the conflict. These areas would either have not undergone physical disturbance, or would be of high value.

The Land Economics and Engineering criteria were not given compatibility ratings as were Ecology, Land Use and Aesthetics criteria. Instead, the Land Economics category was concerned with reduction in productive capacity of the

Table 1. Criteria Used for Corridor Analysis

	Criteria	*Degree of compatibility*
Ecology		
Land Resources	Extreme topography	Marginal
	Unstable soils	Compatible
	Mineral deposits	Compatible
	Geothermal sites	Compatible
Water Resources	Large bodies of water	Marginal
	Areas subject to periodic flooding	Compatible
Biological-Agricultural	Marsh areas	Incompatible
	Forest areas	Incompatible
	Croplands	Compatible
	Crucial/important wildlife habitats	Marginal
	Habitat areas for threatened or protected wildlife	Marginal
	Existing or potential wilderness areas	Incompatible
	Major migration routes	Compatible
	Wildlife preserve/refuge areas	Marginal
Antiquities	Existing significant finds	Incompatible
	Potential significant finds	Marginal
Land Use		
Economic Land Use	Irrigated cropland	Marginal
	Dry cropland	Marginal
	Rangeland	Compatible
	Mining sites	Incompatible
	Mining areas	Marginal
	Timberland	
	non-commercial	Compatible
	commercial, poor	Compatible
	commercial, average	Marginal
	commercial, good	Incompatible
Special Use/Interest Areas	Wildlife refuge	Incompatible
	Wilderness, primitive, natural areas	Incompatible
	Resource/research areas	Incompatible
	Antiquities sites	Incompatible
	Antiquities areas	Marginal
	Recreation sites	Incompatible
	Recreation areas	Marginal
Cultural Features	Townsites	Incompatible
	Airports/Airstrips	Incompatible
	Utility lines	Compatible
Aesthetics Criteria	Open space	Incompatible
	Other than open space	Compatible
	Regularly travelled roads (two miles or closer)	Incompatible
	Regularly travelled roads (outside two miles)	Compatible
	Designated recreations areas	Incompatible
	Antiquities (outside two miles)	Incompatible

Table 1. (Cont'd.)

	Criteria	*Degree of compatibility*
	Antiquities (outside two miles)	Compatible
	Urban areas	Incompatible
	Wilderness-primitive areas	Incompatible
	Scenic areas	
	excellent	Incompatible
	prime	Incompatible
	good	Incompatible
Land Economics Criteria	Irrigated cropland	
	Non-irrigated cropland	
	Irrigated rangeland	
	Non-irrigated rangeland	
	Commercial timber	
	Non-irrigated rangeland	
	Residential	
Engineering Criteria	Occurrence (frequency) of structures	
	Structure cost (installed)	
	Structure foundation cost	
	Line cost (installed)	
	Engineering and contingencies	
	Clearing costs (high, medium and low density)	

land. Seven different uses of the land were investigated where product value could be measured in dollars per acre. Product values of the land uses were obtained and inflated to current dollars. This was then used as the factor per mile of corridor from which losses could be evaluated.

The Engineering category attempted to quantify degree of engineering difficulty for the various segments. Engineering considerations included reliability, difficulty of right-of-way acquisition and cost. Of the three, the best indication was total construction cost, including materials, labor, clearing and design. Variables within construction cost include surficial geology, soil conditions, ground water, topography, accessibility and to some extent, weather. Manifestations of these variables are increased costs for foundations, span lengths, line slopes, equipment delivery and seasonal construction difficulties.

To quantify the Engineering category, total construction cost was calculated by using the equation:

$$C = X + A + 0.03\,(X + A) + 10Y$$

Where:

C = Total construction cost

X = Total installed cost

A = Materials overhead

(X + A) = General overhead

Y = Segment length in miles

Corridor Ranking

After each criterion was evaluated and assigned a compatibility value based on the known or predicted impacts of transmission line construction and presence, each route was measured to determine the amount of impact area included within each segment. The following listing indicates some hypothetical measurements as an example:

Route	*Marshes*	*Extreme Topography*
A	0.3	0
B	0.5	0
C	1.7	0.7
D	30	5

Only marshes and areas of extreme topography are shown, whereas in practice every criterion would be listed and its measurement, whether length or acreage, shown. This is accomplished for all the routes and a total score developed. The total score will reflect the weighted (i.e., whether low or marginally compatible) raw scores. Multiplicative factors to designate the different "weights" must be used to correlate with differing levels of impacts. The total scores must then be normalized (simply, all scores represent a per cent of the largest score) to allow comparison between categories (Table 2). The normalized scores are then summed to determine the lowest (best) scores signifying the route with least anticipated impact.

LIMITATIONS AND ADVANTAGES

The advantages of this method are obvious. It provides for the compilation and quantification of direct and indicative information concerning different resources, into one statement of relative anticipated impacts.

Table 2. Total Compatibility Normalized Scores by Route

Route	*Ecology*	*Land use*	*Land economics*	*Engineering*	*Aesthetics*	*Total*	*Rank*
(G)	86	73	67	100	55	381	2
(C)	96	90	66	99	47	398	4
(D)	94	87	46	89	70	386	3
(H)	83	80	66	94	78	401	5
(I)	79	76	48	98	77	378	1
(A)	100	88	68	98	60	414	7
(B)	98	86	48	87	83	402	6
(J)	77	100	47	92	100	416	8
(E)	93	92	100	97	51	433	10
(F)	96	80	67	97	80	420	9

The disadvantages arise primarily from the criteria selection process. This is a very time consuming step and requires the use of large amounts of information particular to the study area. It is also necessary that some screening process be applied to the criteria selected to assure their acceptance. This methodology has been applied, with modifications, in several corridor analyses. It has been found to provide concise, useable information for decision making.

REFERENCES

1. P. Newman, Environmental Impact: Part 1, *Journal of Environmental Systems, 4,* pp. 97-108, 1974.
2. P. Newman, Environmental Impact: Part 2, *Journal of Environmental Systems, 4,* pp. 109-116, 1974.
3. E. J. Cantilli and J. C. Falcocchio, Suggested Guidelines for the Analysis and Interpretation of Environmental Effects of Transportation Facilities, *Journal of Environmental Systems, 6,* pp. 83-104, 1977.
4. B. Loran, Quantitative Assessment of Environmental Impact, *Journal of Environmental Systems, 5,* pp. 247-256, 1975.
5. F. H. Rohles, The Ecosystem Complex: A New Approach in Specifying the Man-Environment Relationship, *Journal of Environmental Systems, 1,* pp. 321-328, 1971.
6. D. Panagiotakopoulos, A Multi-Objective Framework for Environmental Management Using Goal Programming, *Journal of Environmental Systems, 5,* pp. 133-147, 1975.
7. R. W. Hufstader, Generalized Criteria and Environmental Impact Analysis, *Journal of Environmental Systems, 7,* pp. 115-119, 1977-78.

Direct reprint requests to:

R. W. Hufstader
2315 N.E. 53rd
Portland, OR 97213