10 Procedures and Methods for Wetland and Coastal Area Visual Impact Assessment (VIA)

RICHARD C. SMARDON,
with MICHAEL HUNTER

Introduction

The purpose of Visual Impact Assessment (VIA) of any landscape is to determine the significance and/or severity of visual resource quality change from anticipated activities or land uses that are to take place on or adjacent to that landscape. Since the appreciation of visual resource landscape quality takes place through interaction of the landscape and the viewer, visual impacts are not restricted to the two dimensional geographic boundaries of the landscape itself. The landscape appreciated includes the total three-dimensional envelope of the area, its background, and atmosphere as perceived by the viewer. Examples of visual impacts are physical changes to the landscape, including, but not limited to, adding structures, changing or modifying landforms, water bodies, or vegetation, and obstructing views.

Consideration of visual impacts as a legally mandated procedure is clearly delineated by the National Environmental Policy Act[1] for federal actions. This legal mandate is also expressed by EPA's guideline regulations under Section 404[2] procedures as described in Chapter 2 and the President's executive order,[3] which neatly ties 404 procedures to the National Environmental Policy Act and specifies a broad range of federal activities to be included. Many state agency activities in the United States are potentially involved with environmental impact assessment procedures and more specifically visual or aesthetic impacts under mini-NEPAs. Specific consideration of VIA procedures depends on the language of these acts and the guiding regulations. Use of VIA for wetland landscapes in both inland and coastal contexts, in summary, depends on formal determination of a federal action under NEPA or

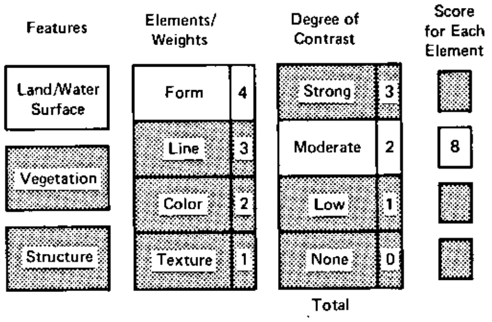


Figure 10.1. BLM's contrast rating system.

Section 404, a state action under mini-NEPA or state wetlands act (see Chapter 2 for specific acts), or in some instance where the visual impact of a proposed change to a wetland area is deemed to be a locally significant issue.

Previously, as with visual-cultural assessment in general, VIA was thought to be strictly a subjective assessment that cannot be methodologically defended or replicated. However, advances have been made in VIA methodology through research efforts. Of course there are still some problems with standards of practice and methodology, but they are equivalent to those experienced by other scientists working to develop accepted productivity assessment procedures for wetlands.

Literature Review

An extensive amount of literature addresses visual resource management in general (see Smardon et al., 1982). The purpose in this chapter is to review VIA studies that pertain to (1) wetlands and coastal areas and (2) to current VIA methodology research. Some of the findings from this literature will then be incorporated in the VIA methodological framework to be developed later in the chapter.

VIA methods according to Palmer (1981) have involved three methodological approaches of: professional appraisal, predictive models, and public evaluation. In actuality, most of the VIA methods in the literature use a combination of these approaches, or they use research regarding predictive models and public appraisals to yield a field-effective professional appraisal method. VIA methods also differ in their focus of intended application. Some methods are meant to be used for all types of land-use changes, while some were developed for specific land-use changes.

Agencywide VIA Methods

Probably the broadest methodology is the contrast-rating VIA system developed by the USDI Bureau of Land Management (1980a). The procedure as used by BLM operates in the following manner:

1. The landscape character as expressed by land features or water bodies, vegetation, and structures is described in terms of form, line, color, and texture.
2. The proposed activity for that particular locale is described in terms of form, line, color, and texture introduced or modified.
3. A contrast rating is then made by multiplying preestablished numerical values of form, line, color, and texture *for* land/water bodies, vegetation, and structures multiplied *by* the estimated degree of contrast (strong −3, moderate −2, weak −1, none −0) to yield subtotals of contrast ratings for land/water texture, vegetation, and structures (see Figure 10.1).
4. If the contrast ratings exceed "allowable" levels set according to the BLM Manual, then the project/feature element of greatest contrast is to be redesigned, the basic presumption being in most cases that too much contrast is "bad" or "not desirable."
5. The process is then repeated after the redesign.

This process is useful in that it provides a record of the landscape as it is and as it will be in the proposed project. It can be used to document which physical portion of the project needs to be reworked or redesigned (e.g., landfill cuts reduced, less vegetation disturbed, structures reduced in size). It can provide the legal documentation for taking action to ensure that mitigating actions are implemented, so from an administrative procedural point of view, the process provides many advantages.

The U.S. Forest Service uses a Visual Absorption Capability (VAC) analysis, primarily for assessing forest-harvesting-induced visual impacts.

VAC determines how much can be done to a

VISUAL ABSORPTION CAPABILITY

Factors		Variables	Rating	Viewpoints V1	V2	V3
OBSERVER POSITION	Superior	+300' - +500'	1			
		+100' - +300'	2	2	2	
	Normal	±100'	3			
		-100' - -300'	4			
	Inferior	-300' - -500'	5			
OBSERVER DISTANCE	Foreground	0 - ¼ mi.	1			
		¼ - ½ mi.	2			
	Middle-ground	½ - 1 mi.	3	3	3	
		1 - 2 mi.	4			4
	Background	2+				
VIEW DURATION	Long	30+ sec.	1		1	
		10 - 30 sec.	1		1	
	Short	5 - 10 sec.	3			3
		3 - 5 sec.	4	4		
	Glimpse	0 - 3 sec.	5			
LANDSCAPE DESCRIPTION		Feature	1			
		Focal	2			2
		Enclosed	3	3	3	
		Panoramic	4			
		Other	5			
SLOPE	Very Steep	45+%	1			
	Steep	30 - 45%	2			
	Moderate	20 - 30%	3			
	Gentle	10 - 20%	4			
	Very Gentle	0 - 10%	5	5	5	5
Lowest rating is the Key Viewpoint				17	14	18

Summary

VISUAL ABSORPTION CAPABILITY

5 - 13 Low
14 - 16 Intermediate
17 - 23 High

Figure 10.2. Sample rating system showing visual-absorption capability.

landscape site before its visual absorption capability is exceeded. Contrast rating as used by BLM, on the other hand, determines whether a proposed change to the landscape would cause an acceptable or unacceptable level of contrast with that specific site.

VAC combines physical factors of the existing landscape, highly changeable perceptual factors, existing visual quality factors (form, line, color, texture), and proposed-activities factors (scale, configuration, duration, frequency) to determine the VAC score for that particular landscape (see Figure 10.2). A low VAC score is restrictive, and a high score means much more activity can be allowed. The VAC score range is then compared to the existing visual mangement objective(s) already determined for that area (see Figure 10.3).

These are the two existing federal-agency-related VIA methods. They are professional ap-

LANDSCAPE MANAGEMENT GUIDE MATRIX					
I-Most Restrictive ↓ V-Least Restrictive		VISUAL QUALITY OBJECTIVE			
		Retention	Partial Retention	Modification	Maximum Modification
Visual Absorption Capability	Low	I	II	III	V
	Inter-mediate	I	III	IV	V
	High	II	III	IV	V

Figure 10.3. Matrix for identification of appropriate landscape management guides.

praisal methods in that they are meant to be used by professional VRM practitioners in the field. They are also meant to be predictive; the assumption is made that the key variables that explain most of the visual impact do, indeed, predict visual impact.

Individual Practitioner/Academic VIA Methods and Research

Probably one of the earliest documented methods of VIA was developed by R. Burton Litton (1973). Litton explains how to study landscape visual impacts by setting up "landscape control points" (LCPs), a network of permanently established observation sites. The visible landscape can be plotted by direct field observations, by laying out a series of sections as rays from a single LCP, or by a computerized mapping technique. Photographs and sketches can be used to document landscape characteristics as they are and then with the modifications in place. A case study applied this VIA analysis to the Teton National Forest in Wyoming. This approach was strictly a professional appraisal, but it delineated some important principles of visual documentation and simulation.

Another early study, partially based on previous studies at Harvard University (Jacobs and Way, 1968), was done for the Corps of Engineers by Steinitz and Way (1970). The Urbanizing Watershed study dealt with the relationship of visual impact to land-use change "like/dislike," perceived "naturalness" of the landscape context, the vegetative opacity of the landscape, the area ratio of impacting land use to existing landscape, and the color spectral difference (or tonal difference) between land use and landscape. A photographic matrix containing different landscape/land-use combinations was used to elicit responses from study participants. Conclusions were that visual impact of land use can be predicted by (1) vegetative opacity of the landscape or the area ratio between land use and landscape and (2) their tonal contrast. These objective variables are screened, according to the authors, by a subjective evaluation (like/dislike) of the form (or land use) introduced to the landscape. The authors found that no significant differences existed between the visually trained and untrained subsamples. It should be noted that most landscapes used for this study were distinctly northeastern, which limits the relevancy of the vegetative opacity variable for many western landscapes. A later study (Hendrix and Fabos, 1975) done with a similar set of landscapes and land uses concluded that visual land-use compatibility, as judged by a cross section of respondents, played a significant role in explaining visual resource quality. Again, this study dealt with northeastern urbanizing landscapes. Note that the variable *compatibility* is well supported by the previous two studies.

The following literature deals with siting issues involved with large or dominant man-made alterations of the natural landscape. This is in contrast to the previous work, which dealt with less dominating activities in more urbanizing landscapes.

A substantial amount of work has been done through the firm of Jones and Jones in Seattle. This work was initiated through a joint project with Battelle Pacific Northwest Laboratories to develop a methodology to evaluate predictively changes in visual quality of a landscape as a result of siting a nuclear facility (Jones et al., 1975). This methodology uses the variables of *intactness, vividness,* and *unity* to account for change in visual quality. The basic method, combined with procedures to select representative viewpoints, amount of facility visibility, viewing distance, observer position, determination of viewing populations, and visual simulation, has been used to assess visual impacts from other activities, including dams, roads, and power lines. (Ady et al., 1979).

In recent work by Jackson, Hudman, and England addressing the issue of visual impact of high-voltage transmission lines, the factors that accounted for the largest percentage of variance include (1) dominance or harmoniousness of the introduced structure and (2) whether the poles are highly salient or close to the viewer:

> Transmission lines become important in environmental assessment only when they are highly visible in environments which otherwise have little evidence of man's impact. The degree of negative impact in such settings increases as power lines become more visually *dominant*. In urban areas or other settings which are not regarded as 'natural', power transmission lines do not significantly distract from the aesthetic quality of the scene. (Jackson et al., 1978, p. 165)

This study involved 1,500 participants, who were shown eighteen sets of 35-millimeter transparencies of four scenes. Rankings were compared for each transparency through the use of preference proportions, Luce Scaling, and Thurstone Scaling. Analysis of scale scores revealed that environmental preference was highly uniform regardless of socioeconomic or other variables.

Daniel and Boster (1979) conducted visual assessments of forest stands using *scenic beauty* as the variable. They now have sufficient data to begin to develop a computer-aided management tool that will predict scenic beauty based on proposed management practices for specific forest types (Daniel and Schroeder, 1979). The scenic beauty estimation method has also been used to compare black-and-white sketches, color sketches, and color slides for simulating landscape modifications (Schomaker, 1978).

Finally, Wohlwill has done extensive research testing the variables *ambiguity, complexity, congruity,* and *novelty* in relationship to man-made structures introduced to the landscape (Wohlwill, 1978, pp. 3–5, 23; Wohlwill and Harris, 1980). This work involved two studies, using students as the predominant sample. The first involved visual simulation (photographs of scale models) of different land uses placed in three types of California coastal-zone environments. The second used slides of a mix of man-made structures in eastern park environments. Results from the coastal study showed that color and size contrast correlated highly with judgments of visual impact. However, judgments of appropriateness of land use with the environmental context was not straightforward (i.e., a lumber mill was judged appropriate to a "scenic" wooded coastal setting typical of northern California).

The second study showed a high level of agreement concerning the role of *congruity* or fittingness in evaluative judgments of different park scenes with varying amounts of man-made features (i.e., buildings, roads, bridges, signs and special purpose facilities for eating, entertainment, and recreation). In both studies the primary landscape alteration/modification was the addition or variance of the man-made structures. As will be noted later, there is a significant difference in the ease with which respondents react to structures introduced to the landscape as opposed to landform, water-body, and vegetational changes.

The development and use of VIA methods has proceeded rapidly in the last decade. Arising largely from a confluence of legal mandates, governmental administrative policies (Smardon, 1979), and the progressive accumulation of research on landscape perception (Craik and Feimer, 1979; Elsner and Smardon, 1979; Zube, 1976), these methods are generally intended to provide land-use managers with objective information concerning the impact of land-use activities on the aesthetic quality of the landscape. This information can be incorporated in the decision-making process, with aesthetic factors taking their place alongside the other important environmental, economic, and social factors concerning land-use options.

An important assumption underlying the inclusion of aesthetic factors through VIA systems in the decision-making process is that they will foster more effective, judicious decisions. That goal can be attained only if the information provided by VIA methods is accurate and systematic. Obviously, the greater the inaccuracy of a given measurement system, the greater is the likelihood and possible magnitude of an error in the decision. This issue is of critical significance where land-use management is concerned, since decisions involving land use often have long-term consequences. Thus the underestimation of the visual impact of a land use might result in unnecessary degradation of the visual quality of the landscape, while an overestimation might result in modification, curtailment, or disallowance of the activity, which in turn could cause considerable social and economic disruption. To avoid these pitfalls, VIA methods of sufficient technical quality should be employed (for a discussion of technical standards in VIA, see Craik and Feimer, 1979). Minimally, the technical-performance features of VIA systems must be evaluated so that decision-makers will know the margin of error.

Closely related issues to margin of error of any given VIA methodology are the legal issues of (1) adequacy of visual analysis given the context of existing laws and policy and (2) soundness of the basic methodology. Many federal and some state statutes call for explicit consideration and treatment of aesthetic or visual resources for certain federal/state actions or within certain land areas administered by federal/state agencies (Smardon, 1978).

Visual resource methodologies are being more closely scrutinized in courtrooms and administrative hearings, for basic adequacy and soundness. The ability of any VIA methodology to stand up to such legal tests is strongly related to the methodological properties of reliability, validity, and generalizability.

Issues of Reliability, Validity, and Generalizability

The quality and utility of a measurement method is largely a function of three properties: reliability, validity, and generalizability. Reliability refers to the consistency and precision of measurement; it reflects the degree to which the obtained measures are replicable in the same or similar circumstances, as well as the attainable level of discrimination among the objects of interest. In the context of VIA, reliability represents the degree to which a measure accurately reflects variation among landscape and land-use conditions. Validity refers to the degree to which a measure represents the construct or variable of interest. Reliability has important implications for validity in that the reliability of a measure delimits its attainable validity. Validity provides an estimate of the degree to which a method is able to capture meaningful variations in the aesthetic quality of the landscape and to depict the impact of land-use activities upon it. Finally, generalizability refers to a specification of the conditions for which the attained levels of a reliability and validity are representative. Factors that could constrain the generalizability of reliability and validity coefficients might include physiographic landscape and land-use conditions, background characteristics of observers used in the VIA procedure, media of presentation of landscape and land-use conditions, and the extent of pertinent landscape and land-use information available to VIA users confronted with specific problems.

The research reported here is directed at an evaluation of the reliability, validity, and some aspects of the generalizability of selected observer-based VIA methods. The emphasis has been on VIA methods with a potentially wide application to a broad array of landscape and land-use contexts. Related findings on the reliability of VIA methods were reported by Feimer, Craik, Smardon, and Sheppard (1979). The following research and findings summarize three years of work done in two increments. The first research increment, which involved the author, Professor Nicholas Feimer of Virginia Polytechnic Institute, and Dr. Kenneth Craik of the University of California, also appears in an article by Feimer, Smardon, and Craik (1981).

The First Increment: VIA Research

Nineteen pairs of landscape scenes were employed to assure the effectiveness of the VIA rating procedures. One member of each pair depicted the landscape before the imposition of a given land-use activity and the other after the imposition of that activity. Since preimpact and postimpact versions of scenes controlled for observer position, lighting, time of day, season, and other variables that are likely to affect ratings were not available, either the preimpact or postimpact version of each pair had to be simulated. Simulation entailed either removing or imposing the land-use activity by means of retouching and painting techniques. (USDI, Bureau of Land Management, 1980b). All stimuli were presented to subjects as 35-millimeter projected slides.

The landscape scenes and land-use activities selected include a broad range of conditions common to the western half of the United States. Landscapes ranged from densely forested mountains to sparsely vegetated desert, and land uses included agricultural, water management, mining, energy, and road development activities (see Smardon, 1979).

Research participants were drawn from three populations: (1) graduate and undergraduate students (n = 54) from the Berkeley and Davis campuses of the University of California; (2) federal agency administrative personnel (n = 87); and (3) landscape architects (n = 41) from the U.S. Department of Agriculture's Forest Service.

Ratings were obtained through three quasi-experimental treatment conditions. In one (Prepost) condition, participants were presented with the preimpact version of each scene; they completed direct ratings for all of the landscape dimensions except *importance* and *severity* (which implicitly apply to impacts) immediately after viewing each scene. Next, they were presented with the postimpact version of the scene and completed contrast ratings as well as the importance and severity ratings. Subsequently, the Visual Contrast Rating method (USDI, Bureau of Land Management, 1980a) was also completed. Thirty-nine members of the student subsample were in this condition.

In a second treatment (Post condition), participants were merely presented with the postimpact version of each scene and subsequently completed direct ratings on all landscape dimensions except importance and severity. Fifteen members of the student subsample were in this condition.

A two-hour training period preceded both the Prepost and Post conditions to familiarize raters with the rating procedures, and with the contrast-rating method in particular. In addition, a subsample of the Post condition (students at the University of California, Davis; n = 27) was given feedback on its reliability levels periodically during the data collection period. However, no differential effects were found in conjunction with feedback and, hence, the subsamples were collapsed into one group for subsequent data analysis.

In the third treatment (Global condition), participants were presented with both the preimpact and postimpact version of each scene, with the order of presentation counterbalanced for subgroups within the condition. Immediately after viewing each version of the scene, the participants completed the scenic beauty ratings. After viewing both versions of each scene, severity (of visual impact) ratings were completed. After all ratings were completed, participants in this condition were asked to reflect on and then rank-order the criteria they employed for judgments of both scenic beauty and severity (of visual impact). The entire federal agency and BLM/Forest Service samples were in this condition. Because of time constraints, they completed only fourteen of the nineteen pairs of scenes.

The two different testing conditions were employed to provide contrast ratings and independent preimpact and postimpact direct ratings. The third testing conditions served primarily to provide an independent set of criterion data on evaluations of aesthetic quality to assess the generalizability of the direct and contrast ratings to observer groups from the first two conditions. Subjects were either untrained in VIA (federal agency sample) or trained but with differential training and experience (BLM/Forest Service sample).

Reliability

Intraclass correlation (Ebel, 1951), the average reliability of a single rater was employed to assess the reliability of ratings. It is derived from a one-way analysis of variance, where scenes (n = 19) are a random variable that constitute the main effect; residual variance is the error term. Because of missing observations for some research participants on various scenes and rating dimensions, it was also necessary to use

Table 10.1 Average Single-Rater Reliabilities for Direct and Contrast Ratings

	Rating procedure		
Dimension	Preimpact (n = 29)[a]	Postimpact (n = 17)	Contrast (n = 29)[a]
Ambiguity	.19	.07	.04
Color	.13	.25	.34
Compatibility	.07	.28	.03
Complexity	.49	.13	.15
Congruity	.17	.25	.03
Form	.45	.14	.15
Importance	—	.27	.13
Intactness	.34	.31	.04
Line	.19	.05	.22
Novelty	.31	.22	.07
Scenic beauty	.18	.20	.03
Severity	—	.21	.25
Texture	.41	.24	.24
Unity	.21	.25	.01
Vividness	.26	.24	.10
Mean	.26	.21	.12

[a] n is the average number of raters used in computation of reliabilities and follows Snedecor (1946).

an average value for the number of raters when calculating the reliability estimates. The appropriate value ($\bar{n}$) was obtained by an application of Snedecor's (1946) formula. The results of these analyses are given in Table 10.1. It is apparent that the reliability coefficients vary substantially within each rating condition. However, both preimpact and postimpact direct ratings tend to manifest higher levels of reliability than do contrast ratings. The average reliabilities for preimpact direct, postimpact direct, and contrast ratings are 0.26, 0.21, and 0.12, respectively. The lower reliability of contrast ratings is most likely a function of the cognitive complexity of the rating task. Rather than merely evaluating some aspect of the landscape and expressing it in terms of scale value, the contrast rating requires a quantitative appraisal of the difference between two variations of the same stimulus, with all the associated mental transformations. Nonetheless, even for direct ratings, the obtained coefficients are clearly below acceptable standards (generally coefficients of 0.70 and higher are desirable). However, these coefficients represent reliabilities for a single rater, and while single raters are often used in applied settings, higher reliability is generally obtained when composite ratings from panels of independent judges are employed (Craik and Feimer, 1979; Feimer et al., 1979; Zube, 1976). In the current context, for example, applying the Spearman-Brown prophecy formula (Guilford, 1954) to the average reliabilities of the respective rating procedures reveals that a panel of ten independent judges would increase the average reliability to above 0.70 for both sets of direct ratings, and to 0.58 for contrast ratings.

Validity

Change in scenic beauty was employed as criterion measure to represent change in aesthetic quality resulting from the imposition of land-use activities. It was obtained by subtracting the average postimpact direct rating of scenic beauty from the concomitant average preimpact direct ratings. This criterion measure for each subsample was then intercorrelated with change scores for each of the direct ratings (again subtracting the average postimpact from the average preimpact ratings) and average contrast ratings of the student subsample.) Since the average score for each rating dimension was used (i.e., a multirater composite), the reliabilities of the dimensions employed in the analysis were at an acceptable level (an average reliability above 0.70 for all rating procedures). The intercorrelation of change in scenic beauty with direct rating-change scores and contrast ratings is given in Tables 10.2 and 10.3. Three direct rating dimensions (compatibility, congruity, and intactness) are significantly correlated with change in scenic beauty for two of the three samples. These variables indicate that changes in the character and coherence of the landscape seem to be associated with perceived changes in aesthetic quality. Changes in landmass features (form) appear to be an important component of the resulting incongruity. Interestingly, none of the contrast ratings generated by the student sample correlates significantly with change in scenic beauty. However, for both the federal agency sample and the BLM/Forest Service sample, severity (of visual impact) does correlate significantly ($r = 0.76$ and 0.68, respectively; $p < 0.01$) with scenic-

Table 10.2 Scenic Beauty Change Scores Correlated with Direct-Rating Change Score

	Change in scenic beauty		
Direct Rating Dimensions (student sample)	Student sample (n = 19)[a]	U.S.federal agency sample (n = 14)[a]	BLM/Forest Service sample (n = 14)[a]
Ambiguity	.38	.27	.08
Color	.04	.04	−.13
Compatibility	.67[c]	.38	.72[c]
Complexity	−.06	.19	.15
Congruity	.56[b]	.53	.67[c]
Form	.59[c]	.47	.78[c]
Intactness	.31	.62[b]	.71[c]
Line	.47[b]	−.07	.23
Novelty	.25	.30	.34
Texture	.06	.26	.20
Unity	.66[c]	.09	.52
Vividness	.06	.08	.23

[a] n is the number of scenes.
[b] $p < 0.05$
[c] $p < 0.01$

Note: Correlations are based on average ratings of respective samples completing ratings.

beauty change. Those severity ratings do not predict from one group to the other. Thus the current data analysis indicates that contrast ratings tend not to manifest prediction of change in scenic quality that generalizes to other populations.

Criterion Rankings

To gain more insight about *which* variables may be important for explaining change in visual quality of severity of visual impact, a separate qualitative analysis was done on data collected parallel to the Feimer and Craik (1979) study. First, after subjects had finished their quantitative ratings, they were asked to rank-order, with the most important first, criteria that they had used in rating preimpact scenes for scenic quality. Second, they were asked to list criteria in the same fashion for assessing severity of visual impact as seen in both the preimpact and postimpact scenes. The theoretical underpinnings of the approach are that after they had finished rating the nineteen sets of preimpact and postimpact scenes they would have some criteria in mind when rating the slides.

This raw data was 143 sets of two pages of rank-ordered criteria for 66 federal-agency personnel (nonvisually trained), 38 students (primarily in landscape architecture), and 39 landscape architects (U.S. Forest Service and BLM). These criteria were then sorted into categories of physical, aesthetic, and global for assessing scenic quality, and categories of visual impact (see Tables 10.4 and 10.5). Within these categories criteria were listed with their rank orders and number of times mentioned. Criteria were counted as additive only if, by content analysis, they were similar. A number of subcategories were then collapsed into the major categories in Tables 10.4 and 10.5. However, only the major criteria with their number of times mentioned and mean rank order are listed.

A number of comments can be made about each table. First are the criteria for assessing *scenic quality*. Under the *physical criteria* category landform or landform features are most often mentioned in two groups out of three, followed by lack of man-made features in two out of three groups. A surprise is the mention of climatic effects or atmospheric factors in all

Table 10.3 Scenic Beauty Change Scores Correlated with Contrast Ratings

Contrast ratings Dimensions (student sample)	Change in scenic beauty: Student sample (n = 19)[a]	U.S. federal agency sample (n = 14)	BLM/Forest Service sample (n = 14)[a]
Ambiguity	–.12	–.16	.17
Color	.08	–.21	.19
Compatibility	.23	–.29	.14
Complexity	.29	–.29	.45
Congruity	.18	–.11	.21
Form	.13	–.03	.04
Importance	.10	.19	.08
Intactness	.15	–.04	.22
Line	.25	–.35	–.17
Novelty	.10	–.15	.23
Scenic beauty	.19	.07	.34
Severity	.24	.22	.38
Texture	.07	–.05	.29
Unity	.19	–.29	.19
Vividness	.17	–.01	.26

[a] n is the number of scenes.

Note: Correlations are based on average ratings of respective samples.

three groups. Vegetative features or characteristics also play a strong role for all three groups. The mixed agency personnel respond more similarly to the landscape architects as a whole than to the students.

In the category of *aesthetic* criteria, color qualities are most often mentioned in two out of three groups, followed by variety/diversity and overall contrast. The landscape architects use more aesthetic criteria than either of the two other groups.

In Table 10.5 under the *visual aesthetic* category, the size/scale of alteration of the introduced impact, distance/scale/visibility, and spatial location are the three major variable sets mentioned beside overall contrast/clash, color, form, line, and texture pattern. Color and form are the most mentioned of the traditional variables used by BLM, which infers that the existing BLM weightings may be questioned, as was found by Feimer and Craik (1979).

In the *global aesthetic* category the criteria mentioned in all three groups are (1) obviousness/dominance, (2) fittingness/appropriateness/compatibility, and (3) naturalness. The latter two criteria are mentioned in Feimer and Craik (1979) as being highly significant in explaining people's underlying motives for their quantitative rating patterns.

The major finding that may be deduced from these two charts is that major variables are not presently included in BLM's visual contrast rating system. Some of these variables are those that can be related to the observed physical properties of landscapes, and some are not. Global nonphysically related variables do not have utility for visual impact assessment purposes because the effect cannot be identified on the physical site and therefore cannot be mitigated. Most often mentioned as aesthetic factors related to severity of visual impact were the naturalness, fittingness, compatibility, and appropriateness of the intrusion. The most prominent physical criteria cited were change in color and form qualities and magnitude of the intrusion.

Table 10.4 Results of Open-Ended Response: Criteria for Assessing Scenic Quality

	Mixed Agency Personnel (N = 66)			Students (N = 38)			Landscape Architects (N = 39)		
	*	Criteria	**	*	Criteria	**	*	Criteria	**
Physical	24	Landform features	2.77	16	Landform characteristics	2.27	18	Landform features	2.58
	21	Vegetative features	3.19	20	Vegetative characteristics	2.9	9	Vegetation and lifeforms	3.67
	17	Water	2.47	7	Water	3.67	13	Water	2.46
	9	Climatic effects	3.44	13	Climatic effects	3.7	13	Atmospheric factors	3.38
	23	Absence of man-made features/disturbance	2.28				17	Man-made elements	4.35
Aesthetic	37	Color qualities	2.06	23	Color qualities	2.9	28	Variety/diversity of elements	2.16
	17	Variety/diversity	2.06	23	Variety/diversity	2.6	26	Color qualities	3.27
	13	Contrast	2.2	24	Contrast	2.6	18	Contrast	2.93
	11	Interestingness	2.00				8	Interest	3.87
							9	Form qualities	3.11
							5	Line qualities	3.2
							11	Texture qualities	3.7
							6	Distinctiveness	2.0
Global	11	Naturalness	1.45	14	Pristineness/ undisturbed naturalness	2.86	12	Naturalness/pastoral	5.16
	13	Composition	2.77				18	Composition/harmony	2.21
				7	Uniqueness/scarcity	1.14	7	Uniqueness/unusual	3.43

*Number of times mentioned.
**Mean rank order from possible 1 to 7.

Thus, as in the correlation analysis, continuity in the general form of the landscape and the resultant compatibility of the land-use activity seem to be the most salient factors in the psychological appraisal of visual impacts. It must be stressed, however, that this analysis of rankings is only tentative. The reliability of the categories employed in this latter analysis and the consequent tallies have not yet been fully appraised.

The Second VIA Research Increment: Stimuli, Research Participants, and Procedures

In the second round of VIA psychometric testing, twenty-five pairs of landscape scenes were employed to assess the participants' ability to use a modified VIA method. Thirty-five seniors and graduate students were trained to use the modified VIA method and were given copies of the manual developed by Sheppard and Newman (1979).

Similar to the previous years' testing, the participants were shown the preimpact 35-millimeter slide, asked to describe the existing landscape, then shown the postimpact scene adjacent to the preimpact scene and asked to describe and rate the visual impact using the modified contrast-rating forms. Again, the visual stimuli were simulated. Simulation entailed either removing or imposing the land-use activity by means of retouching and painting techniques (USDI, Bureau of Land Management,

Table 10.5 Results of Open-Ended Response: Criteria for Assessing Severity of Visual Impact

	Mixed Agency Personnel (N = 66)			Students (N = 38)			Landscape Architects (N = 39)		
	*	Criteria	** *	*	Criteria	**	*	Criteria	**
Visual aesthetic	16	Size of introduced impact	2.0	6	Size	2.11	16	Size/scale of alteration structure	2.32
	5	Distance/scale	2.0	5	Distance/scale	1.8	9	Distance/visibility	4.44
	5	Spatial location of introduced impact	1.76	12	Spatial location	3.0	8	Spatial location	3.25
	11	Amount of Contrast/clash	1.64	11	Contrast	3.09	39	Contrast	2.18
	20	Color qualities	1.95	10	Color qualities	2.3	14	Color qualities	2.0
	12	Form/shape qualities	2.23	3	Form qualities	1.67	13	Form qualities	2.07
	10	Line qualities	2.0	5	Line qualities	2.8	6	Line qualities	2.67
	4	Textural qualities	1.0	4	Pattern	2.75	6	Textural qualities	2.5
Global aesthetic	6	Obviousness	1.17	6	Obviousness/blatency/obtrusiveness	1.17	7	Dominance over existing landscape	1.43
	9	Fittingness/blending	2.42	6	Fittingness	2.0	14	Compatibility/appropriateness/fittingness	2.92
				5	Appropriateness/expectancy	2.0			
	18	Naturalness	1.61	9	Unnaturalness	1.89	5	Naturalism/unnaturalness	2.0
	3	Physical presence of disturbance	2.67	8	Overall visual change	1.25	5	Harmony w/existing landscape	1.4
				9	Aesthetic/visual quality of the setting before change	2.33			
Associational	10	Associated physical criteria	3.11	7	Associated environmental concern	3.38	5	Associated physical criteria	2.2
				5	Landform change	2.2			
	7	Type of object introduced	2.86	15	Type of man-made introduced activity/structure	3.27			

*Number of times mentioned.
**Mean rank order from possible 1 to 7.

1980b). The added landscape scenes and land-use activities were meant to create a more representative cross section of visual stimuli than before. To this end, the new visual stimuli were taken primarily of the Great Basin, canyonlands, the Great Northern Plains, and interior California landscapes with surface mining, coal-fired power plants, and geothermal energy development land-use activities.

After all rating forms and general environmental background forms were filled out, the forms were sent to Virginia Polytechnic Institute and Virginia State University, Blacksburg for keypunching and analysis. The testing was done as part of a visual analysis course taught at State University of New York, Syracuse. The following is a brief synopsis of the latest round of psychometric testing.

Reliability

As indicated by Table 10.6, use of detailed visual contrast rating variables still falls below acceptable levels (< .70) of reliability between individual raters. The consistency of rater behavior using these detailed contrast-rating variables did improve significantly if one compares Table 10.6 results with Table 10.1 from previous testing. The additional guidance provided in the prototype manual is useful, but multiple raters are needed if significant levels of reliability are to be obtained. Table 10.7 indicates similar results for overall element components. Table 10.8 indicates reliability estimates for scale and spatial-dominance ratings.

Table 10.6 Reliability Estimates for Visual Element Components of the Contrast-Rating Procedure

Scale	R[a]	R[b]	R[c]
Land/water bodies			
Color	.52	.84	.97
Form	.35	.73	.95
Line	.35	.73	.95
Texture	.38	.76	.96
Scale	.31	.70	.94
Vegetation			
Color	.28	.66	.93
Form	.24	.61	.92
Line	.34	.72	.95
Texture	.33	.71	.94
Scale	.22	.59	.91
Structures			
Color	.45	.80	.97
Form	.55	.86	.98
Line	.53	.85	.98
Texture	.43	.79	.96
Scale	.53	.85	.98
Average ($\bar{X}$)	.39	.75	.95

[a] Reliability for one rater.

[b] Reliability for the average (composite) of five independent raters.

[c] Reliability for the average (composite) of the entire sample used to generate estimates (K = 35).

Source: Feimer, 1981.

Validity

Ratings taken from the same SUNY, Syracuse, sample were correlated with change in scenic-beauty ratings for the same visual stimuli. In Table 10.9, those figures with asterisks indicate significant correlation with scenic-beauty change. Those variables that react in the same way as scenic-beauty change include *texture* contrast for structures, *scale* contrast for both land/water bodies and structures, and overall *spatial dominance.* Near-significant correlations with change in scenic beauty include *color* contrast for structure, *form* contrast for structures, *scale* contrast for vegetation, *scale* contrast overall, and *scale dominance.* A similar story can be seen in Table 10.10, where scale and spatial-dominance variables are highly intercorrelated with each other.

The results from the correlations and intercorrelations partially reinforce what has been found in other recent studies and in our own previous testing. First, it is much easier for people to judge the visual impact of structures than landform/water bodies or vegetation. Second, the variables that most consistently behave similarly to change in scenic beauty are scale contrast and spatial dominance for all situations, and texture, form, line, and color contrast for structures only.

VIA Methods Applied to Wetlands and Coastal Areas

No standardized guidelines exist for conducting a visual impact assessment, but past assessments seem to have followed one of three approaches according to Palmer (1981): (1) professional appraisals, (2) predictive models, and (3) public evaluations. Professional appraisals are the most common and are discussed in the work of Baird et al. (1979) on the California coastal zone, Roy Mann (1979) on the Chesapeake Bay, and Smardon et al. (1980) on the outer banks of North Carolina. Predictive models tend to be geared more toward research than impact assessment (Palmer, 1981). The last approach, public evaluation, is based on public participation and input and is sometimes included as part of professional appraisals or the research behind the professional appraisal method.

Professional Appraisals

California LNG Terminal Siting

To locate potential California coastal-zone offshore Liquid Natural Gas (LNG) sites and the types of terminals that might occupy those sites,

Table 10.7 Reliability Estimates for Overall Element Components of the Contrast-Rating Procedure

Scale	R^a	R^b	R^c
Color	.45	.80	.97
Form	.47	.82	.97
Line	.41	.78	.96
Texture	.25	.62	.92
Scale	.47	.82	.97
Average ($\overline{X}$)	.41	.77	.96

[a] Reliability for one rater.

[b] Reliability for the average (composite) of five independent raters.

[c] Reliability for the average (composite) of the entire sample used to generate estimates ($K = 35$).

Source: Feimer, 1981.

Table 10.8 Reliability Estimates for Scale and Spatial Dominance Ratings from the Contrast-Rating Procedure

Scale	R^a	R^b	R^c
Scale dominance[d]	.54	.86	.98
Spatial dominance			
Composition[e]	.41	.77	.96
Position[e]	.27	.65	.92
Backdrop[f]	.45	.81	.96
Overall[d]	.40	.77	.96
Average ($\overline{X}$)	.41	.77	.96

[a] Reliability for one rater.

[b] Reliability for the average (composite) of five independent raters.

[c] Reliability for the average (composite) of the entire sample used to generate estimates.

[d] Average number of raters per scene $(\overline{K}) = 35$.

[e] Average number of raters per scene $(\overline{K}) = 32$.

[f] Average number of raters per scene $(\overline{K}) = 31$.

Source: Feimer, 1981.

the California Coastal Commission authorized a study by Baird et al. (1979) regarding site selection and terminal feasibility for Liquid Natural Gas off-loading and storage as well as protection of the California coastal resources. The alternatives studied included island-based terminals, deep-bottom supported terminals, shallow-bottom supported terminals, floating terminals, semisubmergible, and a hybrid of land/sea-based concepts (Baird et al., 1979).

The study was conducted in three steps: design, location, and evaluation (ibid.). First, the conceptual designs for LNG storage facilities were designed by three different designer/engineer firms. These firms designed one floating and two bottom-supported facilities, as shown in Figure 10.4.

Second, zones were studied to ascertain a feasible site for an LNG terminal. This was done by the California Coastal Zone staff and consultants considering factors such as winds, waves, water depths, and safety. The result of this second stage was that seven zones off the southern California coast survived the initial screening. Of these seven, four were eventually recommended, as shown in Figure 10.5. A detailed list of reasons why zones were not recommended included terminal engineering problems; terminal system cost; operational reliability in delivering gas to California residents; public safety; adverse impacts on marine and coastal resources; conflicts with existing recreational, military, and other uses; and problems obtaining approvals (ibid.).

Third, the visual and scenic resources were evaluated. This involved three study aspects: (1) calculating the number of people exposed to views of proposed LNG facilities, (2) determining the percentage of time visible, and (3) analyzing the compatibility of the LNG activities with the coastal landscape viewsheds. The number of people exposed to a particular scene was determined from highway-use figures for coastal routes and residential-development density. The percentage of degree of visibility of the potential site zones from areas where impacts would be felt was determined from visibility data of percentage of the year that clear views of the coast were possible versus views obscured by fog.

Landscape compatibility (that is, existing industrial development versus none) was a key issue. To aid the landscape compatibility analysis, simulations (see Fig. 10.6) were created by air-brushing with watercolor dyes onto the photographs of the selected sites the various facility types at the proper scale. The simulations were useful to the Coastal Commission in three ways (ibid.): (1) policy decision-making, (2) report preparation, and (3) various workshops conducted and public presentations. The islands were undeveloped, while the coastal areas near the Ventura Flats contained oil and gas exploration development. The recommendations echoed the Coastal Commission's dual role to locate an LNG storage facility and to protect California's coastal resources. In summary, the proposed staff findings recommended a floating facility at the Ventura Flats as "the most appropriate site/facility combination" (ibid.).

Chesapeake Bay Peer-Review Wetlands Study

To aid in the maintenance of existing Baltimore Harbor channels and the planning for future harbor development, the State of Maryland decided to locate a diked disposal area in the Upper Chesapeake Bay. A site for the facility was selected by the Maryland Department of Natural Resources (DNR) at Hart and Miller islands. The U.S. Army Corps of Engineers prepared an Environmental Impact Statement (EIS), but the DNR had outstanding questions concerning environmental impacts and contracted with Roy Mann Associates (RMA) to conduct a peer review of these questions (Mann, 1979). Environmental issues included visual impact, and the sites proposed for dredge-disposal areas also included wetland areas.

The visual impact assessment involved the evaluation of ten alternative sites. The methodology used, developed by RMA, is made up of four steps (ibid.): (1) determining significant viewable water surface, (2) defining the lateral viewing zones, (3) determining the numbers of people who had significant views of water surface, and (4) evaluating the visual quality of these views.

Given the dynamic nature of water, the surface of the dike would be visible in limitless combinations. In the first stage RMA limited its concentration to the significant viewable surface (see Figures 10.7, 10.8, and 10.9). As shown in

Table 10.9 Correlation of Visual-Contrast-Rating Variables with Change in Scenic Beauty

Visual contrast rating variables	Scenic beauty change[a]
Color contrast	
Land/water bodies	−.243
Vegetation	.027
Structures	.310
Overall	−.160
Form contrast	
Land/water bodies	−.089
Vegetation	.032
Structures	.375
Overall	.173
Line contrast	
Land/water bodies	−.094
Vegetation	.086
Structures	.367
Overall	.185
Texture contrast	
Land/water bodies	−.135
Vegetation	.074
Structures	.434[b]
Overall	.251
Scale contrast	
Land/water bodies	−.497[b]
Vegetation	−.320
Structures	.434[b]
Overall	.378
Scale dominance	−.359
Spatial dominance	
Composition	.205
Position	−.021
Backdrop	−.135
Overall	.406[b]
Total—Visual Impact Severity	.186

[a] Correlations computed across 25 scenes (i.e., $n = 25$).
[b] $p < .05$

Note: Change in scenic beauty is based on the difference between independent preimpact and postimpact ratings of scenes. The average (composite) ratings of the entire sample of raters were used in this analysis (see Tables 10.1-10.3 for composite reliabilities).

Source: Feimer, 1981.

Table 10.10 Intercorrelations of Visual-Contrast-Rating Variables Significantly ($p < .05$) Correlated with Change in Scenic Beauty

	Scale: Land/water bodies	Scale: Structures	Spatial dominance: Overall
Texture			
Structures	.17	.56[a]	.18
Scale			
Land/water bodies	—	−.64[a]	−.80[a]
Scale			
Structures		—	.73[a]
Spatial dominance			
Overall			

[a] $p < .01$

Source: Feimer, 1981.

these figures, the significant viewable surface would be the water and wetland area that can be perceived above a minimum vertical angle or sight line (Figure 10.8), and where lateral-view exposure is more than 10° (see Figure 10.9). This delimited significant viewable surface can be further diminished by factors of distance, sea-surface characteristics, and atmospheric conditions.

The second step of the study was to determine the viewing zones, or viewsheds. RMA projected sight lines on a topographic map at 30° intervals over the full 360° around the proposed site locations and determined the impacted viewing zone from where views of the facility could be acquired (see Figure 10.10). This was corrected using aerial photos to reflect vegetation heights and building heights, which would serve to block sight lines (see Figure 10.8).

The third step was to determine the size of the affected viewing population. A considerable number of boaters use this part of the Chesapeake Bay, and figures for them were estimated using numbers of boats registered in the home port of the viewing zone. The number of residents was extrapolated from 1970 U.S. Census tract data. Automobile traffic figures came from Maryland Department of Transportation road-use figures. These factors are shown in Table 10.11.

The last step, the visual-quality evaluation, involved constructing simulations of the facility on clear acetate and overlaying them on photographs of the potential locations. These were used to compare "before" and "after" views for each location in terms of obstruction of cross-bay views, compatibility of the dike with the foreground elements, and how much of the interior of the facility with its messy appearance is exposed to view. A rating scale of −5 to +5 was used to assess the impact.

In summary, RMA developed and applied criteria to assess the visual impact of several alternative locations of a near-shore-confined dredged-material facility. The methodology was based on professional evaluation similar to that of the previous study, but it varies in the geographic scale and range of activity.

Cape Hatteras National Seashore Jetty Study

Maintaining the Cape Hatteras National Seashore has always been a battle against erosion. This state of constant ecological and physical change is common to barrier islands in many coastal waterways. The barrier islands of North Carolina "typically have a low vertical profile, are narrow, have a primarily sandy composition, and have exposure to high wave energy" (Smardon et al., 1980).

The channel at Oregon inlet (see Figure 10.11) has been maintained by the Army Corps of Engineers for years. Concerned with the erosion of the islands to the north and south of this channel, the Corps proposed and designed a set of twin jetties that would stabilize the area. The Corps prepared an EIS, but to settle outstanding questions on the visual impacts of this proposal, the National Park Service, Southeast Region, contracted Smardon et al. (1980) to conduct a visual impact assessment and suggest mitigative measures. Visual impacts were especially critical because the area is a heavily used recreation area as well as a wildlife sanctuary for migrating water birds.

The approach used for this study was a combination of procedures Smardon is developing for the Bureau of Land Management (Sheppard and Newman, 1979) and procedures used for

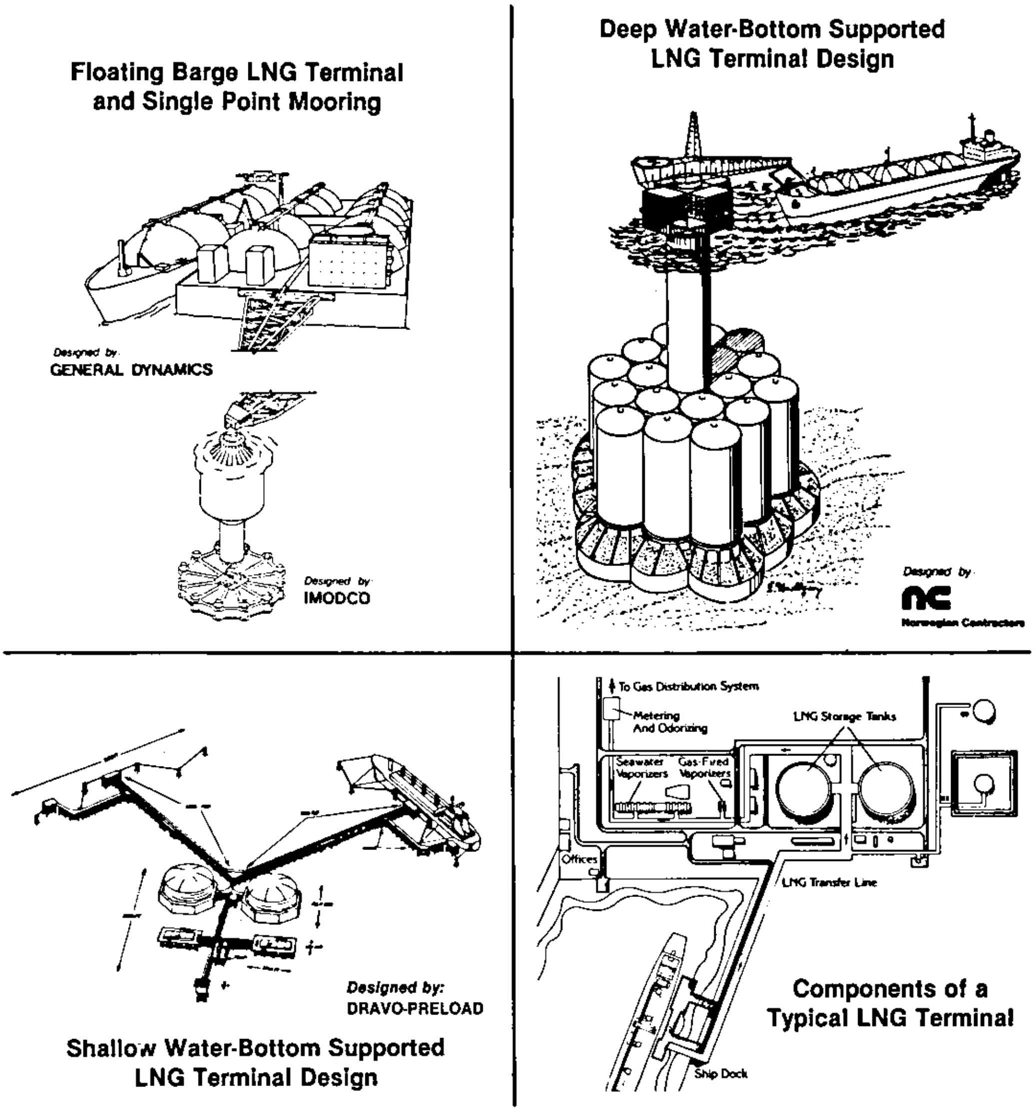
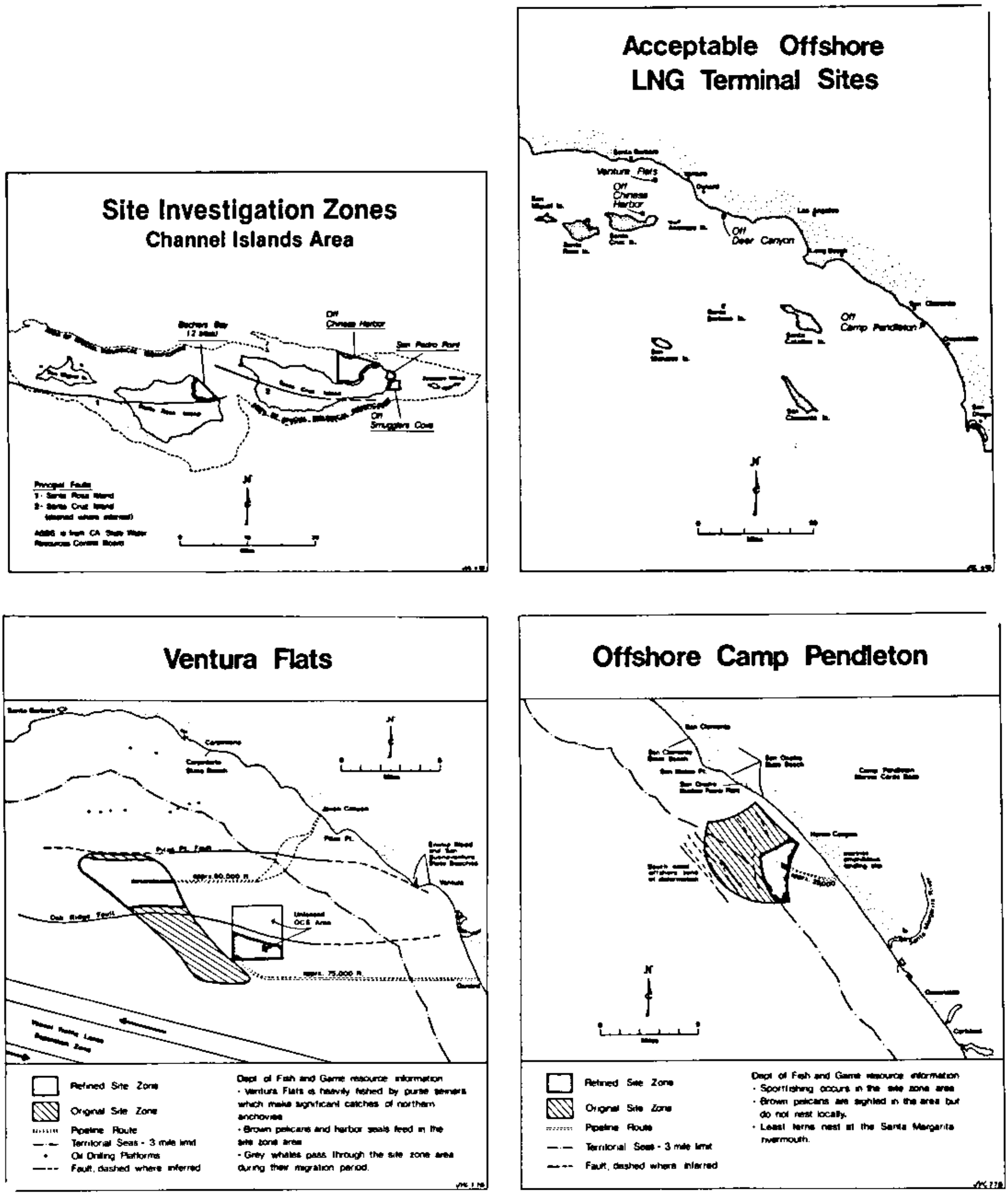


Figure 10.4. LNG terminal designs.

similar coastal shoreline visual impact assessments (Baird et al., 1979; Mann, 1979). It is made up of four steps: (1) describing the physical and visual environment, (2) ascertaining the type, number, and characteristics of recreational users in the area, (3) simulating the modification at key viewpoints, and (4) evaluating the visual impact and discussing mitigative measures (Smardon et al., 1980).

The first step was to describe and visually document the visual environment in its present state. The descriptive approach used a standardized vocabulary of elements of form, color, line, texture, scale, and spatial dominance (Sheppard and Newman, 1979). These same elements were later applied to the proposed modification to give a numerical rating of impact. This initial visual inventory was conducted on-site through interviews with Park Service employees and by taking color 35-millimeter slides. Care was



Dept of Fish and Game resource information
- Ventura Flats is heavily fished by purse seiners which make significant catches of northern anchovies
- Brown pelicans and harbor seals feed in the site zone area
- Grey whales pass through the site zone area during their migration period.

Dept of Fish and Game resource information
- Sportfishing occurs in the site zone area
- Brown pelicans are sighted in the area but do not nest locally.
- Least terns nest at the Santa Margarita rivermouth.

Figure 10.5. Acceptable offshore LNG terminal sites.

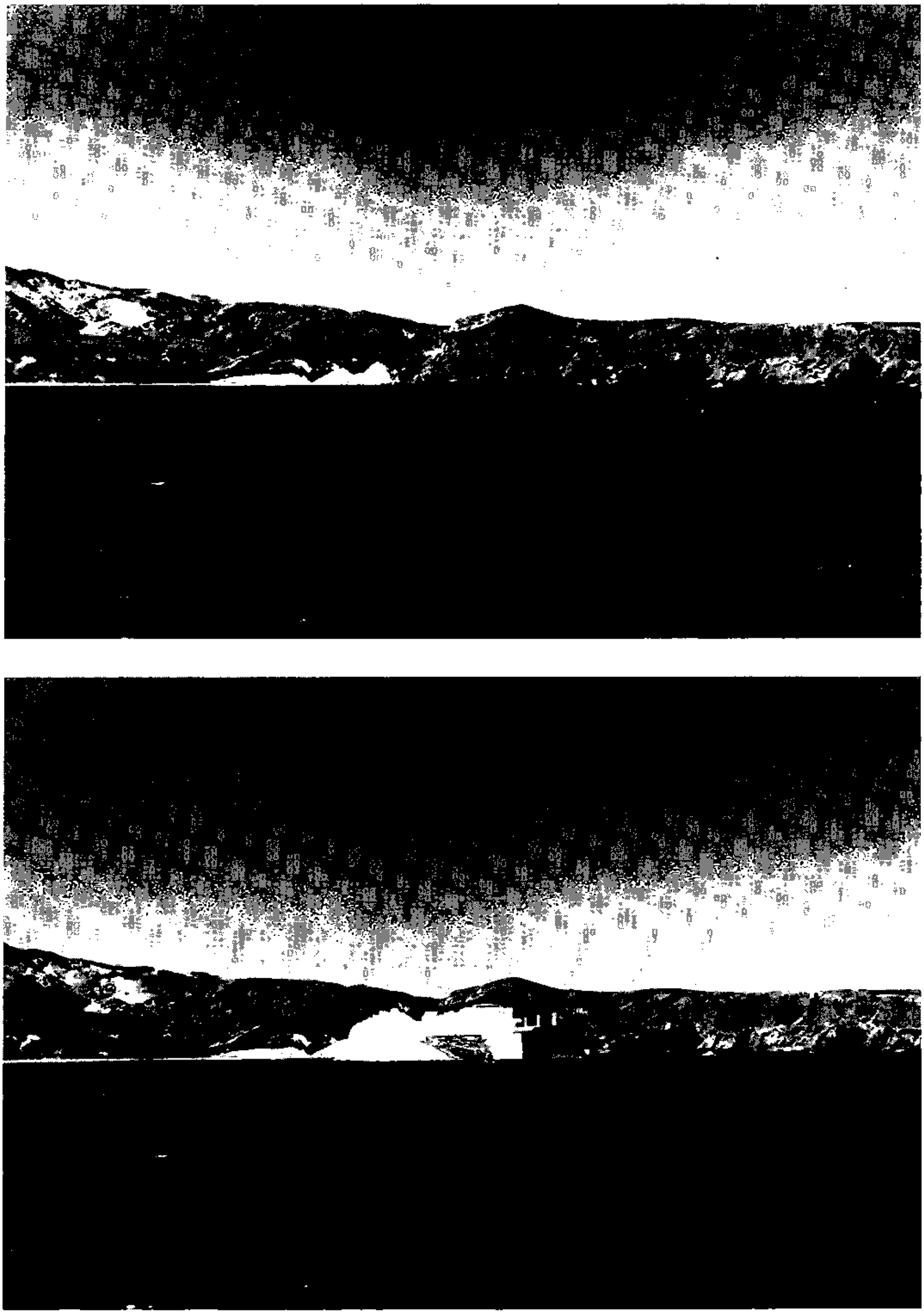


Figure 10.6. Preimpact scene and postimpact simulation off Santa Cruz Island.

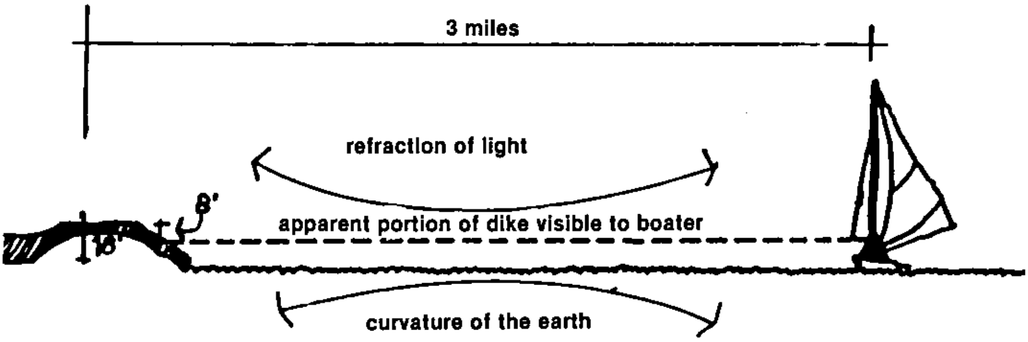


Figure 10.7. Visibility factors, open water (after Mann, 1979).

taken to document the camera angles and viewpoint locations and to provide scale clues within the photographs so that the simulations would be accurate (Figure 10.12).

The second step was to describe in detail the various recreational activities in the area and their general zones of occurrence. The recreational activities included swimming, sunbathing, charter-boat fishing, surf-fishing, off-road vehicle driving, beach walking, bird watching, and camping. This provided a working description for each impacted user population in terms of annual use, time of day, mode of arrival, and average amount of time per day spent in the activity. The information was derived from figures in the EIS adjusted by information gathered in the on-site fieldwork (see Table 10.12).

The third step was to construct the simulations. The EIS provided for twin jetties constructed of either rough-cut rock transported by barge from nearby quarries in the north or cement dolos. Because of cost, Smardon et al. (1980) assumed that the rough-cut rock would be used for construction, so this material was used for the simulations.

The team selected eight possible viewpoints and narrowed them to two critical views (Figure 10.12). The two views were selected for simulation because they represented viewpoints that would have the largest number and duration of

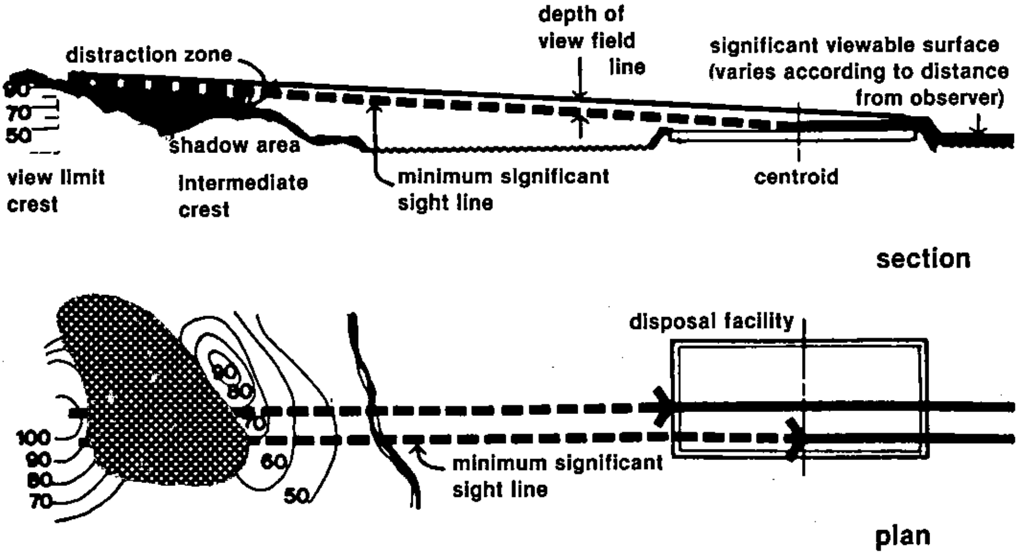


Figure 10.8. Distant-object visibility (after Mann, 1979).

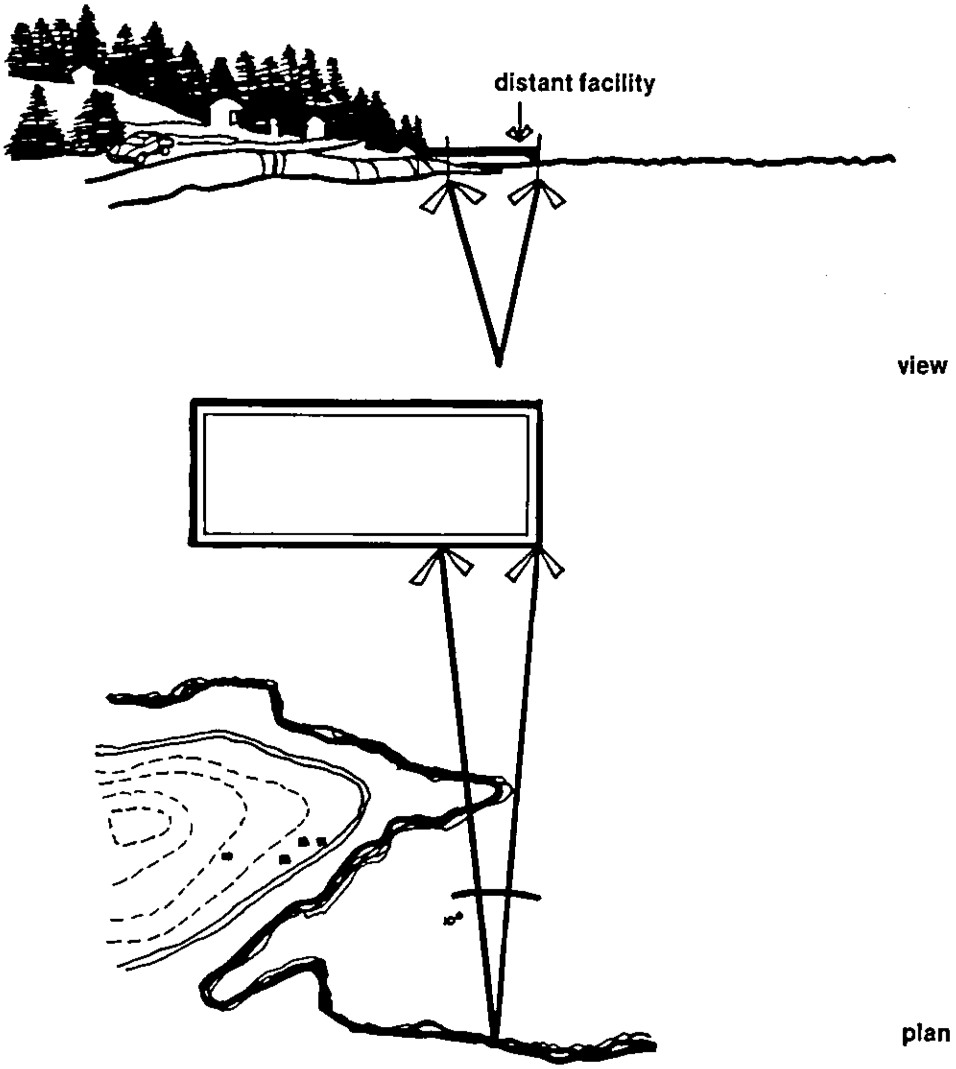


Figure 10.9. Lateral view exposure. A facility must be viewable laterally of terrain and objects to some significant degree if visual impact is to be assessed. A 10-degree lateral arc has been estimated as the average minimum lateral-view exposure necessary for significant visual impact to be recorded (after Mann, 1979).

recreational viewers. They also represented views where the jetties would be in the middle ground for the viewer, so they did not bias the view by putting the jetty too close to the viewer.

Because views in the Oregon Inlet area were found to be panoramic, the simulations were constructed using a series of sequential, matched color photographs of the interest area. An artist created the simulations on clear acetate overlays using colored inks and dyes, and they were mounted in a flip-up style to provide "before" and "after" views of the scene.

The fourth step, impact evaluation, was conducted by two team members trained in the Bureau of Land Management procedure (BLM, 1980a). This procedure employs professional appraisals (i.e., severe visual impact, medium, or no visual impact) with respect to the elements of form, color, line, texture, scale, and spatial dominance (Sheppard and Newman,

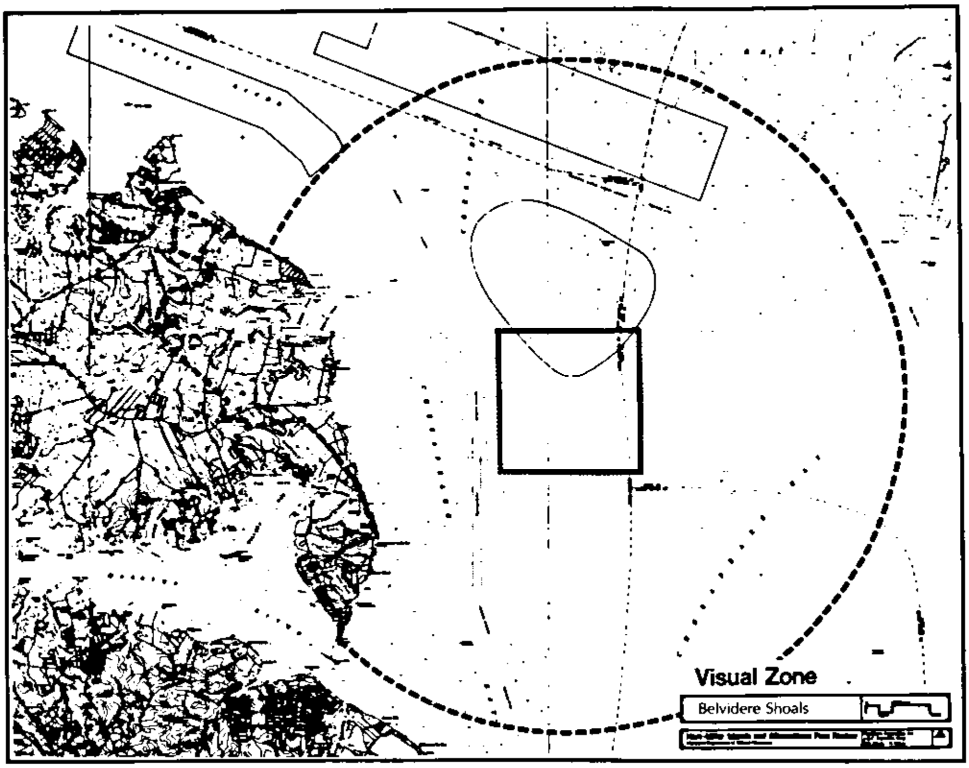


Figure 10.10. Sample viewing zone (after Mann, 1979).

Table 10.11 Evaluation of Impacts on Existing Visual Quality

	Total residential viewing population	Selected major activity centers	Average daily traffic[2]	Recreational boaters[6]
Hart-Miller	3,662	3,000[1]		19,825
Black Marsh	4,192	–		19,825
Hawthorn Cove	4,779	–		16,779
Man O'War Shoals	5,511	–		10,183
Patapsco River Mouth	13,167	–	2,181,000[3]	10,183
6-7-9 Foot Knolls	3,899	–	29,890[4]	21,607
Belvidere Shoals	4,638	–	29,890[4]	21,607
Sollers Point	3,425	–	2,181,000[3]	10,183
Colgate Creek	1,725	–	2,181,000[3]	10,183
Middle Branch	3,841	–	31,620[5]	10,183

[1] Maximum daily visitors; Rocky Point Park.

[2] Computed at 1.5 persons/vehicle

[3] One lane traffic; new Outer Harbor Crossing

[4] One lane traffic; Lane Memorial Bridge

[5] One lane traffic; Hanover Street Bridge

[6] Average no. of persons per boat = 2.82; includes water stored craft only

Source: (1) RMA telephone communication with Rocky Point County Park Manager. (3) Table 21 Outer Harbor Bridge Estimated Traffic and Revenue 1976–1985; Maryland Dept. of Transportation. (4-5) State of Maryland "Traffic Volume Map," 1974. RMA telephone communications with Bureau of Traffic Engineering, Md. Dept. of Transportation (June 1975). (6) Recreational Boating in the Continental U.S. in 1973; Coast Guard, October 1974, p. 51.

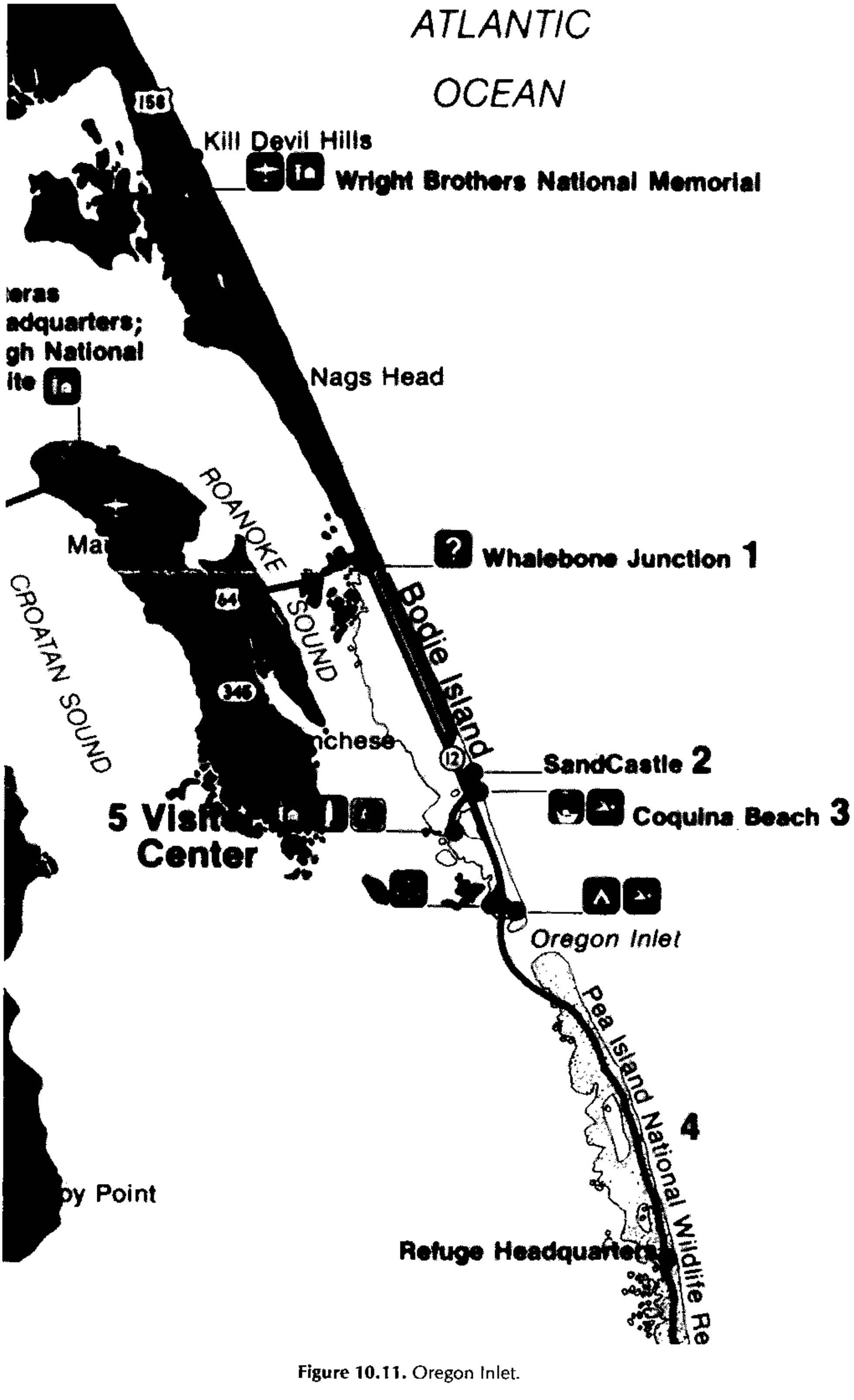


Figure 10.11. Oregon Inlet.