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U.S. Department  
of Transportation

**Federal Highway  
Administration**

Office of Environmental Policy

# Visual Impact Assessment for Highway Projects



# 5 CHARACTERISTICS OF VIEWERS

Visual experience is a compound of visual resources and viewer response. To understand and predict viewer response to the appearance of a highway projects, we must know something about the viewers who may see the project and the aspects of the visual environment to which they are likely to respond. Vision is an active sense; we usually have some reason for looking at the landscape and what we see is unconsciously conditioned by what we are looking for. How we feel about what we see is conditioned by other human factors; many of these are shared among large groups of people and may be important for project planning.

## Viewer Groups and Viewer Exposure

Visual perception is the basic act of seeing or recognizing an object. Naturally, we assume an unobstructed sightline, but other physical conditions can also affect perception. As observer distance increases, the ability to see the details of an object decreases. As observer speed increases, the sharpness of lateral vision declines and the observer tends to focus along the line of travel.

We can differentiate major *viewer groups* by physical factors that modify perception. For highway projects, we begin with the basic distinction of the view from the road (highway users) and the view of the road (highway neighbors). We can use viewshed mapping to further categorize these viewer groups by *viewer exposure*: the physical location of each viewer group, the number of people in each group, and the duration of their view.

## Viewer Sensitivity

The receptivity of different viewer groups to the visual environment and its elements is

not equal. This variable receptivity is *viewer sensitivity* and is strongly related to visual preference. It modifies visual experience directly by means of viewer activity and awareness; indirectly, sensitivity modifies experience by means of values, opinions, and preconceptions. High viewer sensitivity can be critical to project planning and design because it heightens viewer response and increases the importance of visual resource issues. In a few cases, high viewer sensitivity may tend to discourage any visible change to the project environment.

Activities such as commuting in heavy traffic or working on a construction site can distract an observer from many aspects of the visual environment. Head-mounted cameras, for instance, have demonstrated that a driver can look directly at a landmark and still not see it. On the other hand, activities such as driving for pleasure or relaxing in scenic surroundings can encourage an observer to look at the view more closely and at greater length. Therefore, *viewer activity* is another identifying characteristic of viewer groups.



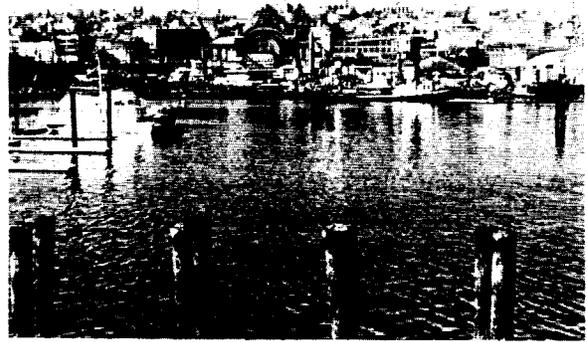
*This dramatic mountain gateway heightens the visual awareness of highway travelers.*

For example, we may well want to distinguish among project viewers located in residential, recreational, and industrial areas.

*Viewer awareness* is the extent to which the receptivity of viewers is heightened by the immediate experience of visual resource characteristics. Visual change heightens awareness: a landscape transition, such as entering a mountain range or a major city, may heighten viewer awareness for a number of miles along a road. Measures that modify viewer exposure, such as selective clearing or screening, may also be deliberately employed to modify viewer awareness. For example, we may well want to distinguish among project viewers located in residential, recreational, and industrial areas.

*Local values and goals* operate indirectly on viewer experience by shaping view expectations, aspirations and appreciations. If the existing appearance of a project site is uninspiring, a community may still object to projects that fall short of its visual goals. At a regional or national level, viewers may be particularly sensitive to the visual resources

and appearance of a particular landscape as a result of its *cultural significance*. This significance may be due to the presence of historic values, scientific or recreational resources, or other unique features: any visible evidence of change may be seen as a threat to these values or resources.



*An elevated highway would traverse the unsightly industrial area on the other side of this waterway. Nevertheless, there has been strong public concern over the visual effects of the highway on future redevelopment and on the historic railroad station in the middle distance.*

# **VIEWER GROUPS**

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*Classes of viewers which differ in their visual response to the highway and its setting. Response is affected by viewer location, activity, and values.*

## **GROUPS WITH A VIEW FROM THE ROAD**

- driver*
- passenger*

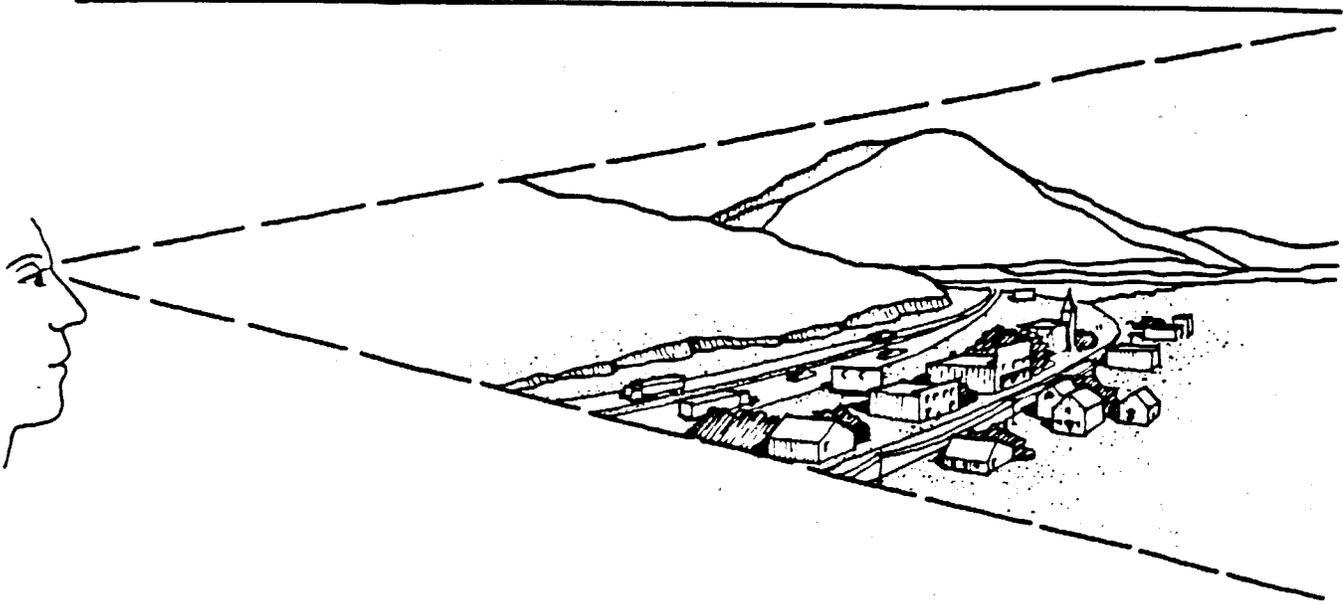
## **GROUPS WITH A VIEW OF THE ROAD IN THE LANDSCAPE SETTING**

- residents*
  - urban & suburban*
  - rural*
- commercial/industrial interests*
- recreational groups*
  - park, resort, overlook, & historic site visitors*
  - river and lake users*
  - scenic railroad passengers*
  - trail users*
- other special interest groups*
  - civic*
  - cultural*
  - environmental*
  - educational*
  - economic*

## **GROUPS WITH A VIEW OF THE ROAD FROM THE ROADSIDE**

- wayside and rest area users*
- cyclists and other traffic in right-of-way*

# VIEWER SENSITIVITY



*The preferences, values, and opinions of different viewer groups can be documented in the following ways:*

- viewer activity & awareness*
- local values*
- cultural significance of the visual resource*

# ACTIVITY & AWARENESS

The degree to which viewers are likely to be receptive to the visual details, character, and quality of the surrounding landscape. Two principal factors affect viewer sensitivity: activity and awareness.

## *• Viewer Activity*

A viewer's ability to perceive the landscape is affected by his activity. In a particular landscape setting, viewer activity may:

- 1) encourage him to look at the landscape, such as pleasure driving, or
- 2) distract him from the landscape, such as commuting in heavy traffic.

## *• Viewer Awareness*

A viewer's receptivity to the visual character of the landscape can be affected by the landscape setting itself, or by expectations about the setting. Major variables are:

- 1) viewing position, such as an overlook or a position near a major landmark,
- 2) recent visual experience, such as a landscape transition, and
- 3) individual preconceptions about the landscape (and the highway's appropriateness in it).

# **CULTURAL SIGNIFICANCE**

At a regional or national level, viewers may be particularly sensitive to the visual resources and appearance of a particular landscape because of:

## *• History*

The landscape may commemorate some historic event.

## *• Scientific or Recreational Resources*

The landscape may be singled out and widely known for values - scientific, recreational, esthetic - directly connected with its appearance.

## *• Uniqueness*

Its visual resources, character or quality may be uncommon or rare in the region or nation.

# **LOCAL VALUES**

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The visual appearance of certain landscapes and certain visual resources within these landscapes may be important to the local community because of:

- *Local Visual Preferences*
- *Local Historical Associations*
- *Local Aspirations and Goals*

The highway agency's community involvement program can help to identify visual resources affected by local values and goals.

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## VIEWER RESPONSE

### VIEWER EXPOSURE

- *viewshed*
- *viewing groups and numbers*
- *viewer location, distance and position*
- *view duration and frequency*

### VIEWER SENSITIVITY: ACTIVITY AND AWARENESS

- *current viewers*
- *new viewers*

### VIEWER SENSITIVITY: LOCAL VALUES

- *current local values and plans*
- *project impacts on these values*

### VIEWER SENSITIVITY: CULTURAL SIGNIFICANCE

- *existing historic, scientific, unique or recreation resources*
- *elimination or change of the resource and its setting*

# Measuring Impact

## KEY CONCEPTS

### Visual Impact:

The degree of change in visual resources and viewer response to those resources caused by highway development and operations.

### Visual Resource Change:

The degree of change in visual resources caused by highway development and operations, assessed without regard to viewer response.

### Viewer Response:

Measures of viewer response to visual resource change include viewer exposure, sensitivity and cultural significance and local values.

Visual Impact = Visual Resource Change + Viewer Response

## VISUAL RESOURCE EFFECTS

When highway projects alter the physical environment, they also alter the visual information in that environment, its visual character, and its visual quality. Several typical project examples will help to illustrate the nature and variety of these visual resource effects.

### Visual Information

Highway projects substitute new visual information for old. The roadway always displaces existing visual resources, but the roadside sometimes retains these resources (particularly vegetation) or replaces them with other resources that are similar. The identity and extent of the landscape components involved can be important in themselves because of visual preferences; viewers may feel that forestlands are visually more important than farmlands—or vice versa. A simple tabulation of the landscape components affected by each project alternative provides a framework for considering these visual preferences.

Viewers also tend to notice and value the unusual. For example, a stand of large trees along an existing road can be sufficiently striking and unusual that a community may object to a widening project that would remove them. Highway projects may have to detour around such features; therefore it is



Removing these live oaks would degrade the visual quality of this historic Florida town.

often useful to identify any landscape components that are scarce or sensitive in the project area or the surrounding region.

### Visual Character

Concern over the appearance of a highway project often is based on how it will affect the overall visual character of an area rather than on the particular visual resources it will displace. Federal law identifies certain settings where effects on character are the paramount visual resource concern. Among these are wilderness areas, rivers in the National Wild and Scenic Rivers System, parks, recreational areas, wildlife and waterfowl refuges, and historic districts, sites, buildings, and structures.

Specific criteria have been adopted for evaluating the impact of development on historic properties. The introduction of visual elements "that are out of character with the property or alter its setting" is considered an adverse effect; such elements would jeopardize viewer perceptions of the reality of the past and its relevance to the present. It is important to note that the visual character of the project is at issue, not the project itself; if the character of the project can be made to complement the character of the historic property and its setting, it may have no adverse visual effects.

In chapter Four we discussed several attributes of visual character that are relevant to highway projects; these include pattern elements (form, line, color, and texture) and pattern character (dominance, scale, diversity, and continuity). Both the project and the project setting can be assessed according to these attributes; if their visual character is similar, the visual *compatibility* of the project will be high. If the visual character of the project contrasts strongly with the visual character of its setting, its visual compatibility will be low.

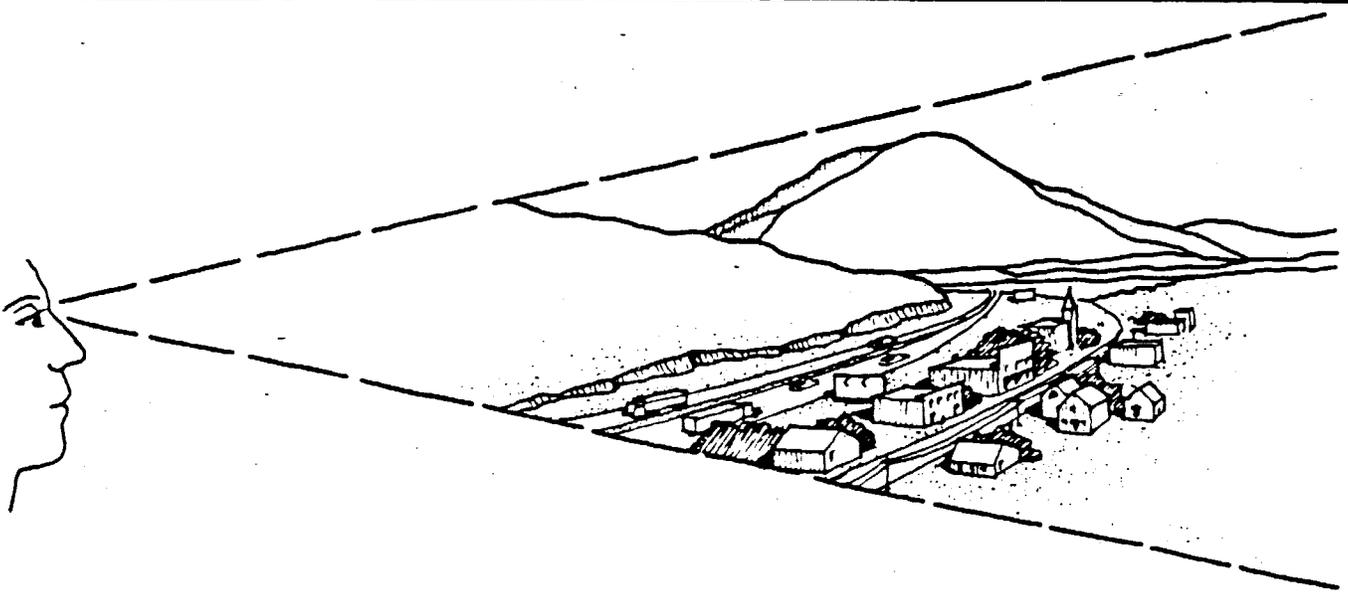
An explicit analysis of visual character frequently makes it possible to modify a



*A steel guard rail was carefully designed to complement the visual character of this historic bridge after the appearance of a concrete barrier proved unsatisfactory.*

project to improve its visual compatibility. For example, objections to the appearance of safety improvements for a historic bridge were resolved, through the required historic preservation coordination procedures, by substituting an unobtrusive steel guard rail for a visually dominant concrete barrier that would have contrasted strongly with the existing bridge in form, color and texture. The steel guard rail is small in scale and is not visually dominant. Some contrast in color and texture was considered desirable so that viewers would not misread the rail as part of the historic structure.

# VISUAL COMPATIBILITY



*The actual or potential compatibility of a project with its landscape setting can be objectively evaluated by examining the:*

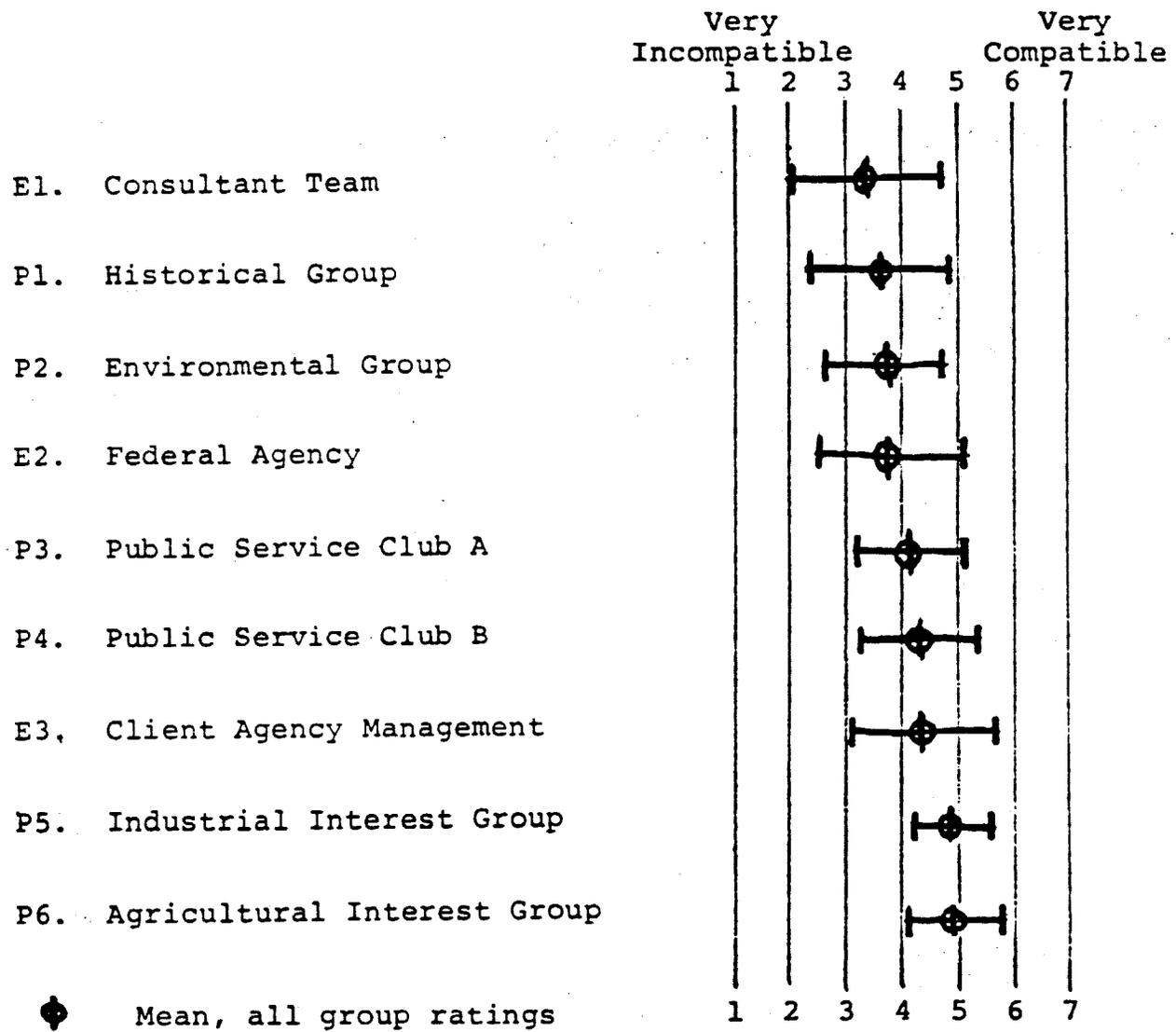
COMPATIBILITY OF PATTERN ELEMENTS

*(form, line, color, texture)*

COMPATIBILITY OF PATTERN CHARACTER

*(dominance, scale, diversity, continuity)*

COMPARISON OF GROUP VALUES AND ABILITY TO MAKE VISUAL DISTINCTIONS  
Group Compatibility, Mean Ratings



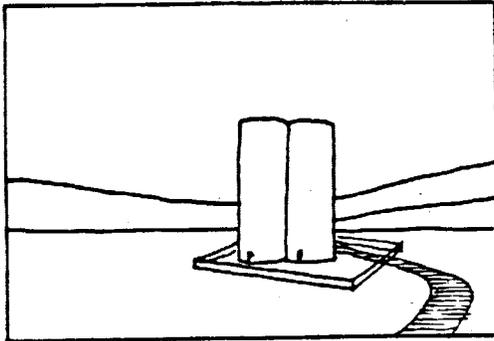
◆ Mean, all group ratings  
 ┌───┐ Standard deviation, all group ratings

What This Diagram Illustrates:

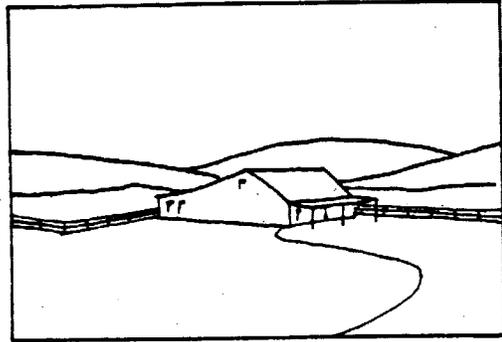
1. There are significant differences in group values about visual resources, related to overall group interests.
2. Expert groups make more discriminating judgments about visual compatibility than the general public.
3. Agency expert groups appear to know how to fit a feature into its visual surroundings, although they may have to be convinced of the need to make the effort.

# COMPATIBILITY: PATTERN ELEMENTS

*Form*

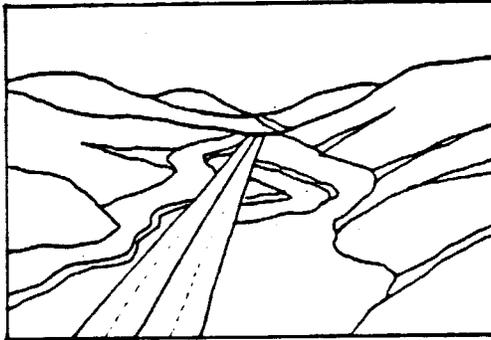


*low*

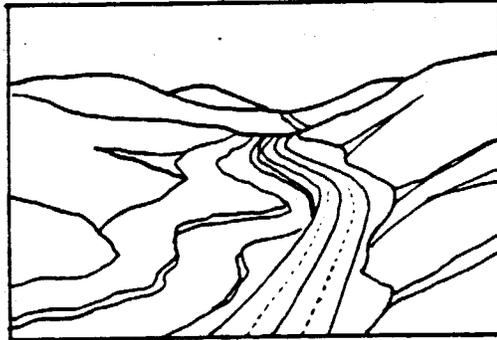


*high*

*Line*

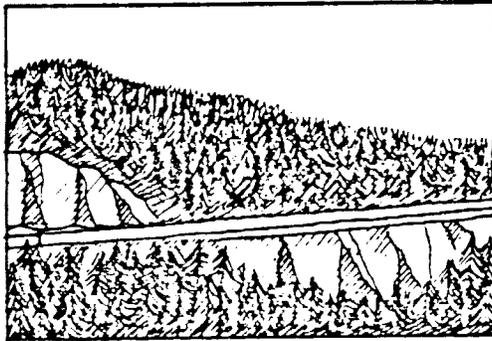


*low*

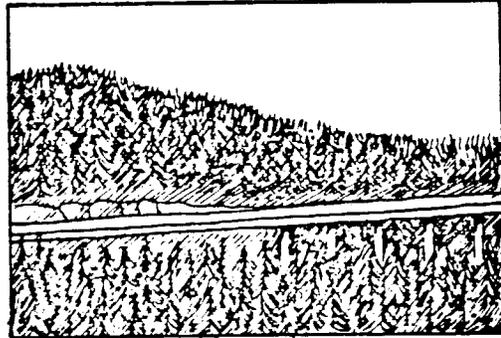


*high*

*Color*

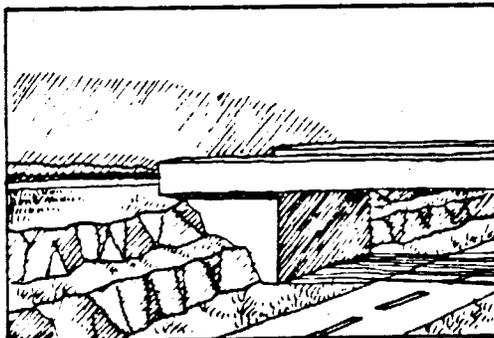


*low*

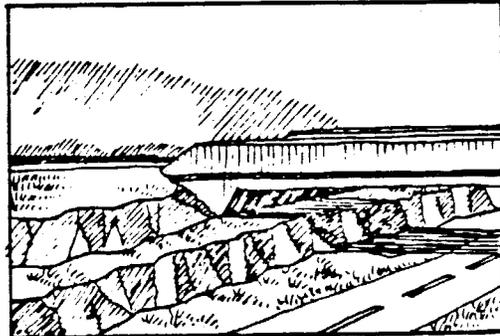


*high*

*Texture*



*low*

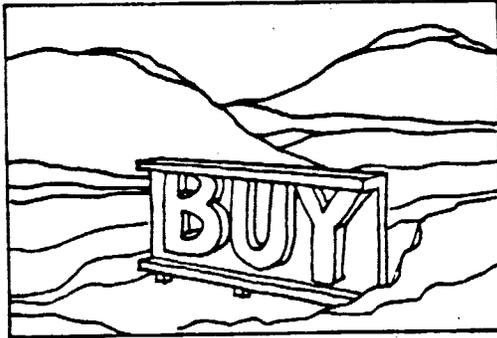


*high*

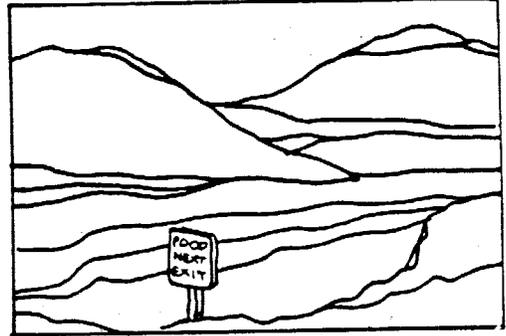
# ...and PATTERN CHARACTER

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*Dominance*

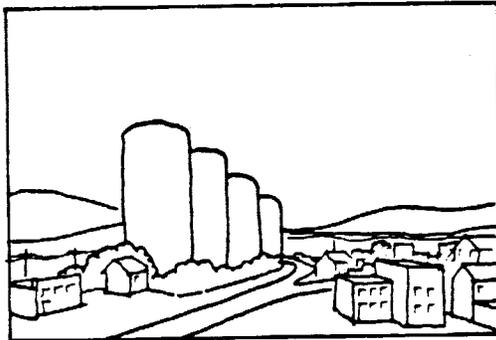


*low*

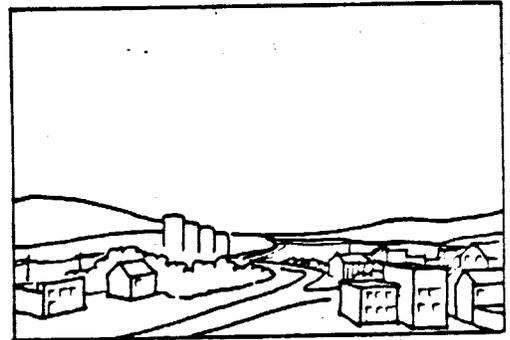


*high*

*Scale*

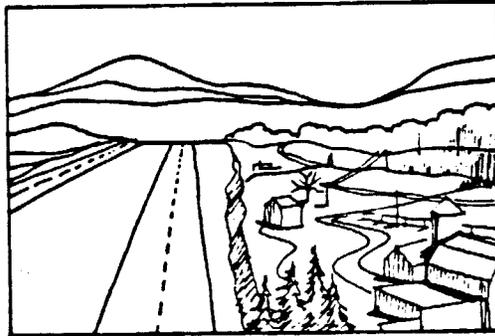


*low*



*high*

*Diversity*

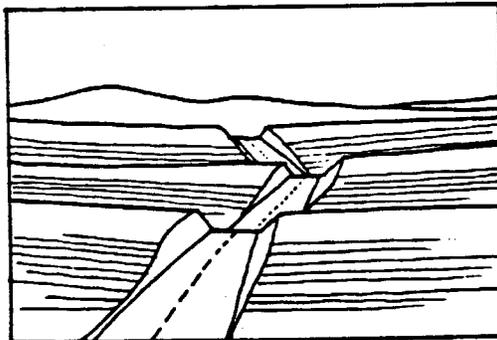


*low*

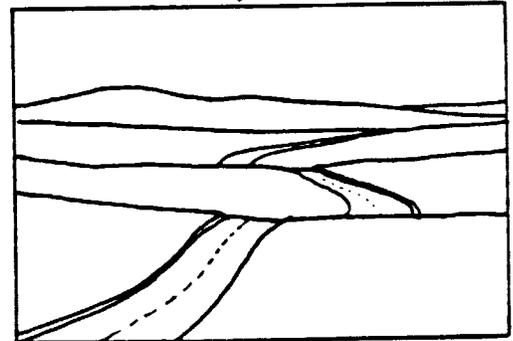


*high*

*Continuity*



*low*



*high*

# VISUAL IMPACT

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$$\text{VISUAL IMPACT} = \text{VISUAL RESOURCE CHANGE} + \text{VIEWER RESPONSE}$$

## VISUAL RESOURCE CHANGE

### CHANGE IN VISUAL INFORMATION

- *existing visual resources*
- *introduced resources*

### COMPATIBILITY OF VISUAL CHARACTER

- *existing character*
- *compatibility of new feature*

### RESULTING VISUAL QUALITY

- *direct measurement of alteration*  
*(appraise built product)*
  - *existing visual quality*
  - *visual quality after development*
- *prediction of alteration*  
*(appraise simulated project)*
  - *existing visual quality*
  - *visual quality after development*

# VIEWER RESPONSE TO HIGHWAY PROJECTS

Several factors discussed in Chapter Two can help us gauge viewer response to a project's visual effects. These factors include viewer exposure and three aspects of viewer sensitivity: activity and awareness, local values, and cultural significance.

## Viewer Exposure

First, will the project be viewed by persons other than its users? If so, what are the viewer groups, how many people are in them and how far away are they? The answers help to establish viewer exposure to the project. Viewer exposure may be particularly high along urban rights-of-way and in public use areas; the latter may include safety rest areas, auto-restricted zones, transit malls, fringe parking and certain joint development projects. High viewer exposure heightens the importance of early consideration of design, art, and architecture and their roles in managing the visual resource effects of a project. As an alternative or supplement to managing those effects, we can manage viewer exposure by adjustments to project location and alignment, and by mitigation measures such as full or partial screening. Viewer exposure may become an important issue where the sight of the highway—however well designed—would intrude on the visual character of historic districts or natural areas. In extreme cases, projects have been depressed or placed in tunnels to restrict or eliminate views of the highway.

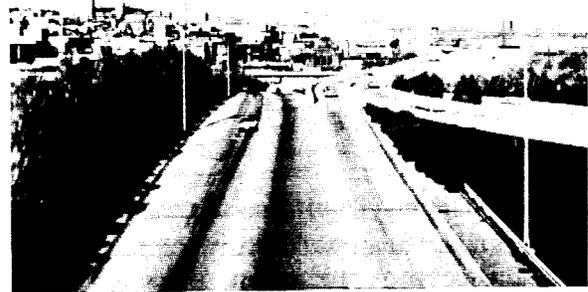
## Viewer Sensitivity: Activity and Awareness

Viewer activity and awareness can be significant variables in the selection of highway alternatives. For example, one location may expose a highway to viewers in a recreation area, a second to viewers in an industrial zone. Alignment and design alternatives, such as "daylighting" a curve, may expose highway users to a view that heightens their awareness of an approaching destination. Conversely, bypass highways

have sometimes eliminated views of bypassed communities and have diminished driver awareness of town centers.



*Highways located in recreational areas are often exposed to a very sensitive group of viewers with strong preconceptions about the visual appropriateness of roads in these settings.*



*Sometimes a highway project can make a significant contribution to the renewal of a city center by increasing the traveler's awareness of the center and improving the visual quality of the entry to it.*

## Viewer Sensitivity: Local Values

Local values and goals may confer visual significance on landscape components and areas that would otherwise appear unexceptional in a visual resource analysis. Highway planners can learn about these special resources and community aspirations for visual quality through project citizen participation procedures, as well as from local publications and planning documents. Community organizations such as arts councils and historic societies should also be consulted. The resulting information

will sometimes surprise the out-of-town expert. For instance, planners investigating location alternatives in a small western city found what appeared to be a promising alternative in a small river valley with open land, private ownership and industrial zoning. Its existing visual resources include an old dam and powerplant, exposed penstock, gravel roads, and several transmission lines. However, contact with community groups revealed that the valley



*Hydropower development seriously encroaches on the visual quality of this river valley, but local residents regard it as a scenic area and oppose further development of any type.*

is regarded locally as a wildlife refuge, an historic area, the scenic core of the city's open space system—and strictly off-limits for new transportation development.

### **Viewer Sensitivity: Cultural Significance**

Regional or national cultural significance is usually accompanied by formal designation (or by study status for designation) that recognizes a property or district for its historic, wilderness, recreational, or other value. While such properties or districts are not necessarily high in visual quality, we have seen that their visual character is often considered important to their cultural value. The planning and design of a highway project in an historic district or the rehabilitation of an historic bridge may have to make concessions to the visual character of the district or bridge. Alternatively, project visibility may be controlled by vegetation, an appropriately-designed acoustic barrier, or other means to avoid perceived visual incompatibility with a setting savored for its absence of visible evidences of contemporary urban civilization.

## **VISUAL EFFECTS AND PROJECT STAGES**

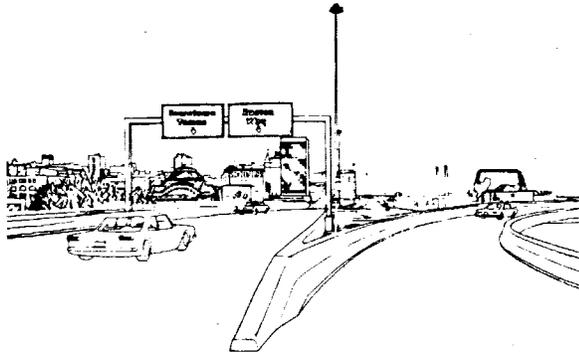
The highway development process can be divided into five general stages: planning, location, design, construction and maintenance. The visual effects of a highway project are most clearly defined in the last project stages, but they are determined progressively throughout the process. The most broad-reaching effects are determined early. If the highway corridor contains resources that are highly valued for their visual character, highway alignment and design may be unable to completely avoid or



*Despite considerable design effort, this bridge approach structure does not succeed in eliminating adverse visual effects on the church next to it.*

mitigate adverse visual impacts that are "locked in" by corridor selection. Conversely construction and maintenance are crucial to the realization of design intentions. Consideration of visual effects and the highway development process can ensure that problems and opportunities are identified soon enough for effective action.

Drawings or simulations of project appearance from representative viewpoints provide a direct means of evaluating the visual effects of highway alternatives. At the design stage, we can illustrate the appearance of the alignment, alternative structures, roadside appurtenances, and roadside planting in detail. Unfortunately, most environmental assessments are prepared earlier, during the location stage. If approximate alignment and typical cross-section are known, these can provide sufficient information to illustrate the general appearance of the highway. If controversy over the visual effects of the project still exists, final environmental



*A lighting and signing alternative is illustrated in this sketch of a view from the road; this visually simple alternative was preferred, partially because of the complex geometry of the roadway itself.*

clearance may be delayed until the studies necessary to provide visual details can be carried out. This has occurred on a number of urban freeway projects and also on highways through scenic areas.

The probable broad-scale visual effects of a project can be considered early in the highway development process, even if project information is insufficient to simulate and assess specific project views. First, the visibility and viewer exposure of alternative corridors can be assessed by mapping the viewsheds of major existing viewer groups. Significant and valued visual resources can then be located and avoided. The landscape units can be identified and their visual quality assessed. Finally, the visual compatibility between the proposed project type and the landscape types representative of the project area can be established by comparing their visual character. By generalizing the principle that high contrast is likely to adversely affect high visual quality, conflict areas can be identified. Highway planners can then avoid placing corridors in these areas or can identify these conflicts for resolution during design.

# 7 VISUAL IMPACT MITIGATION

Mitigation encompasses the enhancement of positive effects as well as the reduction or elimination of negative effects. To be relevant, visual mitigation measures must address the specific visual impacts or problems caused by project alternatives. Different types of mitigation measures are appropriate to successive stages in the highway development process. In the location stage, highway corridors can avoid traversing visual resources that are exceptional in quality or visually incompatible with highway development, while maintaining the potential for views to these resources. On the viewer response side, viewsheds of sensitive viewer groups or historic sites can be bypassed.

During design, alignment can be manipulated to minimize blockage of existing views, to enhance good views from the road, and avoid bad ones. Care can be taken to maximize the visual compatibility of the project with adjoining parks or historic districts. Finally, special effort may be put into the design of structures and public use areas, including the incorporation of art and architecture, to ensure that these project components have high visual quality in

themselves as well as in relation to the larger project environment.

To ensure the full realization of any mitigation actions, highway agencies must coordinate environmental assessment activities with the subsequent design, construction, and maintenance phases of highway development.



*In response to community concerns about the future visual appearance of this area, the highway agency studied structural alternatives for this crossing. This segmental arch design would span the waterway cleanly and enhance its visual unity. This alternative would avoid adverse effects on existing visual quality, but would not markedly improve that quality.*



*Despite the presence of water and boats, the existing quality of this view is relatively low because of the encroachment of fill, dereliction, and a general lack of visual unity. Redevelopment for recreational boating has begun, however, and community expectations for visual improvement are high.*



*Development of a public boat launch and park under the crossing could help to bring the visual potential of the waterway to reality. The inclusion of joint use in this project would provide significant beneficial impacts on visual quality and land use.*

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### Distance Zones:

Three conventional terms in painting--foreground, middle-ground, background--which can be helpful in describing distance relationships.

Foreground (0 to  $\frac{1}{2}$ - $\frac{1}{2}$  mile): That area which can be designated with clarity and simplicity not possible in middle and background because the observer is a direct participant. He can have the impressions of immediate details--bark pattern, boulder forms, or degraded parts. This is a zone of important linkage because it sets a tone of quality or its absence. Intensity of color and its value will be at a maximum level, lacking the effect of color diminution due to atmospheric scattering of light rays. At greater distances, the intensification of aerial perspective becomes an important means of discrimination.

Middleground ( $\frac{1}{2}$ - $\frac{1}{2}$  to 3-5 miles): A critical area for two reasons. This is where the parts of the landscape can be seen to join together, where hills become a range or trees make a forest. This is also where manmade changes may be revealed as sitting comfortably upon the landscape. Or where conflicts of form, color, shape, or scale show up. Colors will be unmistakable but they will be more blue, softer than those of the foreground. Some of the sharpness of value contrasts will be reduced.

Background (3-5 to infinite miles): That area where distance effects are primarily explained by aerial perspective. Surfaces of land forms will lose detail distinctions, emphasis will be on outline or edge, with background becoming an effective foil against which foreground or background is more clearly seen--a figure-ground relationship. Silhouettes and ridges of one land mass against another are the conspicuous visual parts of the background with skyline the strongest line of all (Litton).

### Districts:

The medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters "inside of", and which are recognizable as having some common, identifying character. Always identifiable from the inside, they are also used for exterior reference if visible from the outside. (Lynch)