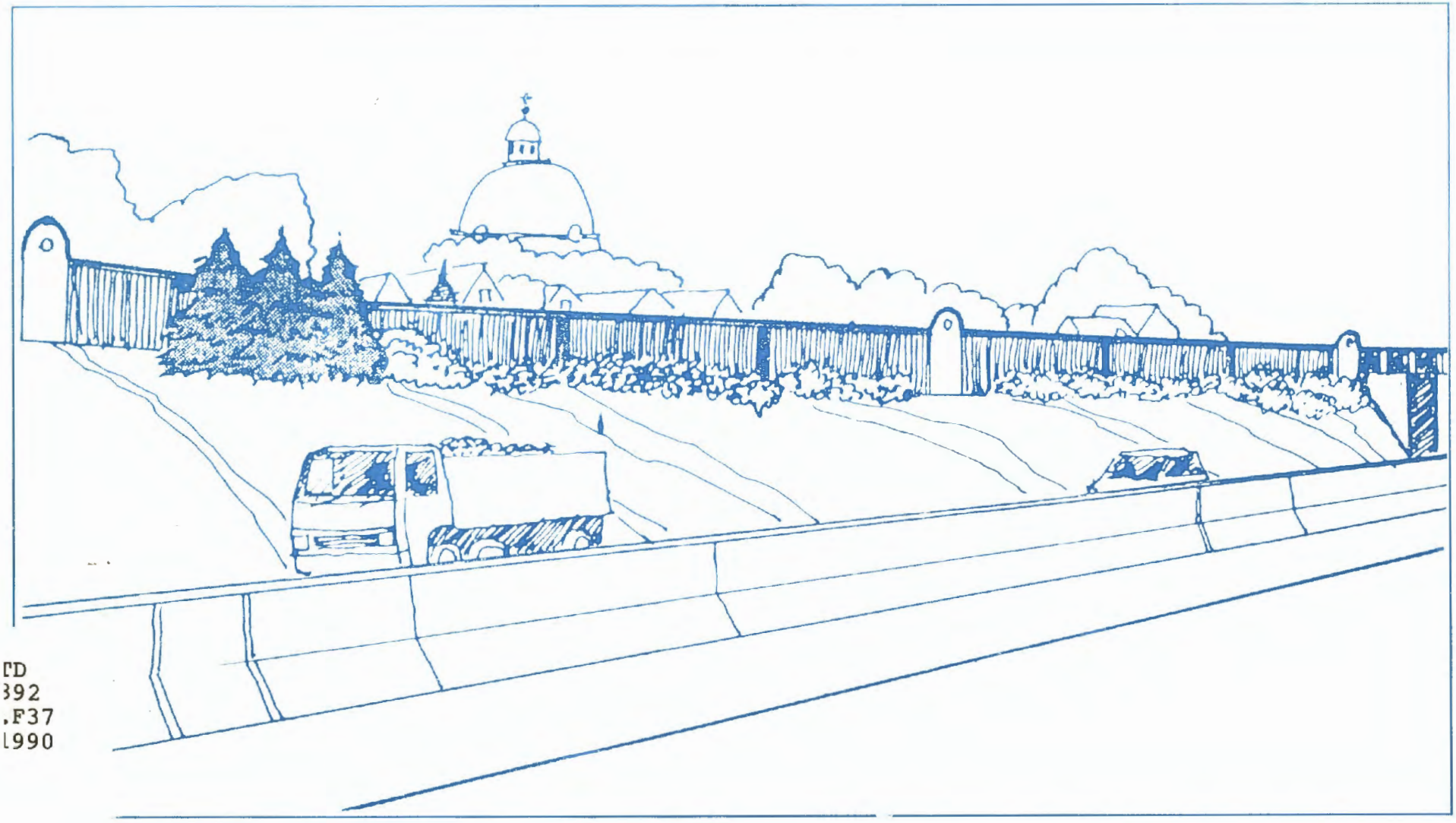
U.S. Department of Transportation

Noise Barrier Design Guidelines

July 1990



Noise Barrier Design Guidelines

Final Report
July 1990

Prepared by
Julie Farnham and Ed Beimborn
Center for Urban Transportation Studies
University of Wisconsin—Milwaukee
Milwaukee, Wisconsin 53201

Distributed in Cooperation with
Technology Sharing Program
U.S. Department of Transportation
Washington, D.C. 20590

DOT-T-90-15

ABSTRACT

The purpose of this report is to provide guidelines and suggestions for the improved design of freeway noise barriers in the Milwaukee region and elsewhere in the State of Wisconsin. The guidelines have been developed to encourage an attractive and efficient system of noise control and to achieve design continuity throughout the area. The report illustrates how inventories of the technical, cultural and natural landscape can be used in design. A variety of techniques of wall shape and texture and landscaping application are provided which can be adapted to specific environments. The desired approach views the wall and landscape as an integrated system that should be designed to reflect and enhance the surrounding community. Diversity in design of both the wall and landscaping should be sought and systems should be designed to reflect the historic/ethnic heritage of the neighborhoods. A broad range of options should be provided which can creatively enhance the environment that is seen as well as heard along freeways. The concepts developed in the study are illustrated through several prototype designs.

Sound good/look good.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This report was prepared in response to a legislative request included in the 1989-90 state budget to look at ways to improve aesthetic characteristics of freeway noise barriers.

We would like to thank Rep. Timothy Carpenter for his support in this the project and for the help provided through his office by Paula Doyle and Curt Finkelmeyer in arranging meetings. A task force was established to guide this project including: Michael Gonia of the Wisconsin Department of Transportation, Kenneth Yunker of the Southeastern Wisconsin Regional Planning Commission, and John Erickson as represented by Robert Buffone of the City of Milwaukee. This task force provided useful insight and input on the project and we thank them for their assistance. We would also like to thank Linda Rupp for her expert help in processing and setting up this report. The opinions expressed in this report are those of the authors and not necessarily those of state or local government, the legislature, or the members of the task force.

Introduction and Background

Introduction:

Purpose

These guidelines are primarily intended to serve as a tool for designers of freeway noise barriers in the Milwaukee metropolitan area. The primary purpose of establishing guidelines is to encourage an attractive and efficient system of noise control and achieve design continuity throughout the metropolitan freeway system. A secondary purpose of this report is to provide an analysis of the existing freeway environment to determine its unique characteristics and aesthetic opportunities.

Report Organization

This report includes three major sections: An introduction and background, a guide to the general aesthetic design of barriers and landscaping systems, and an application of the design guide to prototypical situations and opportunities along the I-94 freeway corridor in the southern part of Milwaukee County. Appendices provide more technical "catalog" information on available barrier and landscape materials.

Introduction:

Goals and Objectives

The goal of this project was to develop a process for system-wide planning for implementation of noise barriers which enhance and improve the aesthetic quality of Milwaukee County's freeway environment. This goal has two primary objectives:

1) To analyze the "system-wide" area to identify prominent physical and cultural patterns describing and expressing the character of Milwaukee County. This objective is based on the fact that barrier locations are not always continuous, but must fit into a continuous freeway environment. It is intended that an analysis of the system-wide environment will serve as the basis for integrating barriers into the overall urban context. Expressing these larger urban patterns could enhance the overall freeway environment and experience.

2) To explore alternative design solutions for barriers in site specific contexts. Specifically, these designs should accomplish the following:

   i. To design new barriers and landscape as an integrated unit

   ii. To integrate new barriers and landscape with existing barriers and landscape

   iii. To design new walls to be as attractive as possible to minimize the need to screen with landscaping

   iv. To design barrier and landscape to reflect and enhance specific cultural and physical characteristics of neighborhoods

Background: Noise Barriers Considerations

Noise barriers are being used with more frequency to solve problems of noise pollution from freeways in urban areas. Concern for the negative impacts of noise on the environmental quality of adjacent properties prompted the creation of federal and state regulations which require the placement of noise control measures in urban areas for new projects. Acceptable noise levels are often exceeded in nearly all segments of urban freeway with normal levels of freeway traffic. Consequently, noise barriers could be warranted for large portions of the freeway network and there could be a need to build extensive systems of noise barriers over the next decade. As a result of these concerns many cities and states are in the process of retrofitting their urban freeways with noise barriers. These projects are often implemented piecemeal without a comprehensive approach to integrate noise barriers into the urban environment. As a result they often appear as strictly technical solutions to the problem with relatively little attention given to their aesthetic impact on the environment.

Noise barriers can have a substantial effect on the visual environment of a highway and its surrounding environment. They are long continuous structures, often more than fifteen feet high, made of various materials. They can significantly change the view from the road by blocking view of the roadside and creating a monolithic uniformity of walls instead of changing urban scenery. They also can change the view towards the road for the surrounding community. There can be an increased sense of the noise barrier as a community barrier which separates an area from other places. Nonetheless, noise barriers may be highly sought after by neighborhoods as a means to reduce freeway noise levels. What is needed is a way to provide the benefits of the sound reduction which at the same time creating a positive visual image for road users and the surrounding communities. This report will suggest ways in which this can be done. Issues that need to be addressed in noise barrier design include:

1) Aesthetics: How to provide an attractive noise barrier that is complementary to and enhances the surrounding community and provides an improved urban image?

Background:

2) Cost: How to provide a barrier/landscaping system that has a reasonable cost to build as well as to maintain?

3) Effectiveness: How effective is the noise barrier in reducing sound levels?

4) Maintenance: How to minimize maintenance cost of the barrier and plant materials, how to minimize graffiti and potential legal/liability problems?

5) Safety: How to provide for a safe roadway and neighborhood, to protect safety of personnel performing maintenance activities, to maintain emergency access?

6) Acceptability: How to create a barrier/landscape system that can gain the enthusiastic support of the surrounding community as well as various political decision making groups?

Background:

Criteria for Noise Barrier Installation

The decision to install a noise barrier is based on criteria developed by the Federal Highway Administration and the Wisconsin Department of Transportation. FHWA permits states to use federal funds to install barriers along existing roadways and along new projects. WDOT had an administrative rule, TRANS 405, which sets criteria for barriers. These are as follows:

1) Noise barriers shall be designed to provide protection only to the ground floor of abutting buildings and not other parts of the buildings.

2) For the department to consider a site for construction of a noise barrier, the site shall meet the following criteria:

   (a) For retrofit projects, a receptor shall be exposed to existing noise levels which equal or exceed the levels in Table 1.

   (b) For new highway projects, a receptor shall have predicted future noise levels which equal or exceed the levels of Table 1 or which exceed existing noise levels by 15 decibels or more.

   (c) A noise barrier protecting a receptor shall reduce noise levels by a minimum of 8 decibels.

   (d) The total cost of a noise barrier may not exceed $30,000 in 1988 dollars per abutting residence. The department may annually adjust this $30,000 maximum figure up or down based on changes in the construction price index after 1988. Other land use categories shall be analyzed on a site specific basis to determine cost effectiveness.

The department can determine areas which are eligible for the installation of noise barriers through noise analysis. This is done chiefly by computer forecasts of sound levels using the

Background:

STAMINA software. Those areas which exceed the noise criteria shown in Table 1 can be identified. Eligibility for a barrier does not necessarily mean that one will be installed, since other criteria and budget must be considered. Furthermore priorities need to be set among various locations where barriers could be placed. Some of the parameters that could be used to set priorities are:

1) Number of dwelling units affected
2) Cost
3) Age of dwelling units versus age of highway
4) Forecast noise levels
5) Average daily traffic and
6) Noise insertion loss

Other factors such as citizen requests, geographic factors and input from other government agencies may also be considered.

Background:

TABLE 1		
NOISE LEVELS CRITERIA FOR CONSIDERING BARRIERS		
Land Use Category	Leq(h)[1] (dBA)	Description of Land Use Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not includes in Categories A or B above.
D	---	Undeveloped lands.
E[2]	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

[1]"Leq" means the equivalent steady-state sound level, which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same period. For purposes of measuring or predicting noise levels, a receptor is assumed to be at ear height, located five feet above ground surface.

"Leq(h)" means the hourly value of Leq.

[2]"Use of interior noise levels shall be limited to situations where exterior noise levels are not applicable.

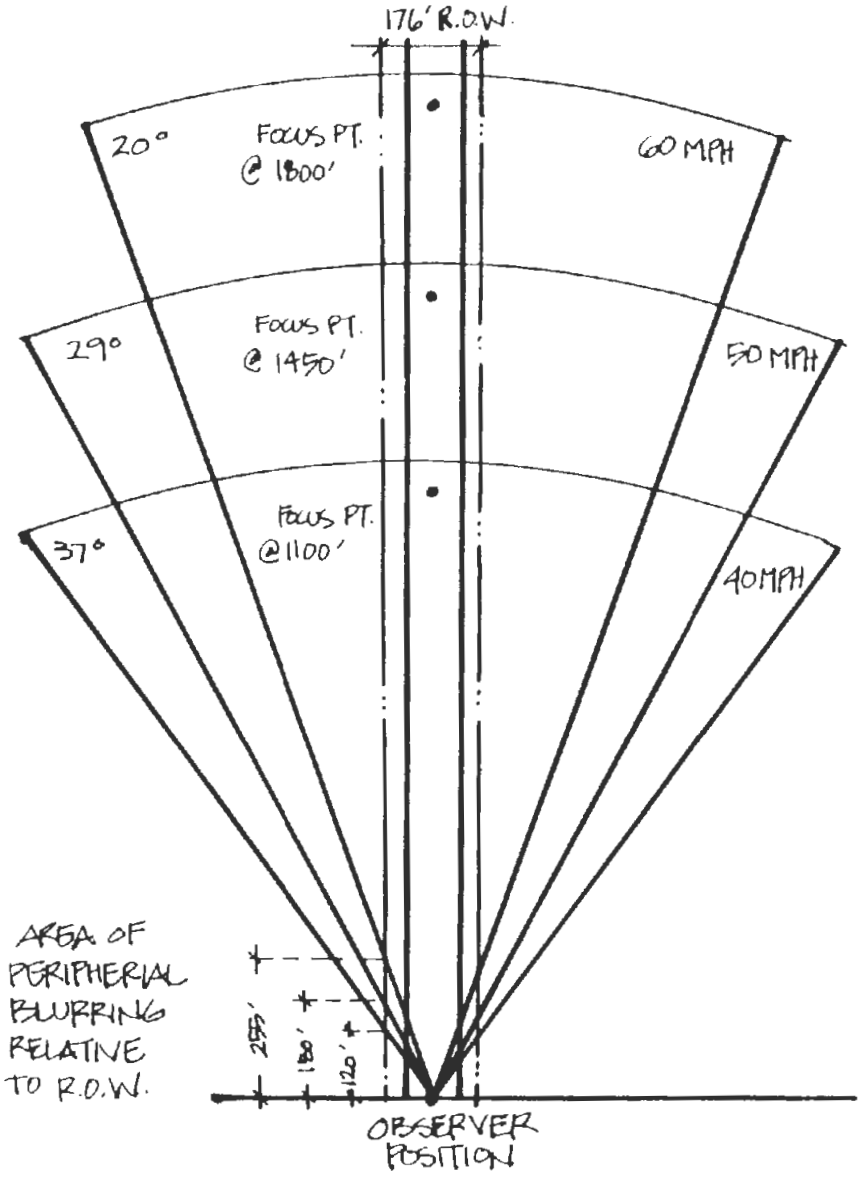
History: Cr. Register, August, 1989, No. 404, eff. 9-1-89.

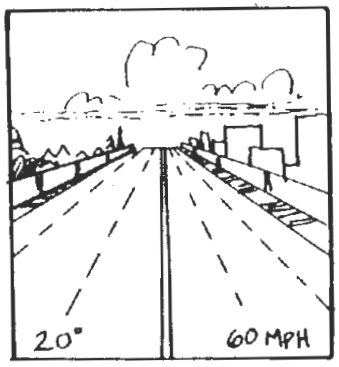
Design Guide: Basic Design Principles

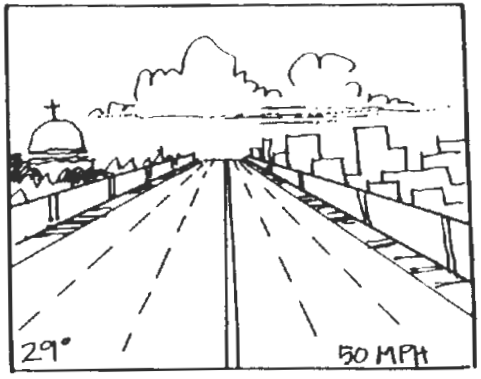
This section is intended to provide a basic introduction to design principles that can be utilized in barrier and landscape design. It will also include discussion on how and what people see when travelling on highways. Issues to be addressed include distance and motion, line, form, scale, balance, rhythm and sequence and orientation. Each of these factors must be considered and carefully chosen in order to create a design that is compatible with its surroundings.

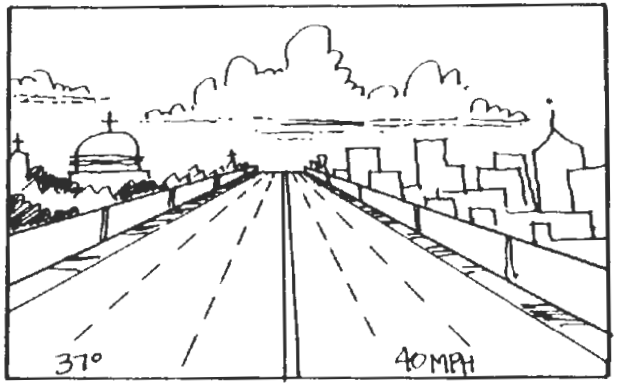
Distance and motion affect what motorists see when driving through the freeway corridor. Speed alters the peripheral cone of vision and the distance to the motorist's point of focus. Figure 1 illustrates the vision cone for three vehicular speeds. In general, as speed increases, the cone of vision narrows and the focal distance increases. Likewise, at slower speeds, peripheral vision is expanded and the focal distance is closer to the observer. Vision cones delineate the area within which objects are generally in focus. Objects outside these cones become blurred.

Figure 1: Distance and Motion









Design Guide:

Lines are created by joining two points. Lines are fundamental to three dimensional forms. The character of forms is expressed by lines. Smooth, flowing, horizontal lines may suggest calm and serenity, while bold, vertical, angular lines may suggest strength and tension. The most prominent line created by a noise barrier is the top profile (Figure 2). Lines can be created on the surface of the barrier wall using various materials and texture patterns. Lines may also be implied. For example, a row of street trees may appear to form a solid line.

Form depicts volume in three dimensions --length, width, and depth. A barrier wall itself is a three dimensional form. This is commonly referred to as positive form. The horizontal wall configuration can be designed to create spaces which are commonly referred to as negative spaces or forms (Figure 2).

Scale establishes a frame of reference. It is a relative measurement. People commonly relate to their environment using the human body or other elements of familiar dimension as the reference measurement. Noise barrier walls can be 15' tall or more. Such a wall would appear massive and overpowering located adjacent to a back lot line since residential fences are more commonly 4 to 8' tall (Figure 2). The perceived scale of barrier walls can be reduced through the use of landscaping and/or in the design of the wall itself (e.g. materials, configuration, etc.).

Balance creates order and unity by attaining a sense of equilibrium. Two basic types of balance include: symmetry and asymmetry (Figures 3a and 3b). Symmetry results when elements are arranged equally around a central axis, creating a mirror-image effect. Symmetry is considered to be a formal type of balance. Asymmetry is more informal, lacking a central axis. Elements are juxtaposed in such a way that they counterbalance each other without creating a mirror image.

Figure 2: Fundamental Elements of Design

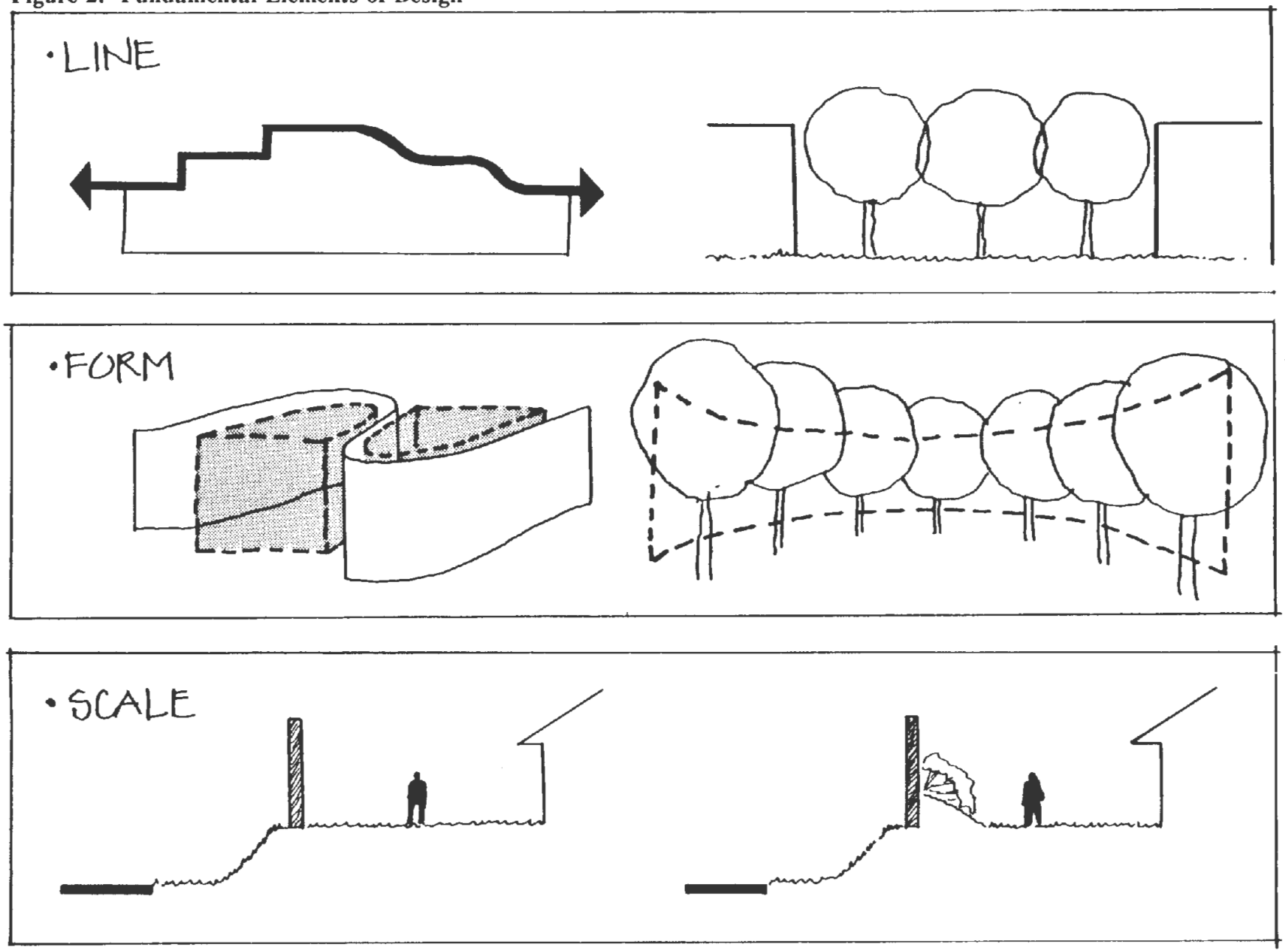


Figure 3a: Symmetrical Balance

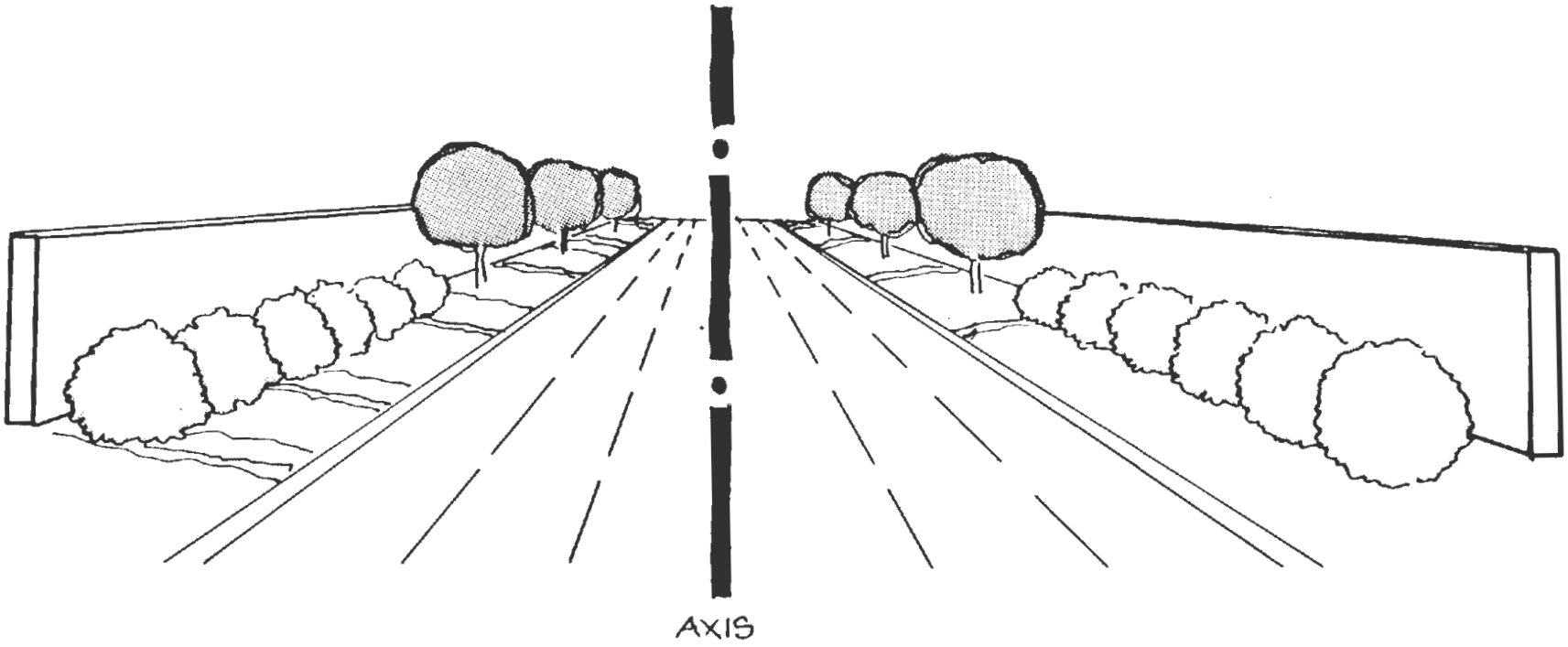
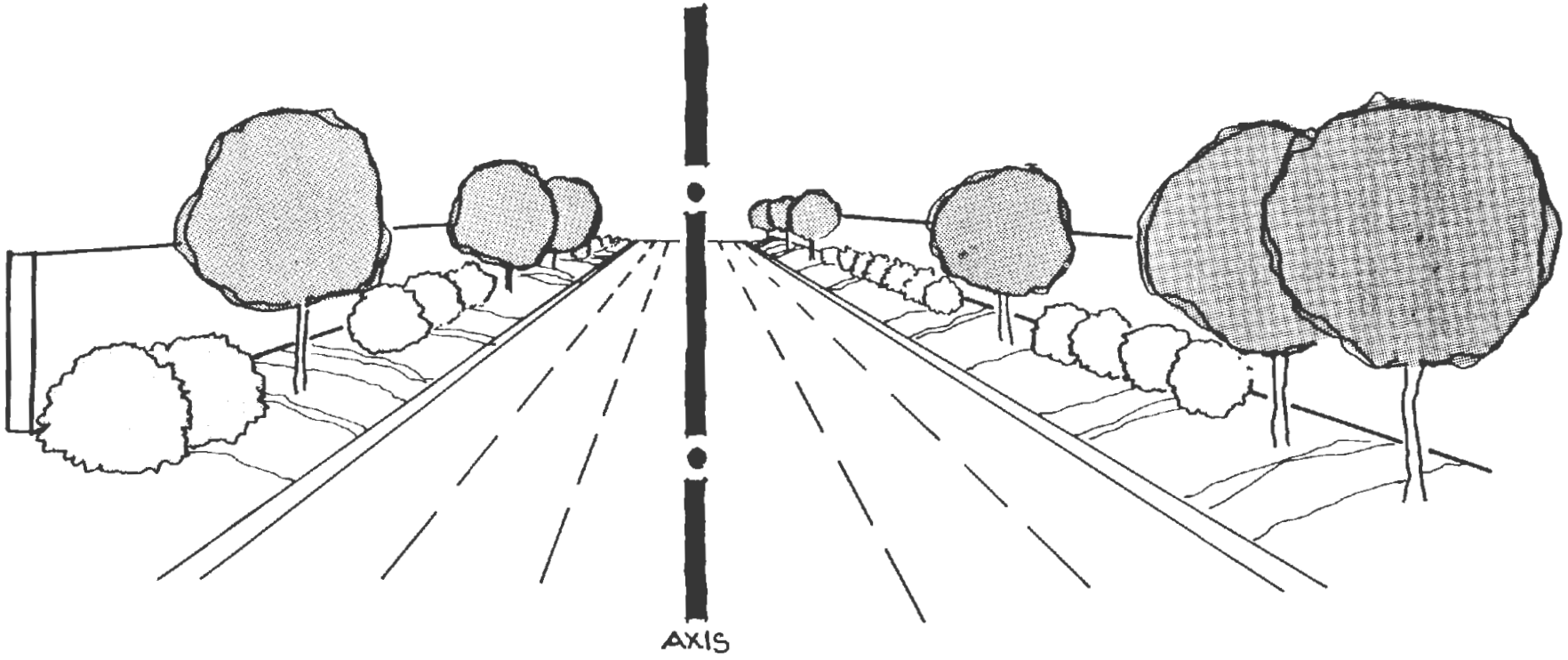


Figure 3b: Asymmetrical Balance



Design Guide:

Rhythm and sequence establish consistent, recognizable patterns (Figures 4 and 5). Repeated patterns create a sense of familiarity and comfort. They also provide a sense of progression, unless continued indefinitely. Rhythm and sequence can be created using both the barrier wall and/or landscaping.

Figure 4: Rhythm

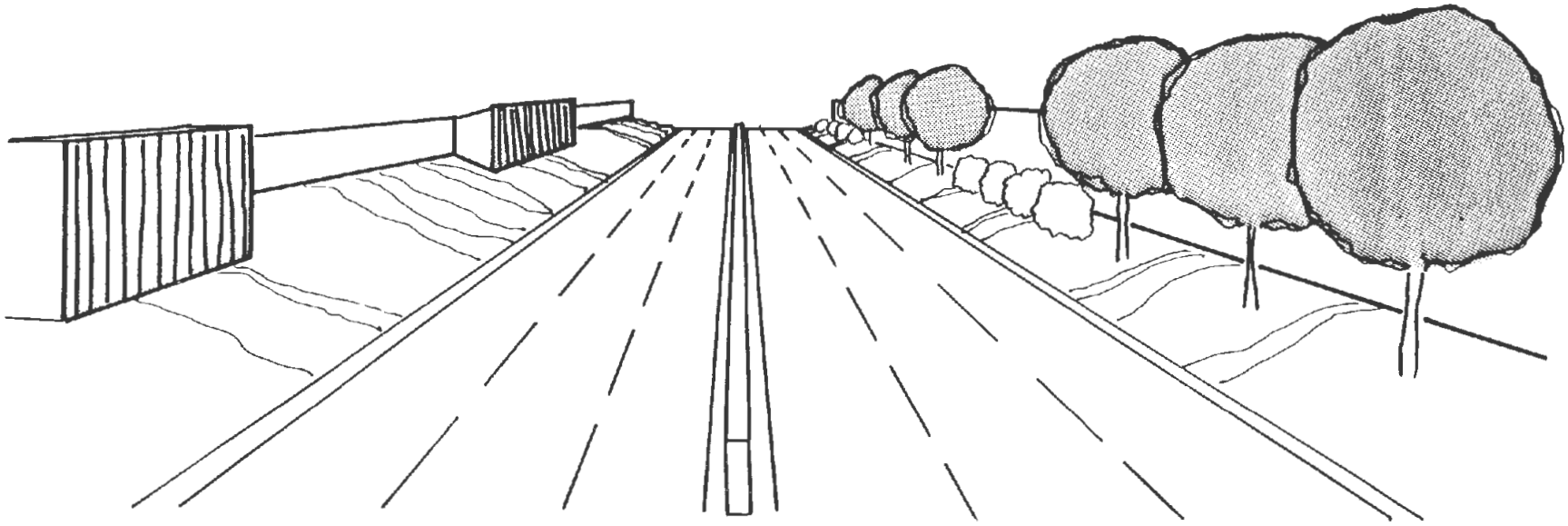
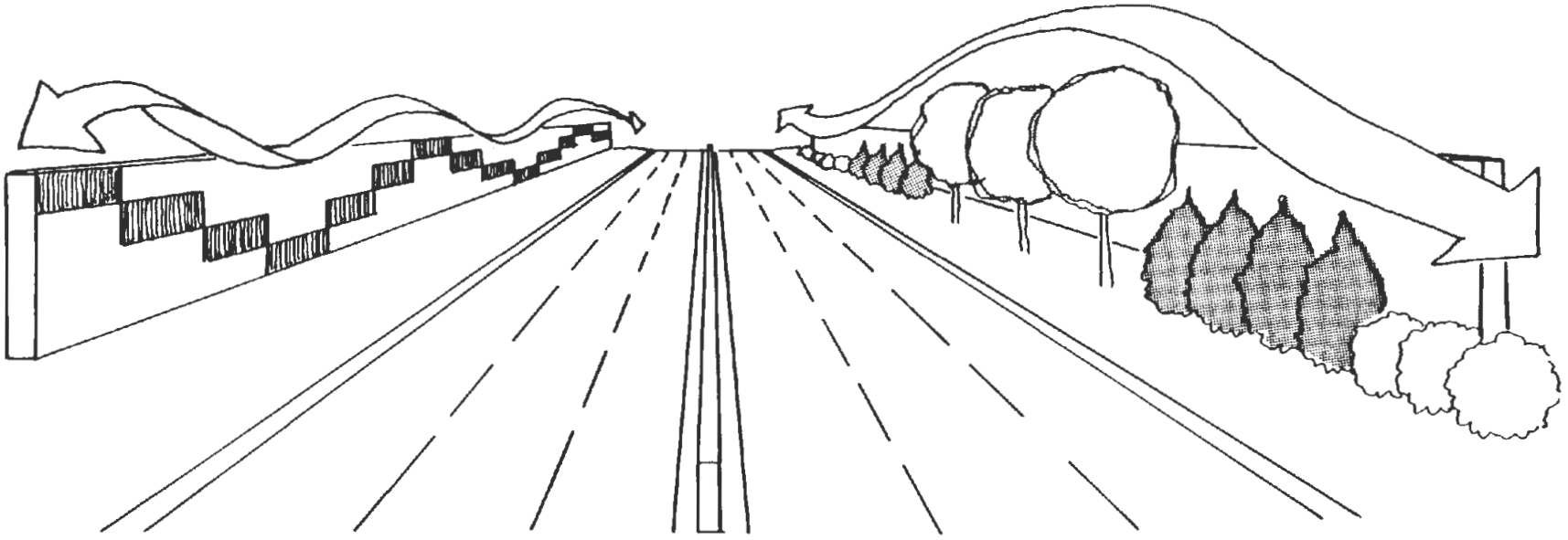


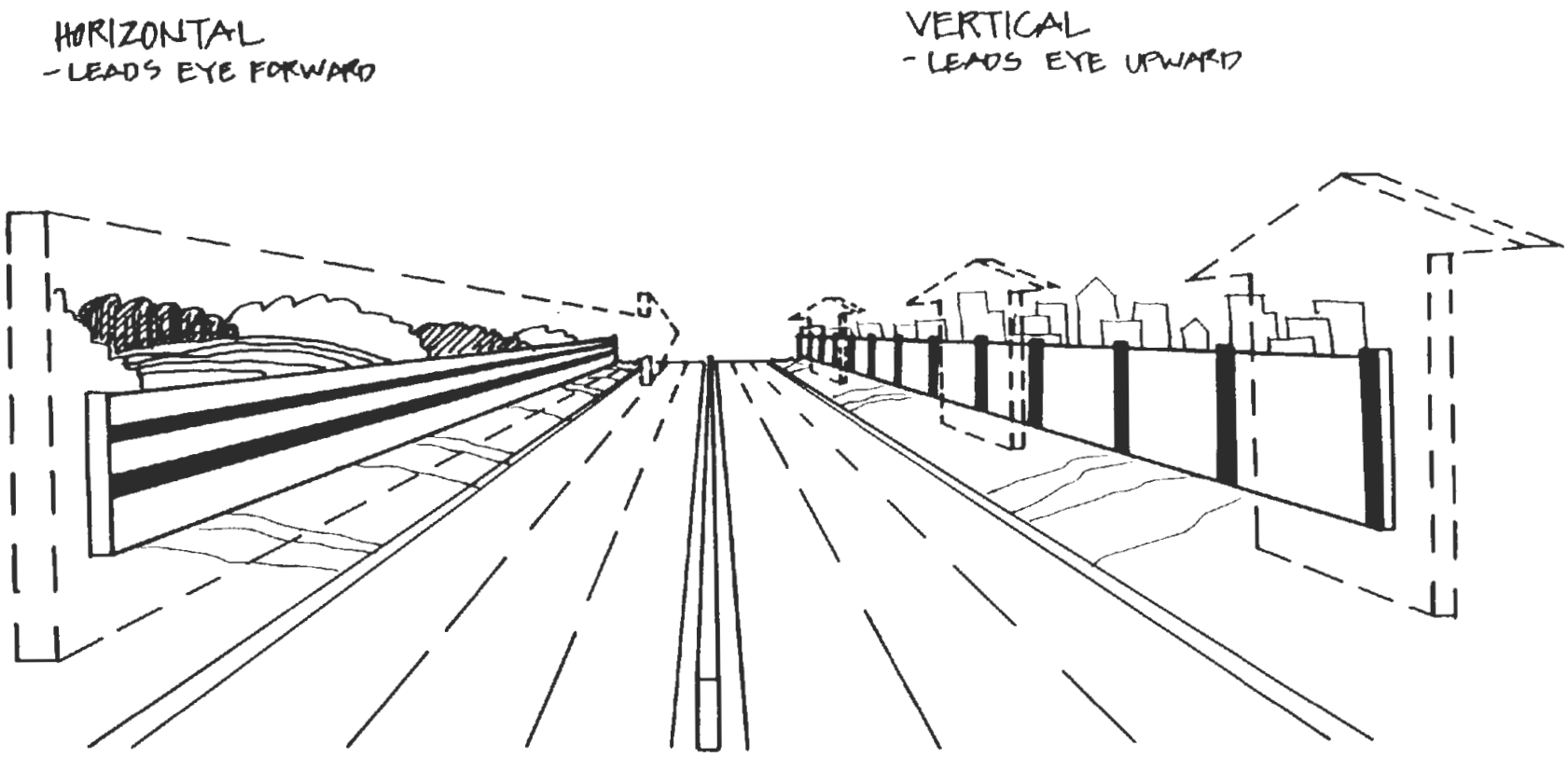
Figure 5: Sequence



Design Guide:

Orientation refers to the dominant visual direction established through design (Figure 6). Horizontal orientation is associated with relatively flat and expansive landforms. This type of orientation tends to direct the eye forward, reducing the apparent height of a barrier wall by emphasizing its relationship to the horizon. Vertical orientation is associated with upward reaching forms such as skyscrapers. This type of orientation tends to direct the eye upward, increasing the apparent height of a barrier wall.

Figure 6: Visual Orientation



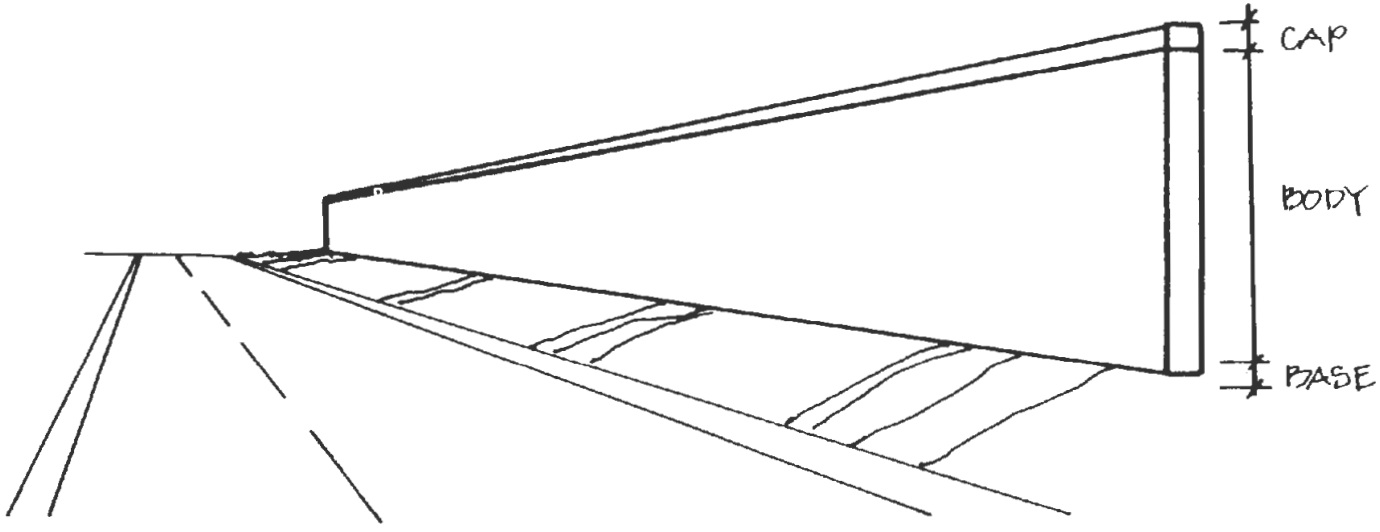
Design Guide: Barrier Design

This section is divided into subsections pertaining to design issues specific to barrier structures, landscape treatment, and integrating barriers and landscape.

- **Parts of the Barrier Wall**

Walls consist of three basic parts: the cap, the body, and the base (Figure 9). The cap provides a top edge to the wall -- giving it a definite finished appearance. The body is the dominant part of the wall. The base refers to where the body meets the ground. It provides a sense of connection with the landscape.

Figure 7: Parts of a Wall



Design Guide: Barrier Design

- **Top Profile**

The profile line created by the top of the wall defines the general character and form of the wall. The top profile can be designed to reflect, contrast, or remain neutral to the surroundings. Figure 8 illustrates and example of a peaked top profile imitating a steepled skyline, and a horizontal, wavy top profile contrasting the vertical forms of the urban downtown skyline.

- **Wall Configuration**

The configuration of a barrier wall can be altered by changing its horizontal alignment. Figures 9 and 10 illustrate two common wall configurations: serpentine and castellated. Both of these break up the line of the wall creating a more three-dimensional form. This results in a more visually interesting wall. In addition, the "negative" space created by the undulations can function as planting pockets. While these configurations potentially increase the structural strength of the wall, they also increase the cost. How much the cost would increase depends on specific details such as materials and the degree and quantity of undulations.

Figure 8: Top Profile of Wall

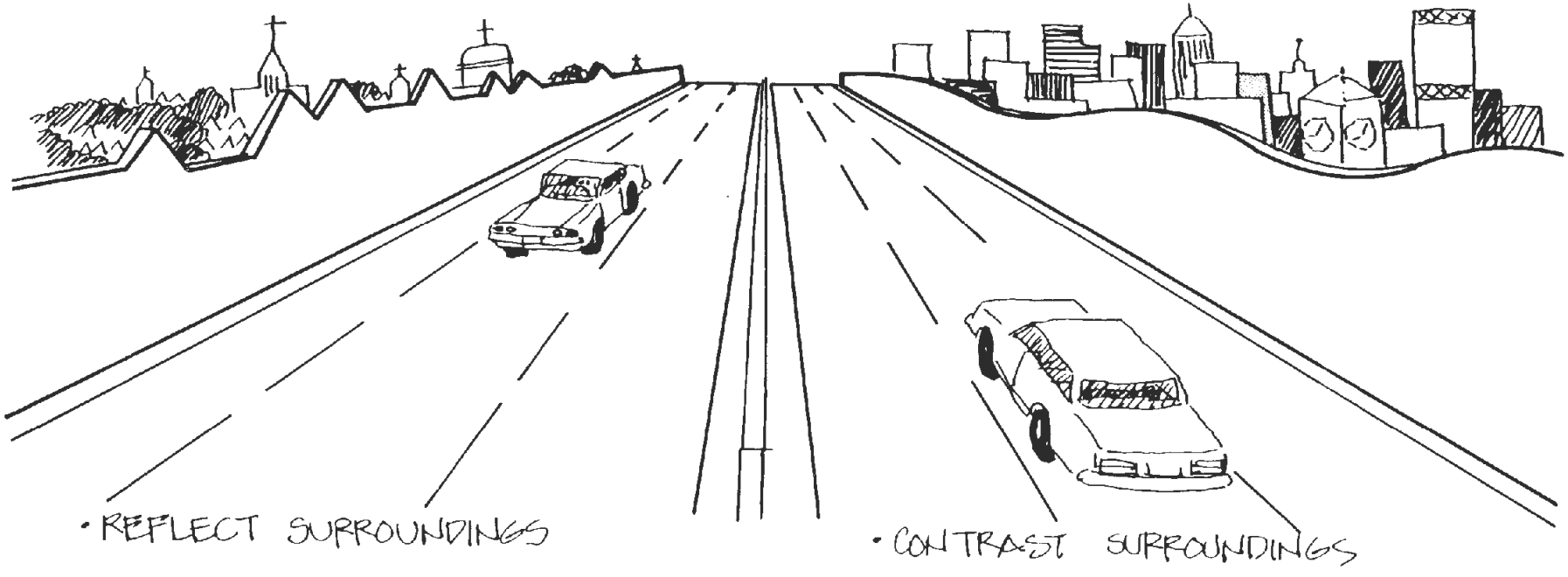
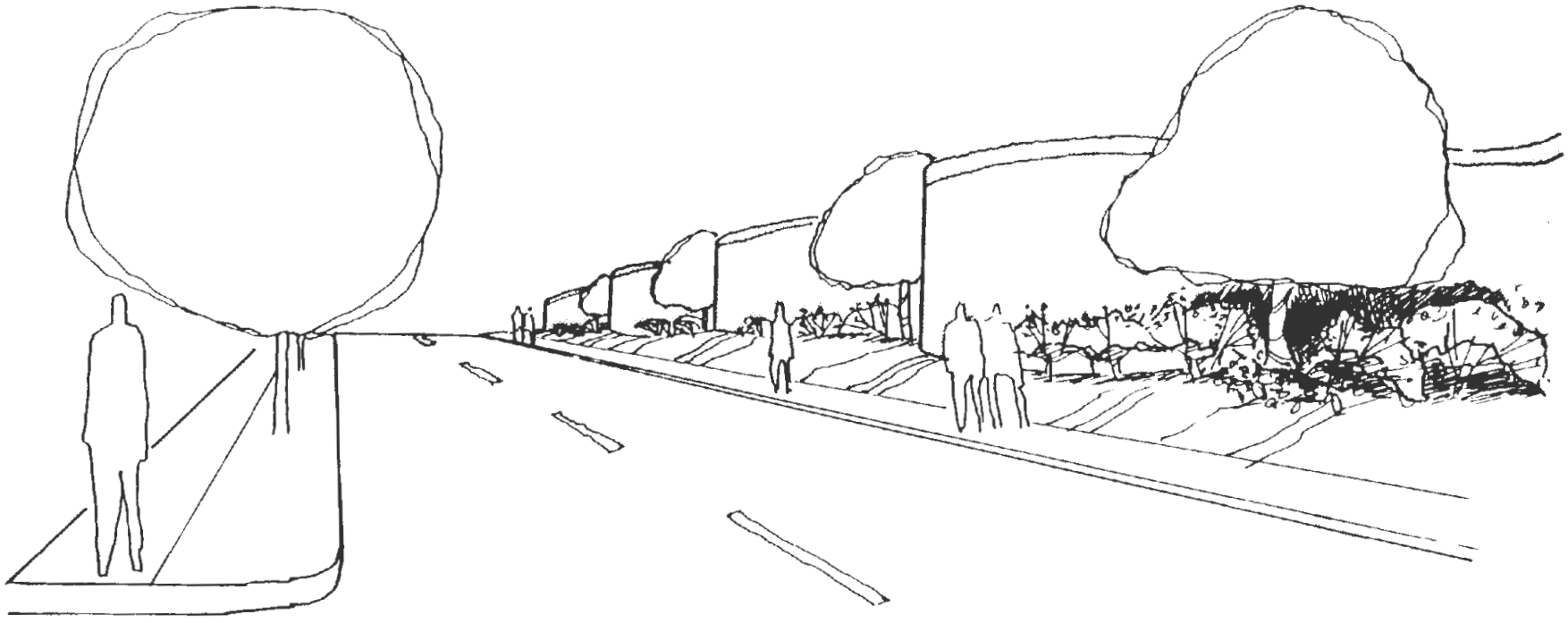


Figure 9: Serpentine Wall Configuration



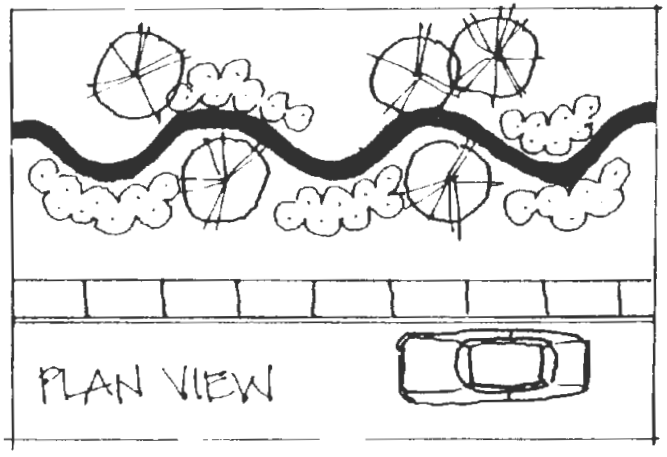
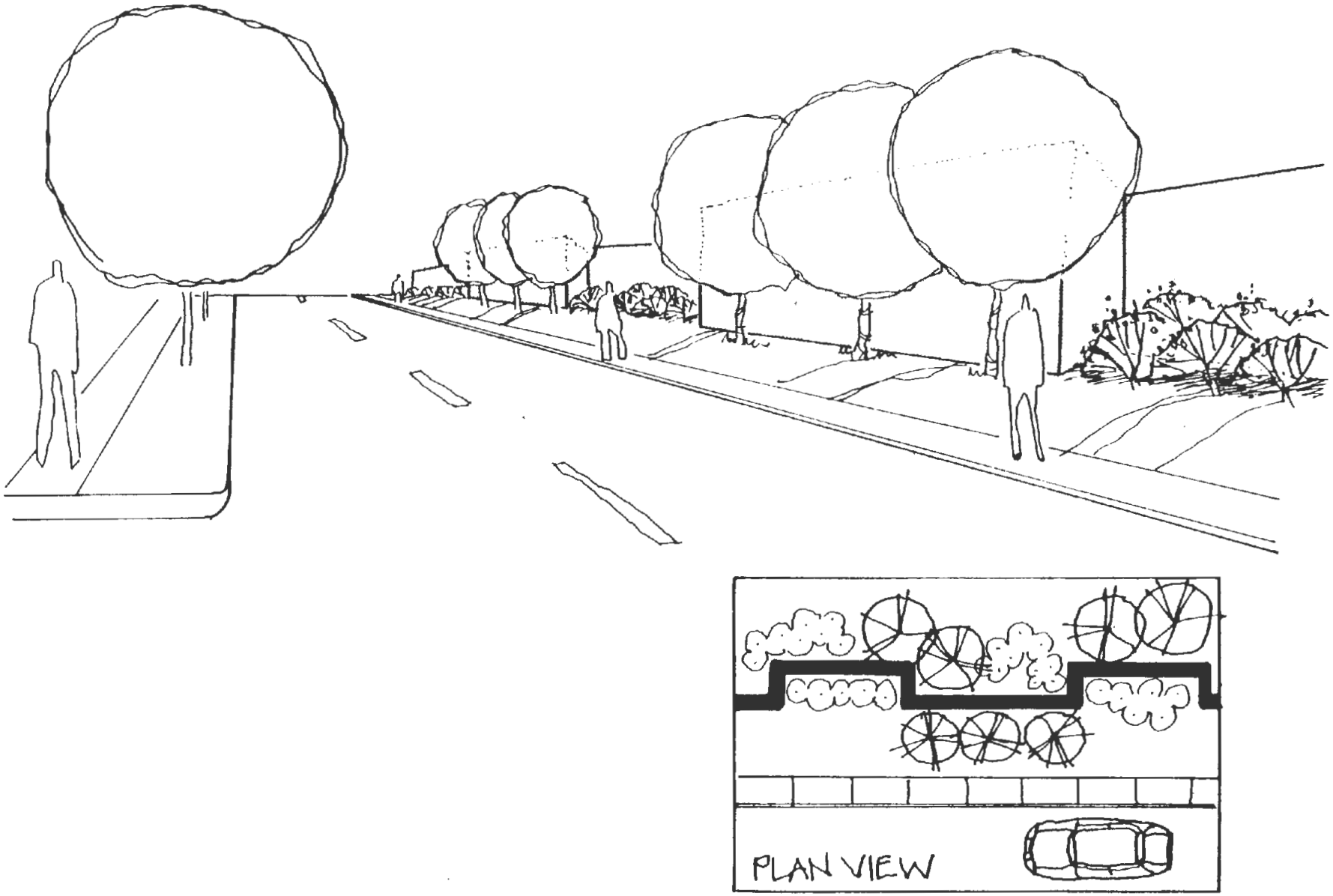


Figure 10: Castellated Wall Configuration



Design Guide: Barrier Design

- **Materials and Textures**

The most common materials for constructing noise barriers are precast concrete, metal, and wood. Brick is also used, but only to a limited extent because of higher cost (Figure 11). Several surface finishes and textures are available to provide a large variety of options for barrier wall design. Appendix B lists the common barrier wall materials and various surface finishes and textures currently available.

The character of the barrier wall is directly related to the materials and textures used in the design. In general, wood appears inherently more suburban and rural than concrete or metal, which appear harder and more urban. However, in spite of the material used, the character of the wall can be significantly modified by the type of surface treatment used on the wall body.

Surface texture and patterns can be applied to lend any desired character. How texture and patterns are perceived depends on the speed of the observer (Figure 12a, b, c). At high speeds, textures become blurred and patterns may not be discernable. Coarse textures and simple, bold patterns should be used in high speed situations. On the other hand, the residential side of noise barriers is commonly experienced by slower moving observers. People walking or driving at slow speeds are able to distinguish finer textures and more intricate and complex patterns.

Figure 11: Common Barrier Wall Materials

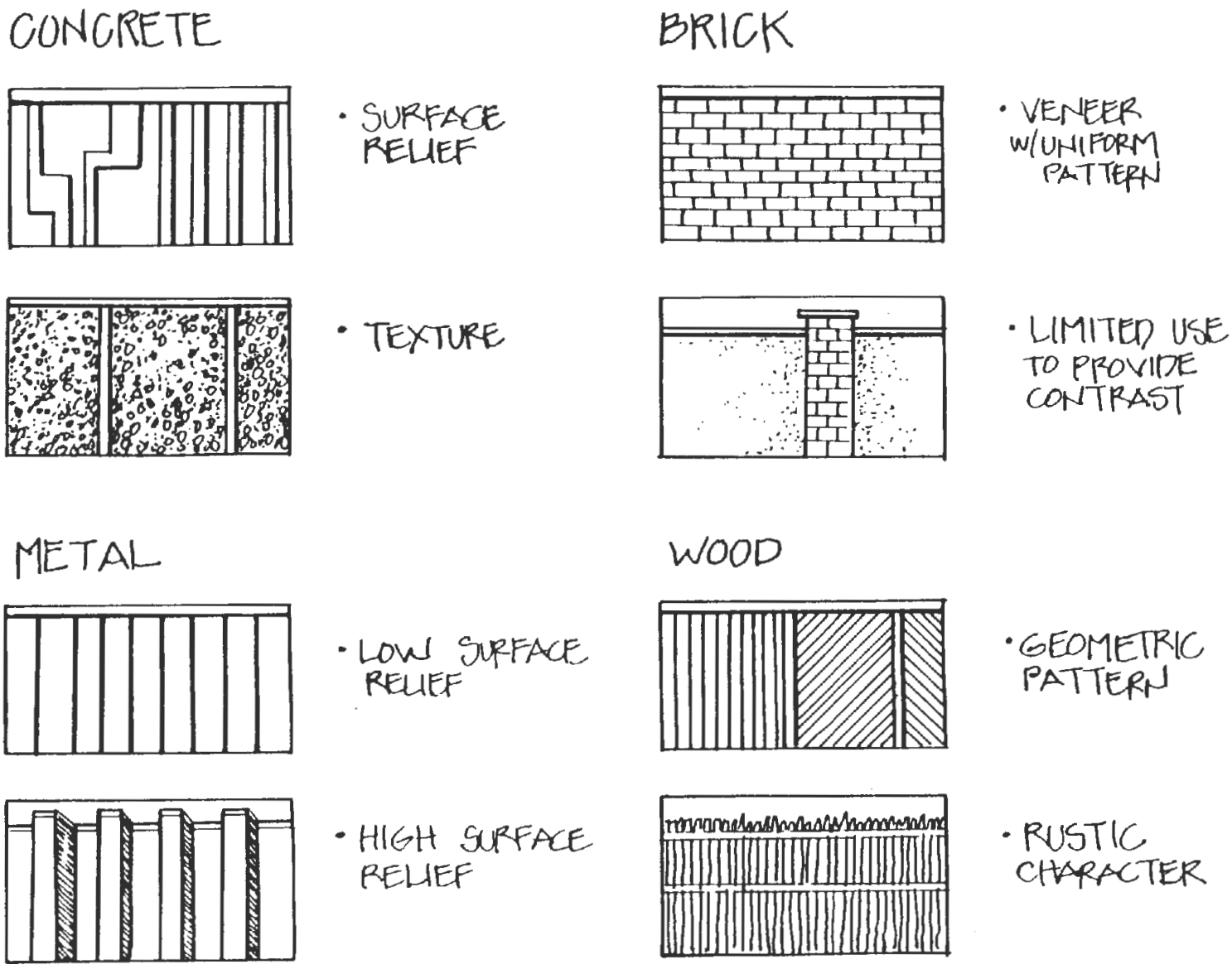
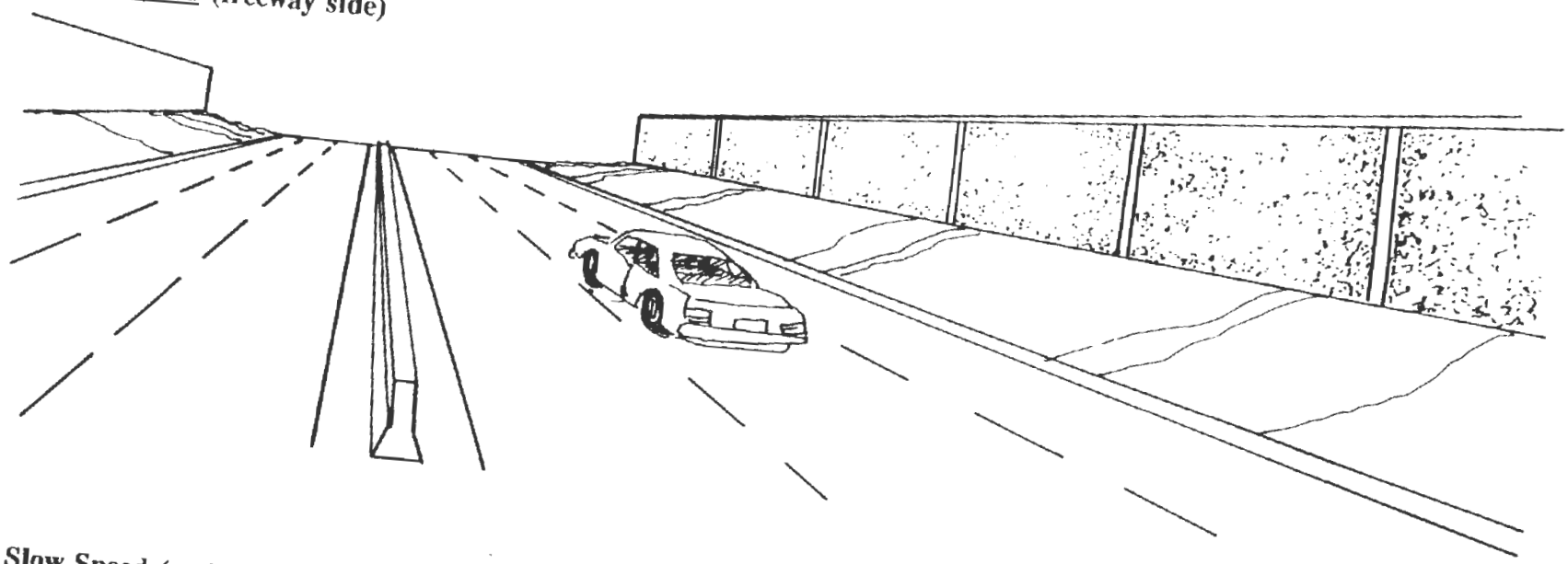
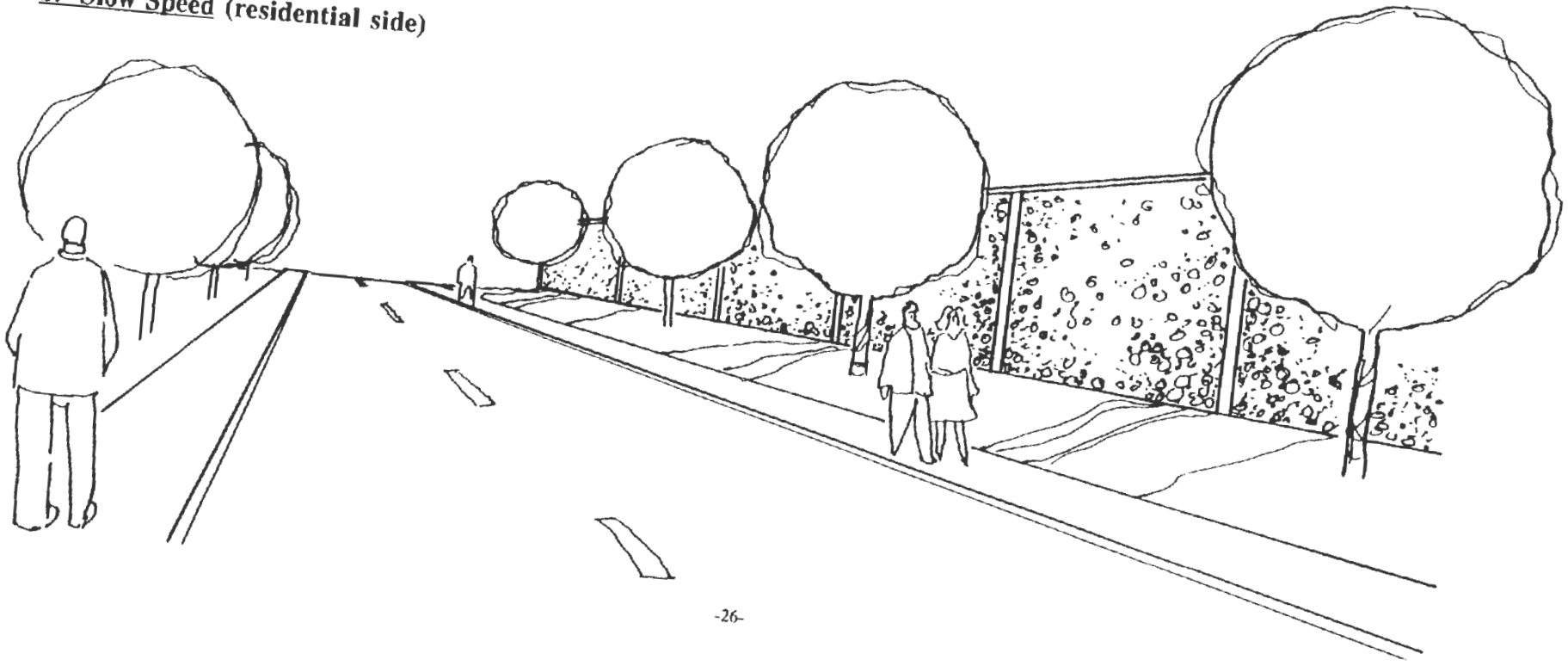


Figure 12: Wall Texture

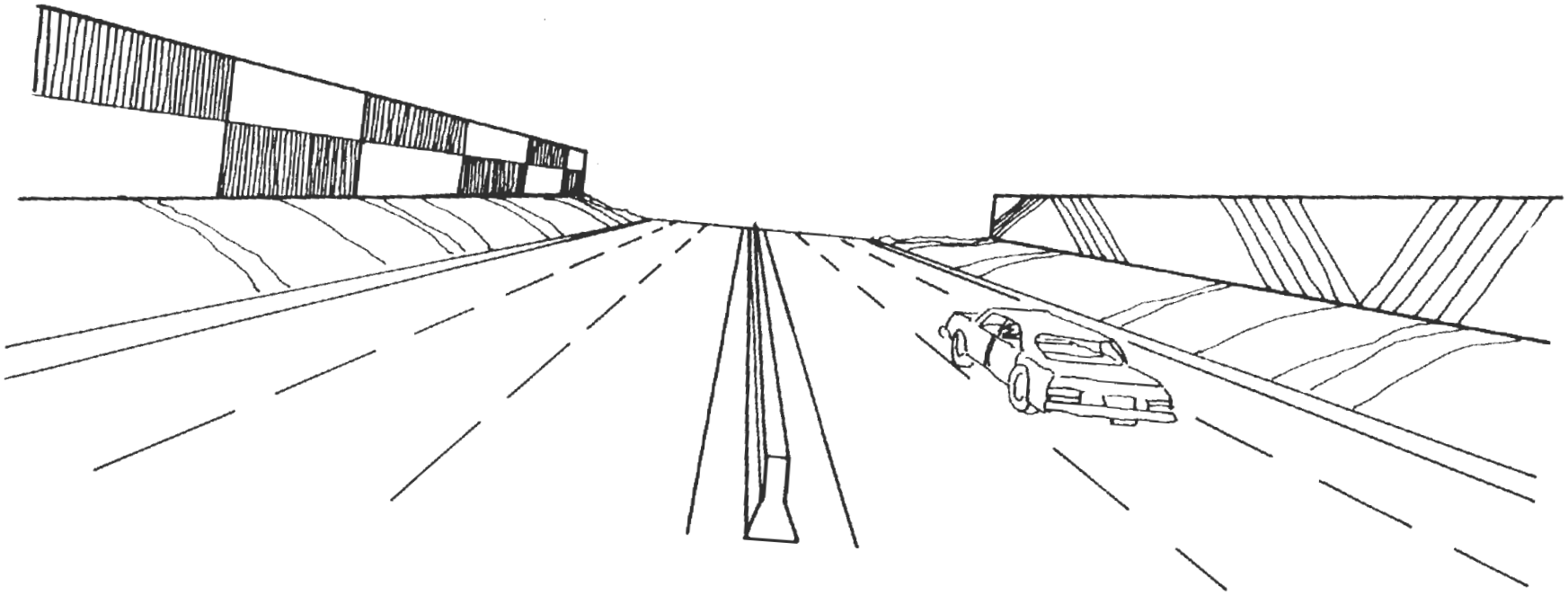
a. High Speed (freeway side)



b. Slow Speed (residential side)



c. Wall Texture

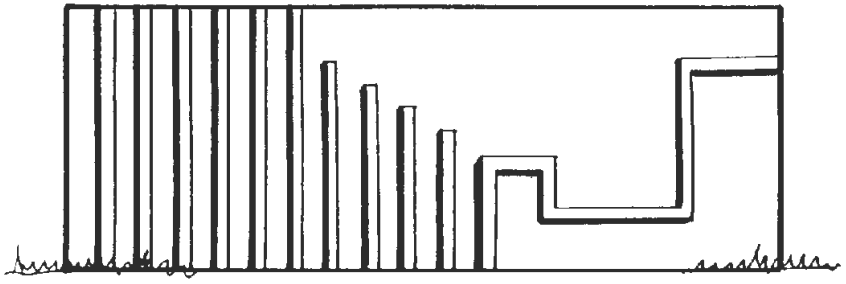


Design Guide: Barrier Design

Variety can also be achieved through the use of contrast on the wall surface. Smooth and rough textures can be juxtaposed and pattern orientations may be varied to create contrast (Figure 13). Relief on wall surfaces can create shadow patterns. A variety of colors can be used to create contrast.

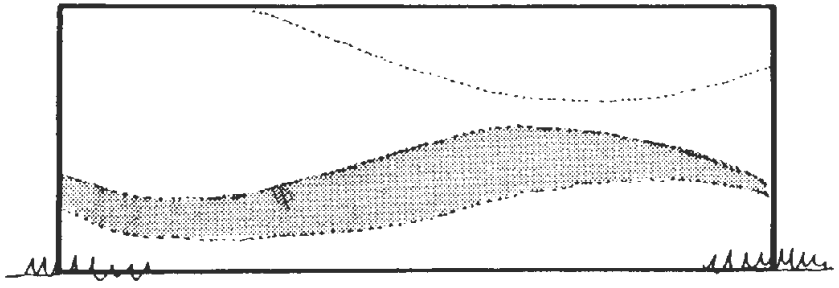
Other important considerations when selecting barrier materials include cost and maintenance. On a cost per linear foot basis, metal is the least expensive material (see Appendix B). Obviously, standardized units are cheaper than custom pieces. Likewise, unornamented panels cost less than decorative or textured panels. The challenge to designers is to create variety within the constraints posed by standardized units, and to use customized panels in strategic locations to provide visual impact without being prohibitively expensive.

Figure 13: Surface Contrast

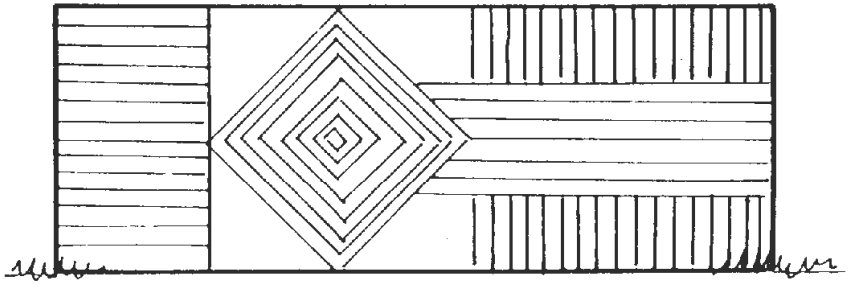


• SHADOW
- SURFACE RELIEF CREATES SHADOW PATTERNS

• TEXTURE
- SMOOTH; FINE; COARSE



• COLOR VARIATION
- PIGMENT; PAINT; MATERIALS



• PATTERN ORIENTATION
- HORIZONTAL; VERTICAL; DIAGONAL

Design Guide: Landscape Plant Materials

Plant materials are grouped into general categories relative to their size and habitat (Figure 14a). These categories include:

- Overstory -- tall plants (typically trees) that form overhead canopies
- Understory -- shorter plants (shrubs and small trees)
- Ground cover -- plants that grow close to the ground (typically less than 12" tall). May be used to stabilize soil or slopes.
- Vines -- plants that attach themselves to other objects for support.

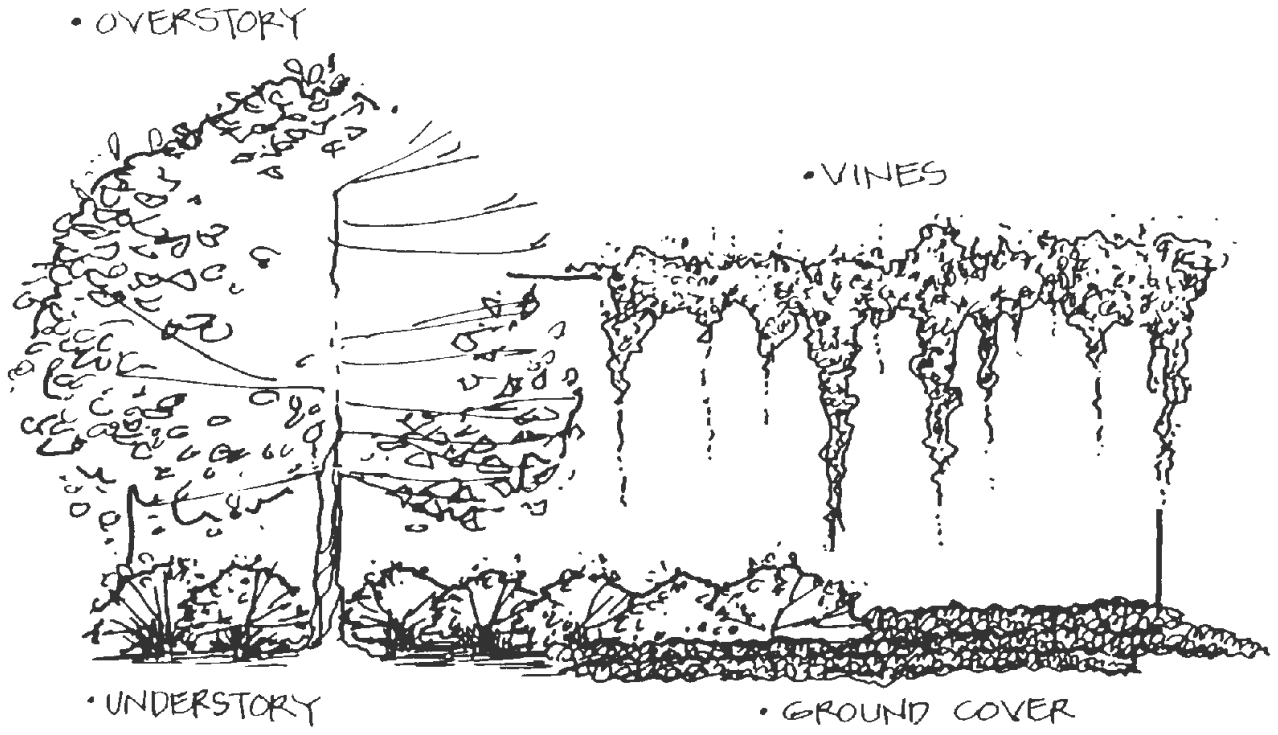
Plants may also be grouped into categories based on their texture -- fine, medium, or coarse (Figure 14b).

- Fine textured plants are characterized by small leaves and twigs, smooth bark, and slender, graceful branching habits.
- Coarse textured plants are characterized by large leaves, thick and/or corky twigs and sturdy or stiff branching habits.
- Medium textured plants are those not distinctly fine or coarse.

For design purposes descriptive plant form categories have been developed because certain forms lend themselves to specific functions and portray particular characters or moods. Figures 15 and 16 illustrate common form descriptions for trees and shrubs.

Figure 14: Plant Categories

a. Size



b. Texture

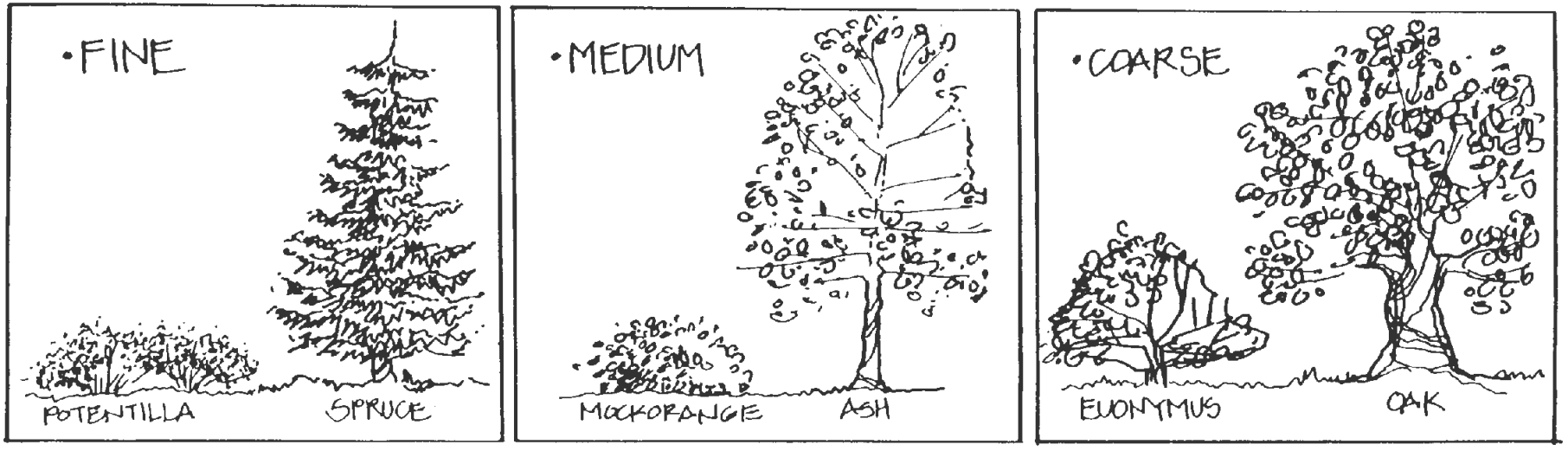


Figure 15: Common Tree Forms

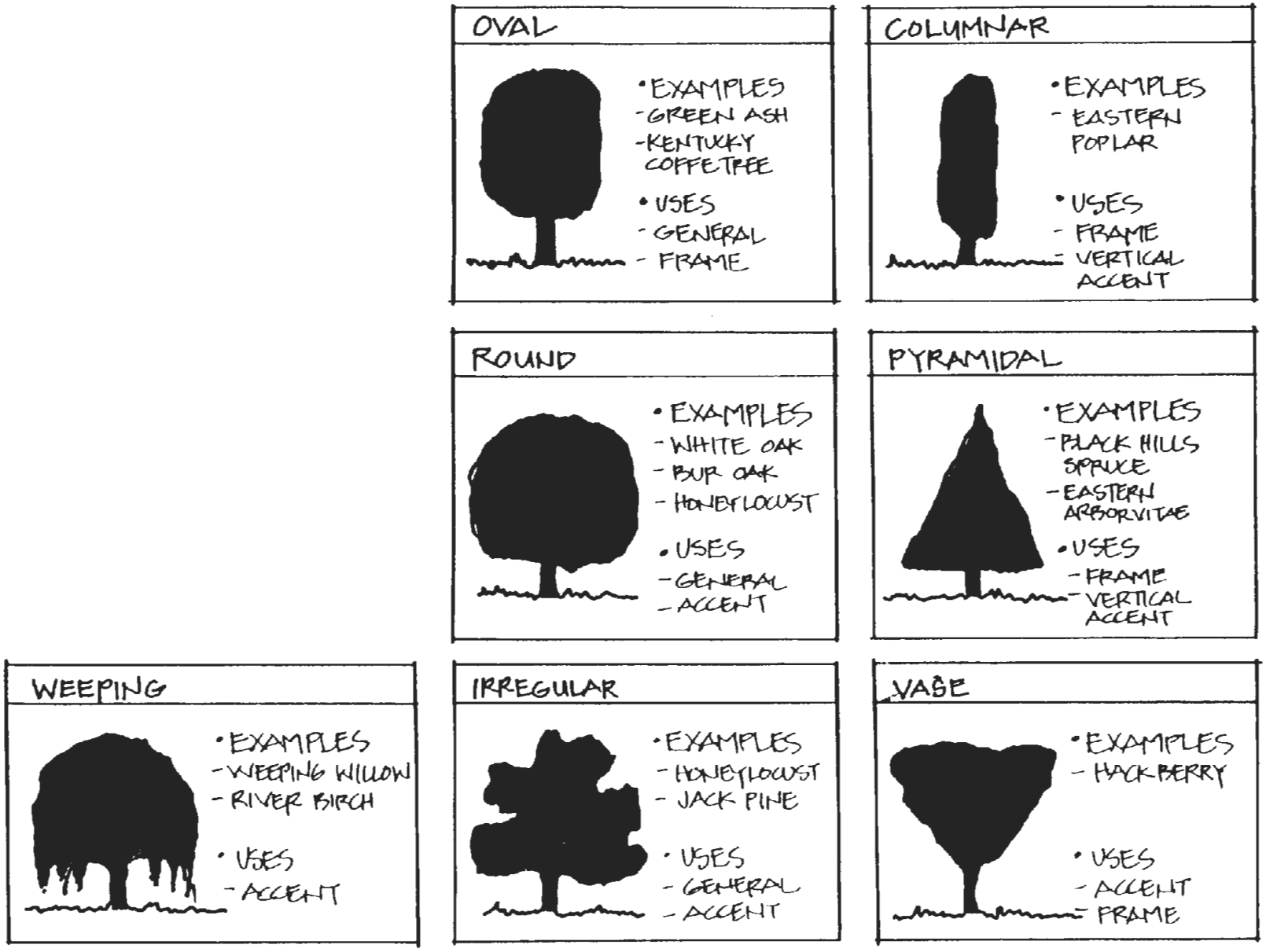
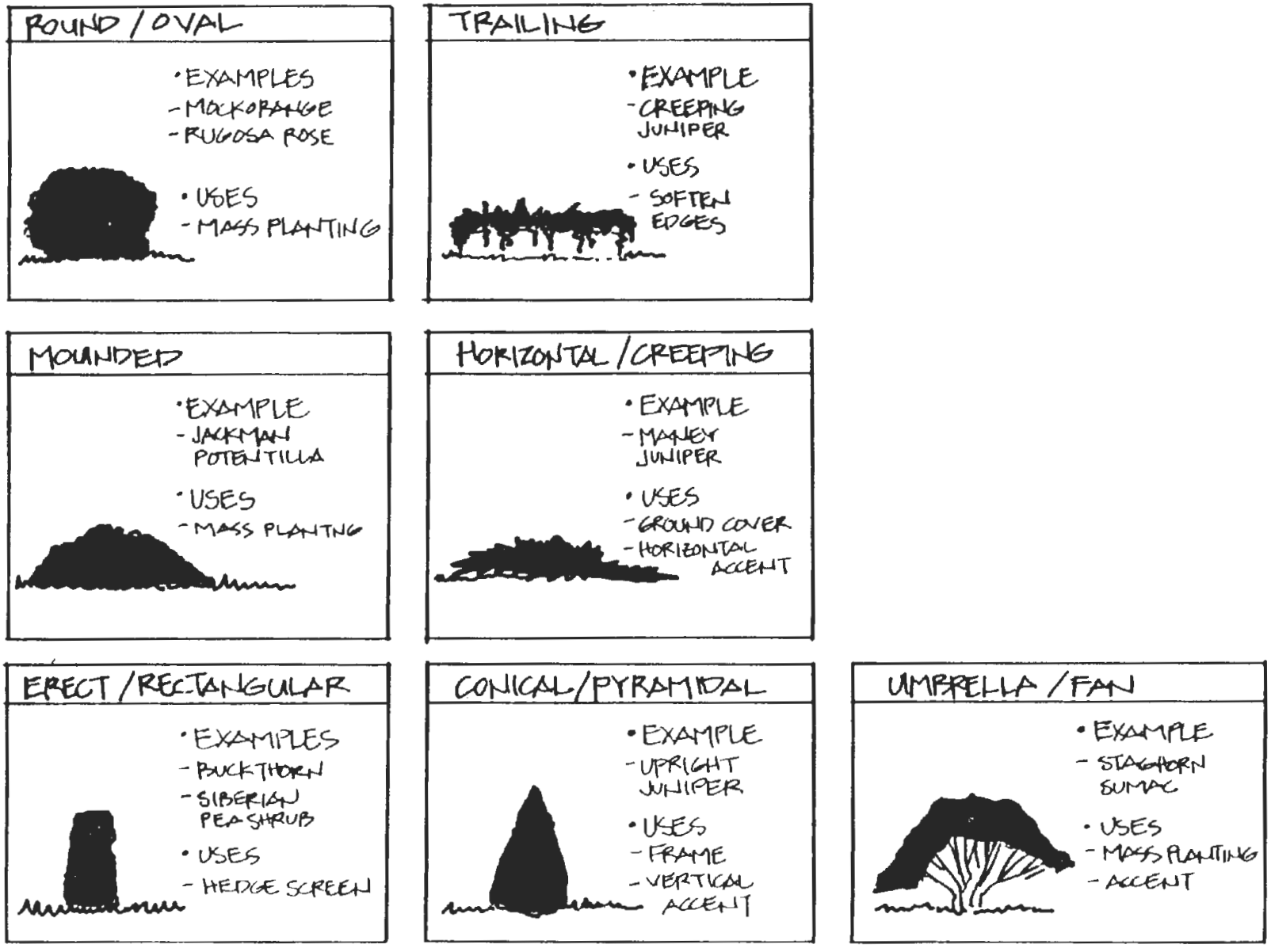


Figure 16: Common Shrub Forms



Design Guide: Natural Landscaping

Using plants native to a region makes aesthetic and economic sense. Urban development, agriculture and road construction destroys much of the original plant communities that existed prior to settlement. Restoration of the original plant community helps blend the roadway into the surrounding landscape and provides an interesting and aesthetic view of the road. Wild flowers and prairie grasses contribute a wide variety of textures and colors to the roadside landscape. Flowers bloom at different times, from spring to fall, offering a continuous display of changing colors. In addition, many prairie grasses change color throughout their growing season.

The establishment of natural landscaping along a highway requires careful selection of plants and some patience. Prairie grasses and wild flowers will take two to three years to establish themselves and may require a nurse crop when planted. During the first several years the roadside will be dominated by annual weeds. These will eventually be replaced by the perennial grasses and wild flowers of the prairie environment. Plants should be selected to provide for a diversity of color, height and flowering time. This will result in a more naturalistic landscape with a variety of textures and colors throughout the year. Prairie plants change over the season with short growing flowers appearing early. These are gradually replaced with taller flowers and grasses later in the season.

Prairie habitats are divided into five types: wet, wet mesic, mesic, dry mesic and dry. Wet prairie areas have saturated soils, typically deep clay silt loam and peat and are dominated by sedges rather than grasses. Mesic prairie is a medium condition with medium deep silt or sandy loam soils. Dry prairie tends to have shallow sand or limestone soils. Each species of native grass or flowers has a set of habitats which it prefers. Roadsides tend to have a variety of conditions ranging from wet areas along ditches to drier zones along embankments.

Design Guide:

In addition to aesthetics, natural landscaping can reduce roadside maintenance costs. Fertilization and mowing activities can be significantly reduced. Once established, prairie grasses and wild flowers provide an excellent means of soil stabilization. Native plants can be especially resistant to drought and will continue to thrive even when other types of plants dry up. Ideally prairies should be burned once every four to five years during early spring to reduce build-up of dead grasses and to eliminate woody plants. This adds nutrients to the soil and accelerates growth in the subsequent seasons. Controlled burning along a roadside may require special efforts to maintain safety. An alternative may be to use mowing or to forgo burning for longer time intervals.

The use of prairie plants along roadsides is becoming increasingly popular. The Wisconsin Department of Transportation has initiated a major project in central Wisconsin along U.S. Highway 51 to establish prairie grasses and wild flowers along the roadside. In addition many states have active programs to plant wild flowers along roadsides and have "adopt a roadway" programs to facilitate maintenance and landscaping. Currently one-fourth of one percent of federal funds for landscaping are to be used for native plantings along highways. Appendix B lists some grasses and wild flowers currently used by WDOT.

Design Guide: Uses of Landscaping for Aesthetics

Landscaping can be used in several ways to improve the aesthetics of freeway corridors, and noise barriers in particular. Figures 17 through 21 illustrate several functions of landscaping relative to noise barriers.

- Noise barrier walls can be softened through the use of plants that camouflage their hard edges (e.g. cap, base, and ends). Vines cascading over the top of walls and base plantings can be used effectively as softeners.

- The scale of barrier walls can be reduced by using plants to break up the expanse of wall surfaces and to reduce the relative height of the wall. Mature overstory trees are tall relative to a 15' barrier wall. Planting overstory trees in front or behind a wall can effectively reduce the apparent wall height. Shrubs and vines can be used to break up the expanse of the wall body.

- Visual direction can be added through the use of plantings that accentuate horizontal or vertical lines. Creeping vines and low spreading ground covers emphasize horizontally while pyramidal, conical and columnar plants provide vertical elements, drawing the eye upward.

- Plants can be used to create points of focal interest or accent. Plantings that provide contrast in color, form and/or size will be visually prominent. Accent plantings can provide aesthetic stimulation for motorists. They may also be used to subtly direct views and provide locational cues.

- Plants can be strategically placed to frame views and objects.

Figure 17: Soften

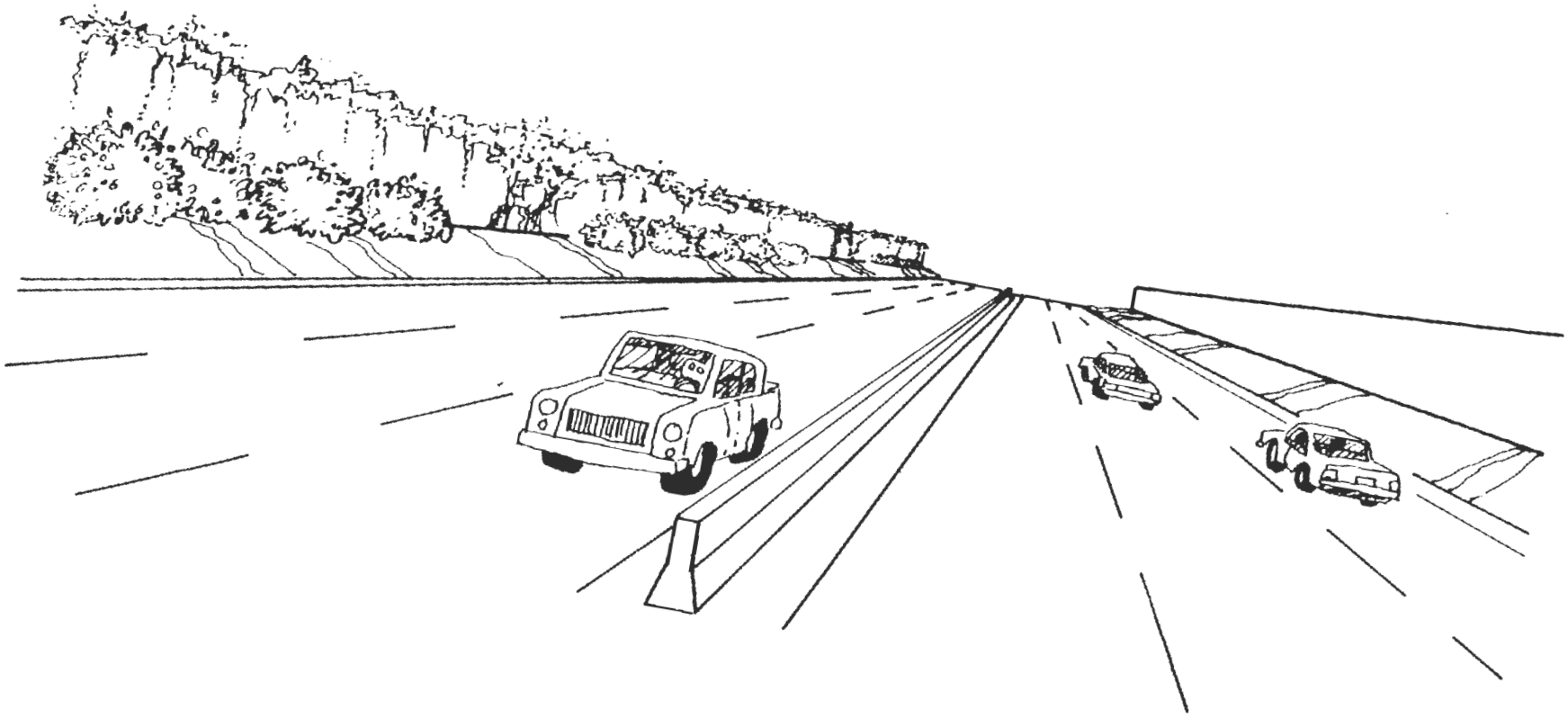


Figure 18: Reduce Scale

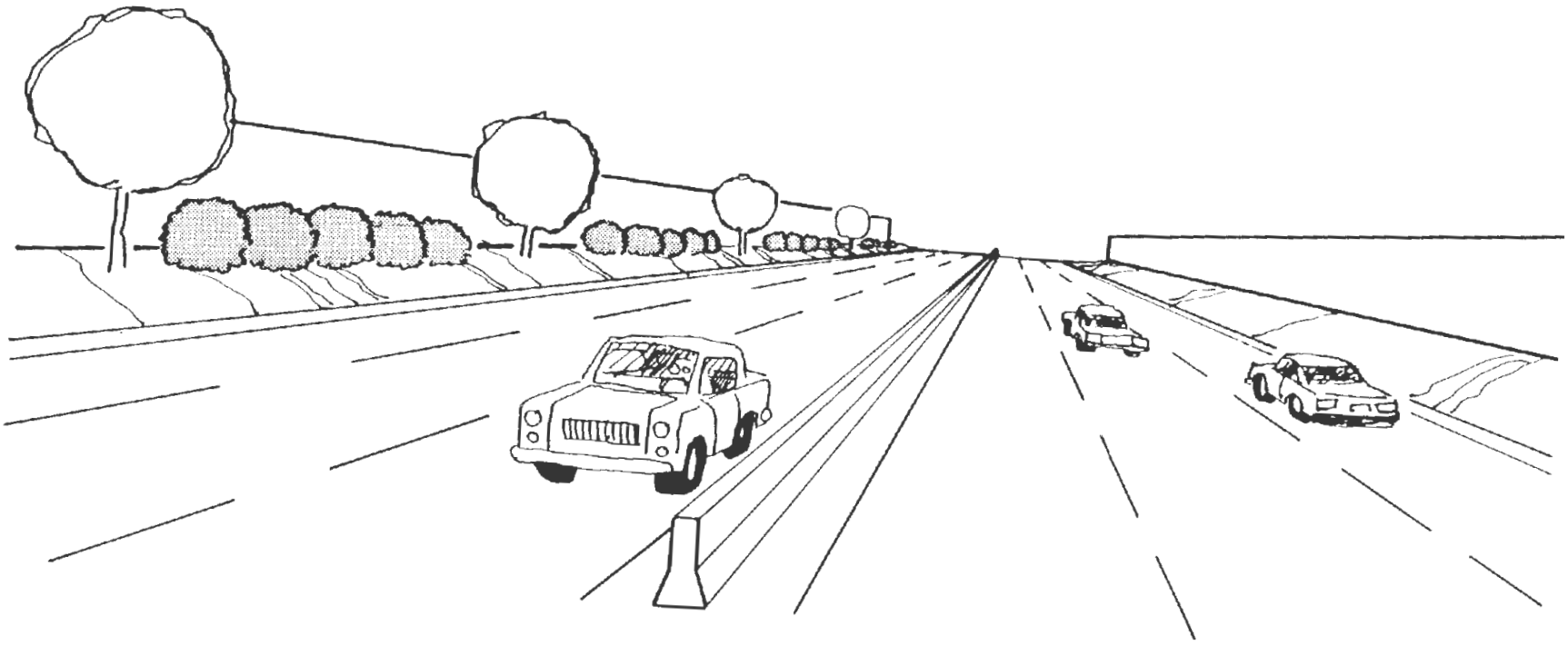


Figure 19: Horizontal and Vertical Emphasis

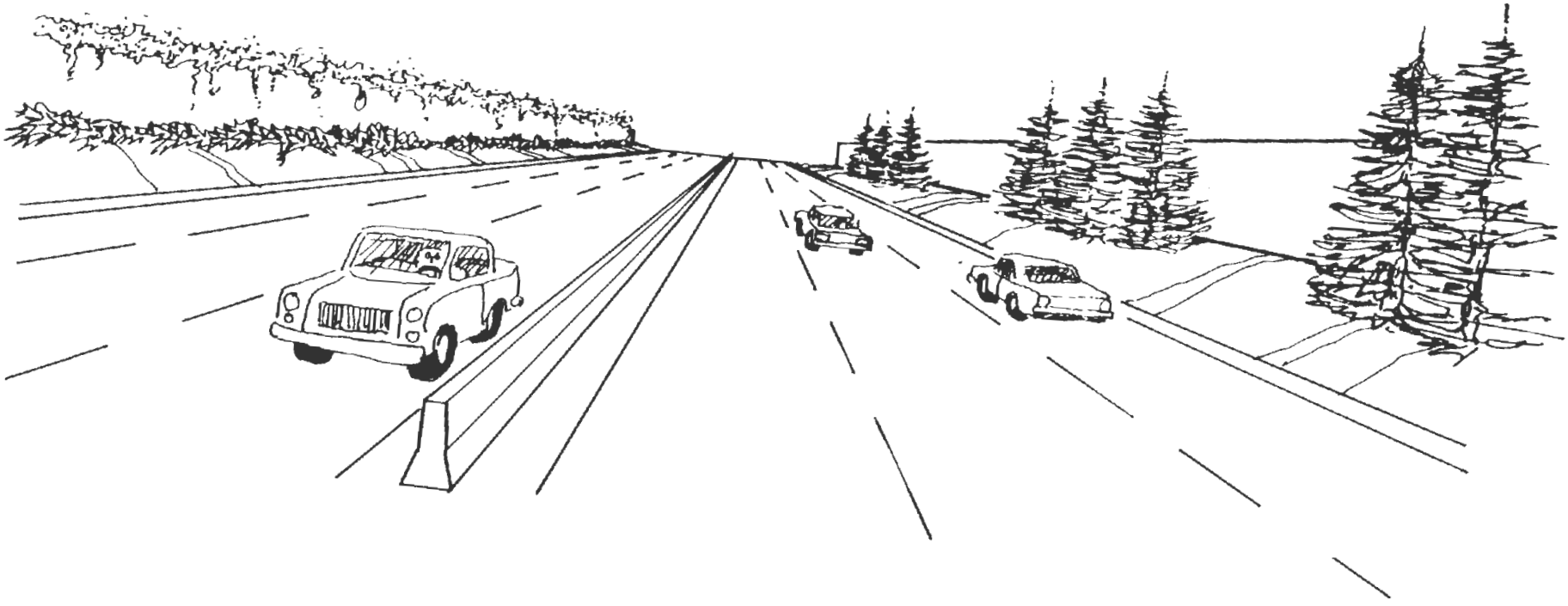


Figure 20: Create Accent

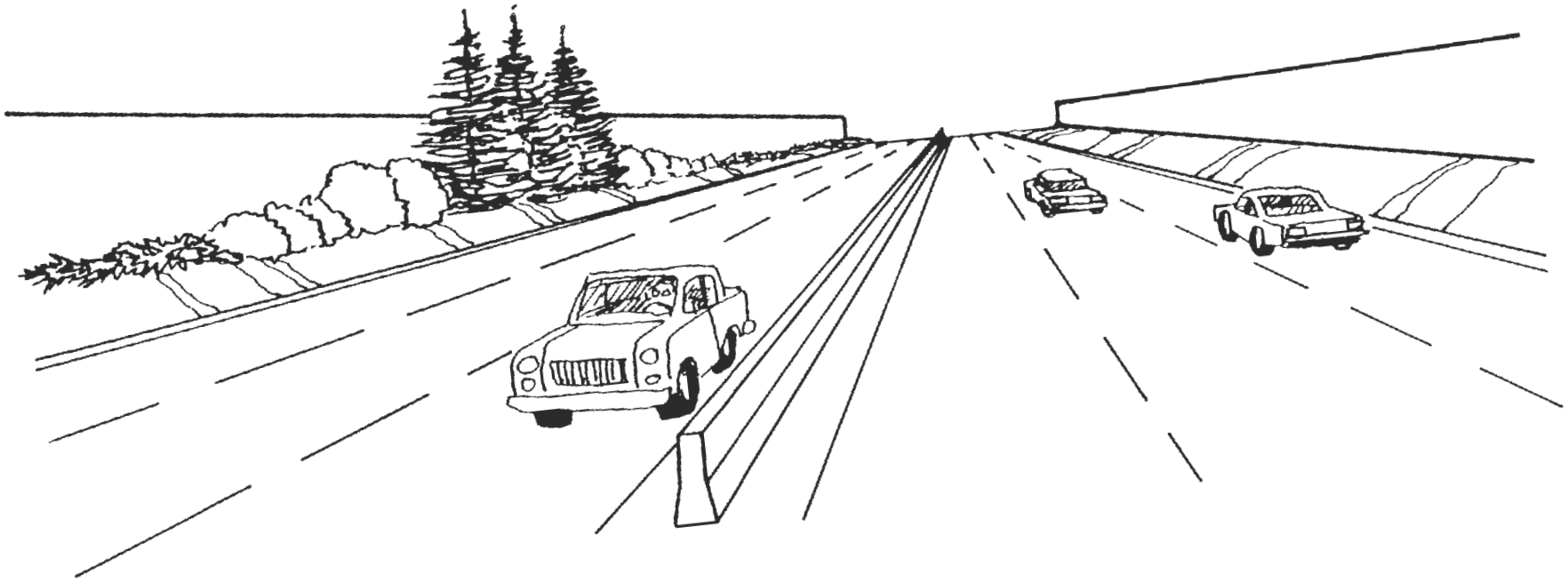
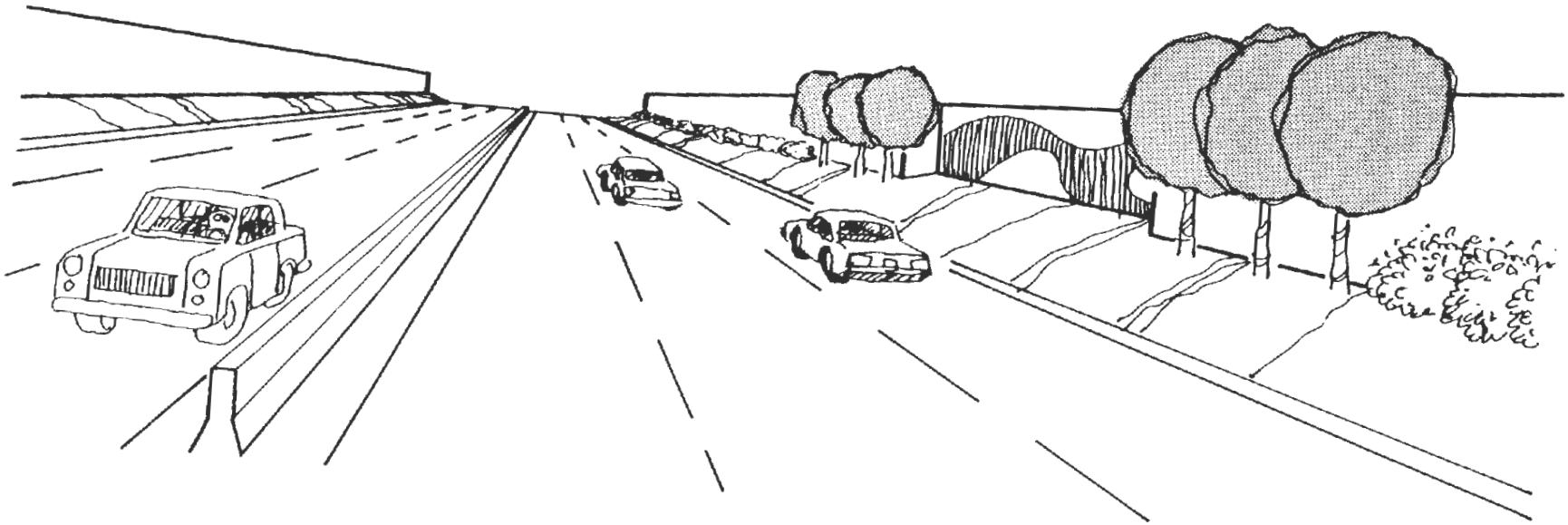


Figure 21: Framing Element



Design Guide:

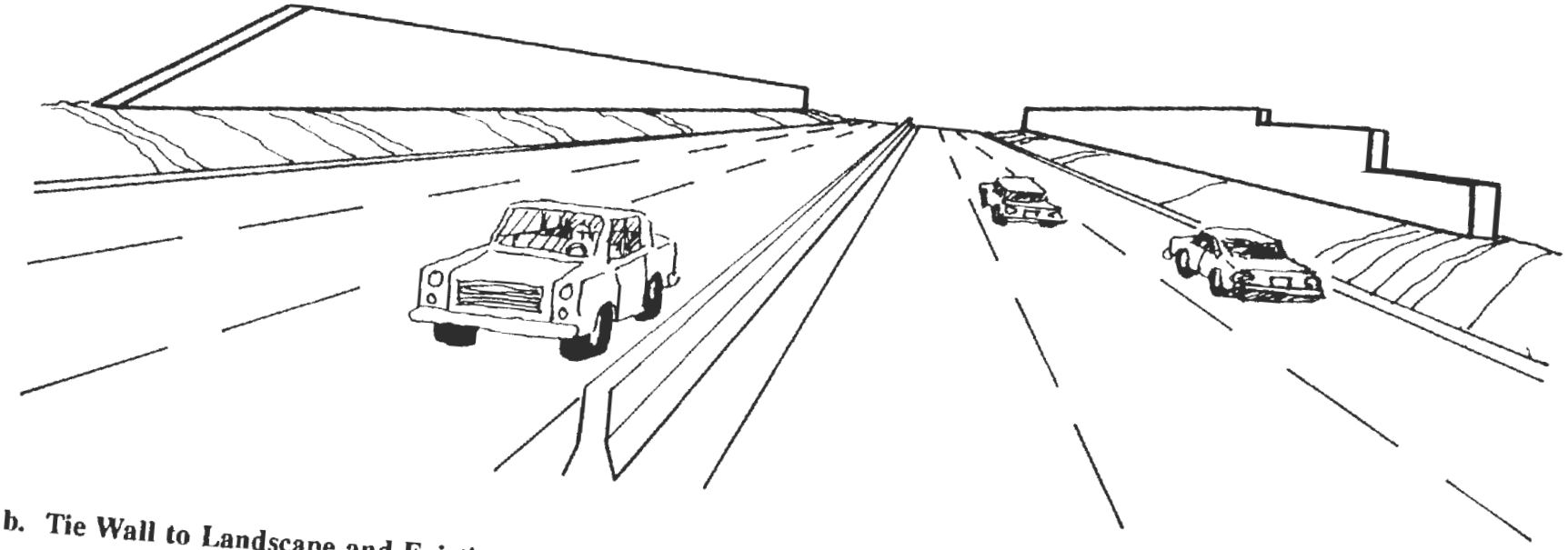
Integration of Wall, Landform, and Plants

A primary goal in designing noise barriers is to integrate them into the landscape. Problems develop when barrier walls are placed on the landscape with little attempt to integrate them with the surrounding landforms or existing built elements such as bridge abutments, endwalls, and guardrails. As a result, barrier walls can appear as obtrusive objects in the environment. Barrier walls can be integrated with the landscape in two basic ways. The structure itself can be designed to appear to "grow" out of the landscape, or the landscape (plants and earth) can become part of the barrier structure.

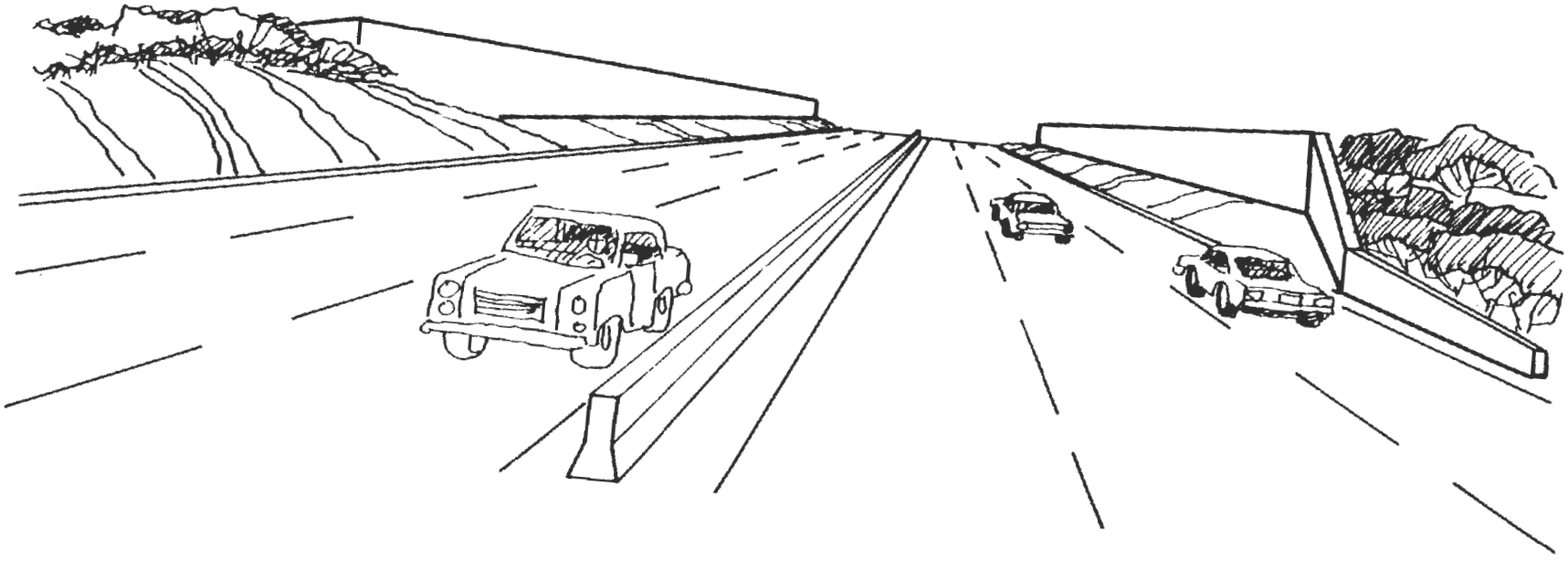
Wall endings can be designed to integrate barriers with the landscape (Figures 22a and 22b). Gradually tapering or stepping them down to the ground level will give the appearance that the wall is literally growing out of the ground. Earth berms and plantings may also be used at wall ends to tie the barrier into the landscape. In situations where existing structures such as bridges and guardrails are present, an attempt should be made to connect the wall end with the structure. This will provide visual continuity between highway structures.

Figure 22: Integration of Wall, Landform, and Plants

a. Wall Endings



b. Tie Wall to Landscape and Existing Highway Structures

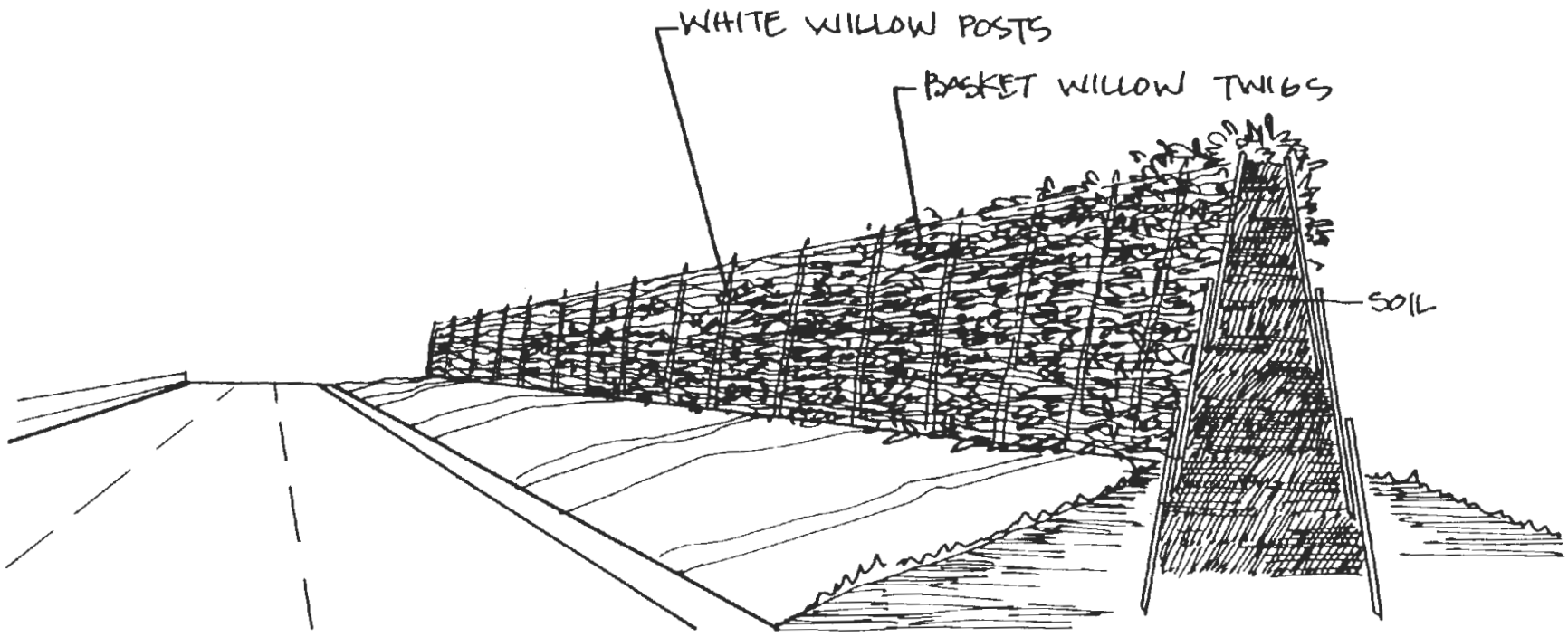


Design Guide: Integration of Wall, Landform, and Plants

Plants and wall structures can be integrated in a variety of ways. The wall itself can be designed using earth and plants as the primary construction materials. Living barriers, which are used in Western Europe, are such an example (Figure 23). These are essentially vertical earth walls which function as the growth medium for willow plants. The earth is contained in a frame constructed of white willow posts interwoven with basket willow twigs. The twigs sprout leaves, covering the structure and giving the appearance of a wall-like hedge. To protect against dry periods, irrigation systems are installed within the wall. Other maintenance is quite minimal, consisting of trimming excessive growth every two years and performing weed and disease control as necessary. In Germany these walls have life expectancies of twenty to thirty years.

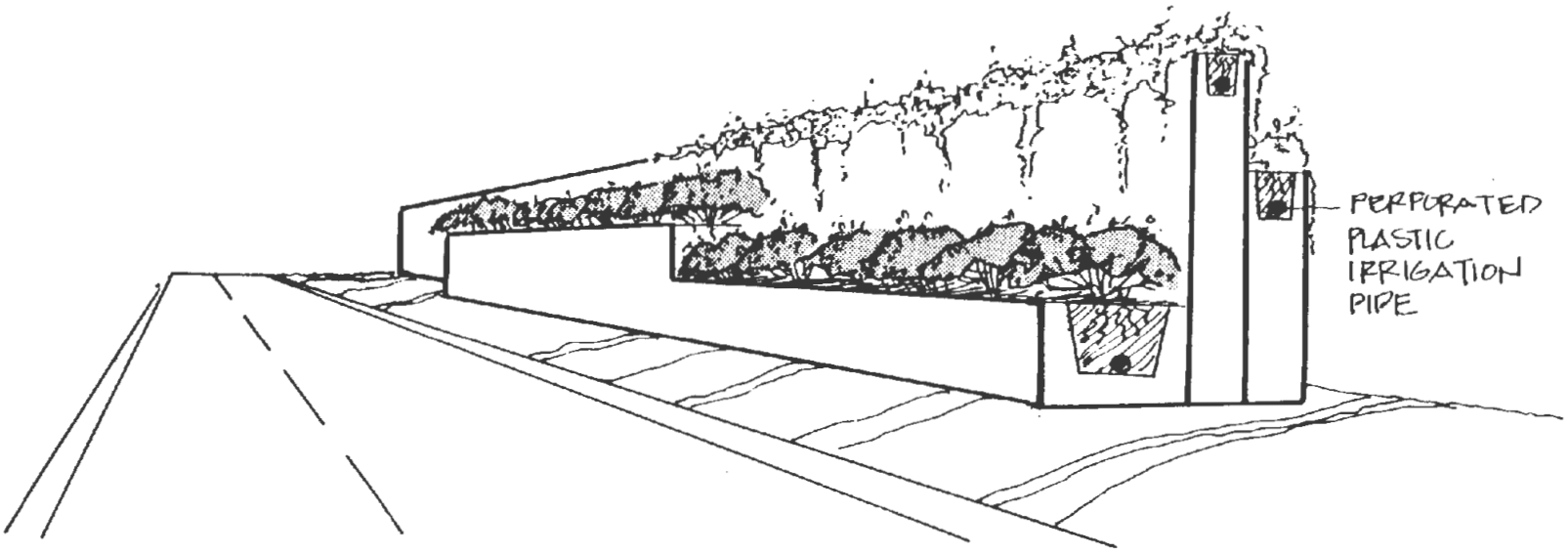
Living barriers provide an attractive alternative to the common barrier constructed of hard materials, both in terms of appearance and maintenance. However, willows are deciduous plants and therefore lose their leaves in the fall. The attractiveness of these walls during the winter months may be a point of concern. In addition, the basket willow does not thrive in Southeastern Wisconsin. Until an acceptable substitute is found, this limitation might make living barriers difficult to implement here. As used in West Germany these barriers are in the range of 12 feet high. It is not known if higher barriers such as would be used in the Milwaukee area can be built and maintained.

Figure 23: Living Barrier



A similar approach would be to design planter troughs into the wall structure (Figure 24). Irrigation systems could be incorporated into the troughs. The level of the planters could be varied to produce a cascading effect. Because of the more elaborate, multilayered design, this type of wall could be expensive. In addition, the types of plants that can grow and survive in planters are limited. Above ground planters are susceptible to freezing temperatures unless they are quite large and adequately insulated. Annuals are commonly used in planters in urban areas and would be appropriate and very attractive in wall planters. However, they must be planted annually and are therefore too maintenance intensive for extensive use. They might, however, be appropriate on a limited basis.

Figure 24: Planting Troughs Nested in the Wall

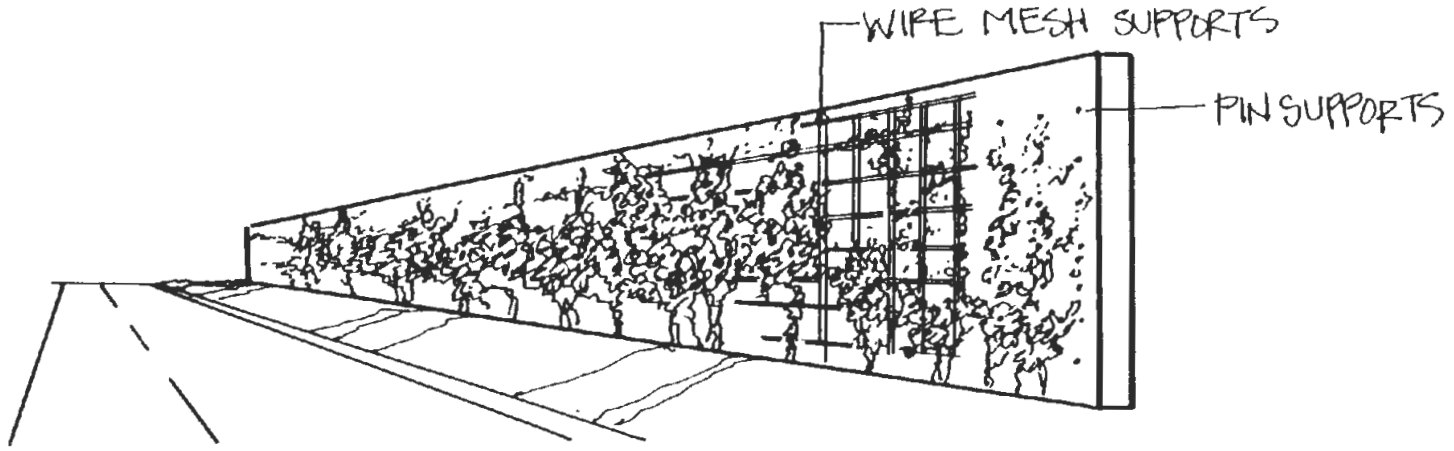


Design Guide: Integration of Wall, Landform, and Plants

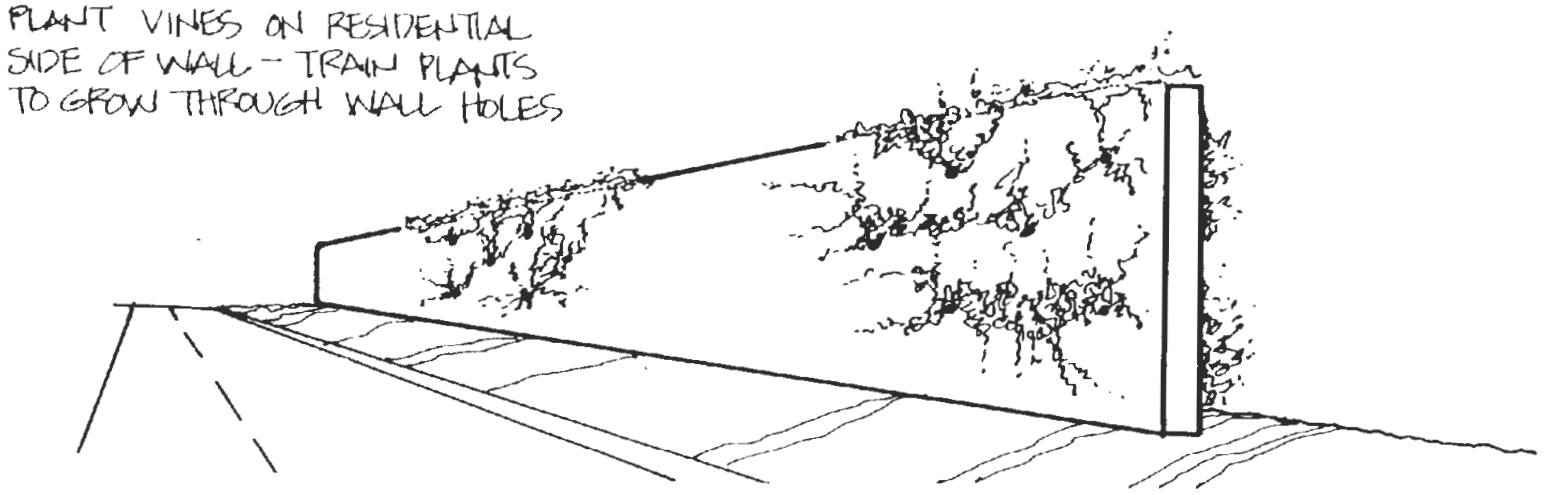
Plants can be integrated with walls by attaching them to the surface or by providing holes through the wall which they can grow through (Figures 25a and 25b). These approaches are especially appropriate in situations where planting space is very limited. Vines are the most appropriate plant type for either of these approaches. Vines can attach themselves to the surface of concrete and wooden wall materials. Wire supports can be used to attach plants to metal surfaces. A system of wires and pins can be attached to the wall surface which vines can use for growth support. Vines planted on the residential side of the noise barrier will eventually cascade over the top. In addition, small holes can be drilled through the wall surface to allow the vines to grow through and spread on the freeway side.

Figure 25: Integrate Wall and Plants

a. Attaching Plants to Walls



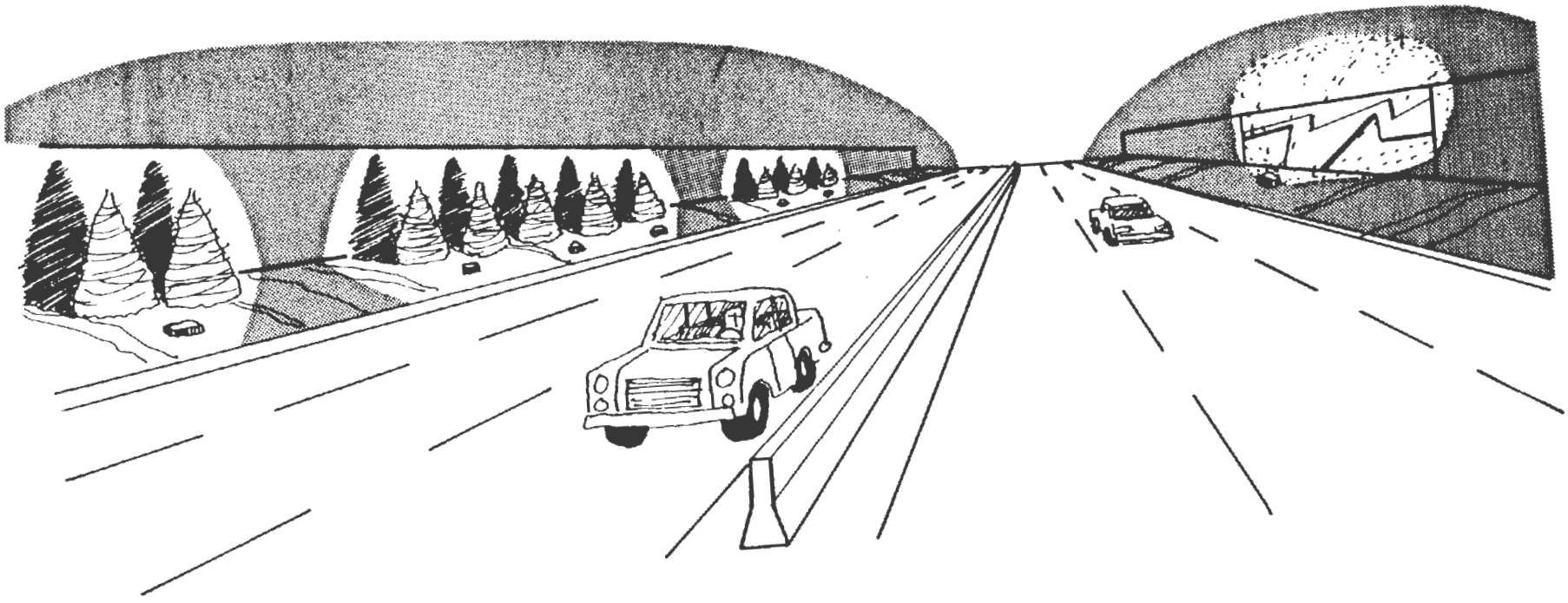
b. Utilize Plants on Opposite Side of Wall



Design Guide: Lighting

Freeway lighting is typically limited to tall overhead fixtures required to light the roadway. Decorative lighting can be used to provide nighttime variety and focal interest (Figure 26). Light fixtures can be placed to cast shadows on the surface of barrier walls. Shadows may be created by plants and/or surface relief on the barrier itself. This may be especially desirable in the winter when landscape color is subdued. Light fixtures can also be attached to the wall itself to provide a "wash" of light over the surface. Segments of barrier walls that have been specifically ornamented may be highlighted with spot lighting.

Figure 26: Lighting to Create Shadow Patterns and Spotlight



Design Guide: Maintenance

Maintenance contributes greatly to the attractiveness of noise barriers and landscaping and is a primary economic concern in the design of barriers and landscaping. This section will discuss the major issues relevant to maintenance and how they can be addressed through design and/or management and maintenance practices.

Maintenance Goals and Objectives

Maintenance begins as soon as the barrier and landscaping are installed and continues throughout their life span. Consequently, it constitutes a substantial ongoing cost expenditure. A major goal of maintenance is to minimize the cost. This is best achieved by using quality materials, appropriate to the given situation, and proper construction techniques which will also increase the life of the wall.

A consistent schedule of maintenance must be followed to ensure that little problems are taken care of before they turn into large and potentially expensive catastrophes. Therefore maintenance capabilities must be considered during the design phase. It is better to use simpler designs that can be adequately maintained than to use more elaborate schemes which demand a disproportionate amount of maintenance to remain attractive and effective.

Maintenance Issues

Material selection is an initial concern to the designer. The chosen material must be durable enough to withstand local environmental conditions. Of the common barrier materials, wood is the least durable material, being more susceptible to weathering damage. However, all materials designed for use in barrier wall construction should be manufactured to be adequately durable. Again, using quality materials, even if the initial cost is higher, will pay off in the long run.

Design Guide: Maintenance

Another concern relative to material selection is vandalism. Vandalism is a major maintenance concern regardless of the construction material used. Vandalism can range from physical destruction to surface defacement. The best way to deal with vandalism is to minimize the opportunities for its occurrence. Noise barriers present a blank canvas for "graffiti artists". Using plants, particularly vines, to obscure the wall surface reduces the potential canvas area. Rough surface textures can also be effective in discouraging the defacement of barrier walls with spray paint or other surface applied substances since the texture obscures legibility of the graffiti. Physical destruction can be held in check by minimizing access to the wall. Prickly plants can be used as armor to dissuade potential vandals from getting too close to the wall.

On the other hand, access to walls is necessary for maintenance purposes. Likewise, access must be provided for landscape maintenance. Typically access is gained on the side of the wall that will receive maintenance (freeway or residential). While some barriers are designed with maintenance doors, this is discouraged because of the potential for persons other than maintenance personnel to use them.

Identify Actors and Duties

Wisconsin state statutes indicate that maintenance within the freeway corridor is the responsibility of the state (WDOT). The state can contract with counties or municipalities to provide maintenance activities. The Milwaukee County Department of Public Works currently maintains all of the freeway corridors within its jurisdiction. Specific maintenance tasks are delegated to the County by WDOT area maintenance supervisors. Roadside maintenance generally includes care and protection of trees and other vegetation, and planting to prevent or minimize soil erosion.

Design Guide: Economic Considerations

Retrofitting urban freeway corridors with noise barriers is an expensive endeavor. For example, costs can be over $2 million per mile for a single side of a freeway. The state may use federal funds to cover the cost of barrier construction. Noise barrier projects compete for available funds with other projects such as bridge replacement, freeway modernization, safety improvements, resurfacing and capacity improvement projects.

Several factors affect the cost of barriers and landscaping. Materials are probably the most fundamental cost factor. Type of material used affects cost as does the quantity of material used. Experience in Milwaukee County thus far has shown that metal barriers have been the least expensive. Wood barrier use has had a unit cost about 50% higher than metal while concrete has had a cost 65% higher than metal (Appendix A). The elaborateness of the design has a direct bearing on the quantity of materials used. Barrier designs with undulating configurations require more materials and therefore will cost more. Landscaping will add cost to a barrier system, but it is not as critical as the selection of a material. A limited landscaping may add 5% to the cost, an average landscaping 8 to 10%, while an elaborate system could add 15 to 20% (Appendix C). Actual costs will depend upon the extent of work, site conditions, and maintenance considerations.

Design trade-offs are inevitable. Priorities will vary from location to location. Decisions must be made as to how much should be spent on the barrier versus the landscape treatment. An elaborate landscaping scheme coupled with a lower cost barrier material may be cheaper than using simple landscaping with more expensive material. Such tradeoffs should be made clear to local citizens and elected officials so they can select the option which best fits with their community. In some contexts dense landscaping may be required to blend the barrier with its environment. In such a situation, a simple barrier could be used, retaining more of the funding allotment for landscaping. In other, especially more urban locations, the form of the wall may be the most important design feature, with a simpler landscape scheme used to accentuate the wall form. For more complete cost comparison information refer to Appendix A and Appendix C.

Design Prototypes: Inventory and Analysis

The first step in the development of prototype designs identifies the opportunities and constraints presented in the community by physical and cultural features. The purpose of the inventory and analysis was to 1) identify regional patterns and features that could potentially impact the visual quality of noise barriers and the freeway corridor; 2) to identify unique cultural, historical or natural features which could be used to set a theme for the design of a noise barrier/landscaping system, and 3) to identify prototypical situations relative to the location and function of noise barriers.

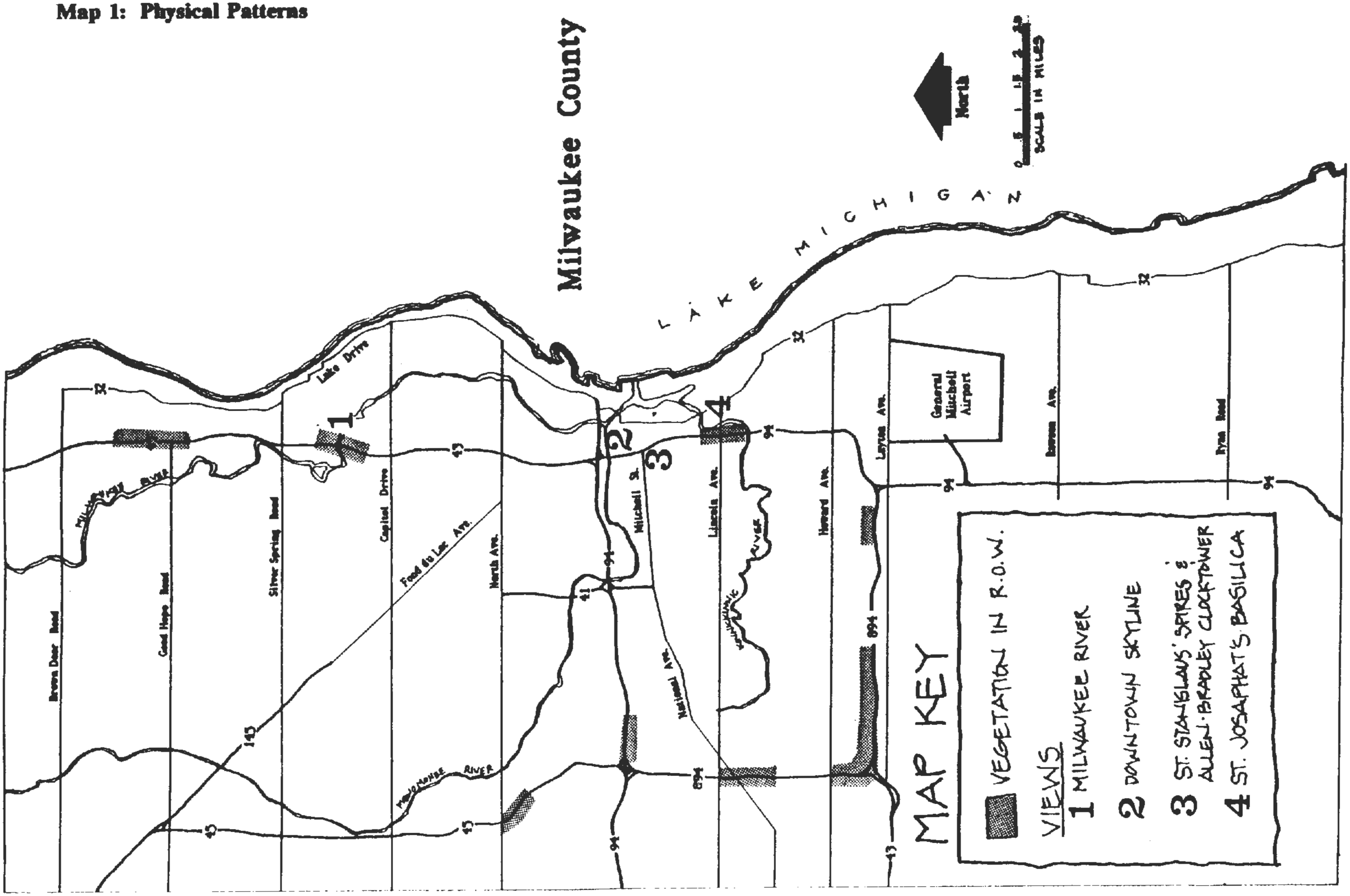
Both research and a windshield visual analysis (video) were conducted to gather information on the following patterns and features on a county-wide scale:

i. Physical (e.g.) topography; vegetation; unique features; and views
ii. Cultural (e.g.) ethnic enclaves; landmarks; former uses ("ghosts")
iii. Land use (e.g.) urban; suburban; rural

Physical Patterns

Analysis was limited to those locations with existing noise barriers and those identified as candidate barrier locations. The most prominent physical features were the existence of mature vegetation in some locations and the visually dominant presence of power lines. Map 1 identifies specific locations along the freeway system where existing vegetation provides a significant asset. In many of those areas the vegetation is within the existing right-of-way (R.O.W.) or near the R.O.W. fence line. A decision must be made as to where (residential or freeway side) a line should be cleared for construction access. While the most appropriate approach will vary by location, a high priority should be given to preserving and utilizing as much of the existing mature vegetation as possible.

Map 1: Physical Patterns



Design Prototypes: Inventory and Analysis

Significant Views

Three locations were identified where future noise barriers could provide visual obstruction of desirable views. These are identified on Map 1 and include:

1) The Milwaukee River at the intersection with Hampton Avenue -- while the current elevation of the freeway bridge spanning the river precludes expansive views, further minimization of this view opportunity should be avoided.

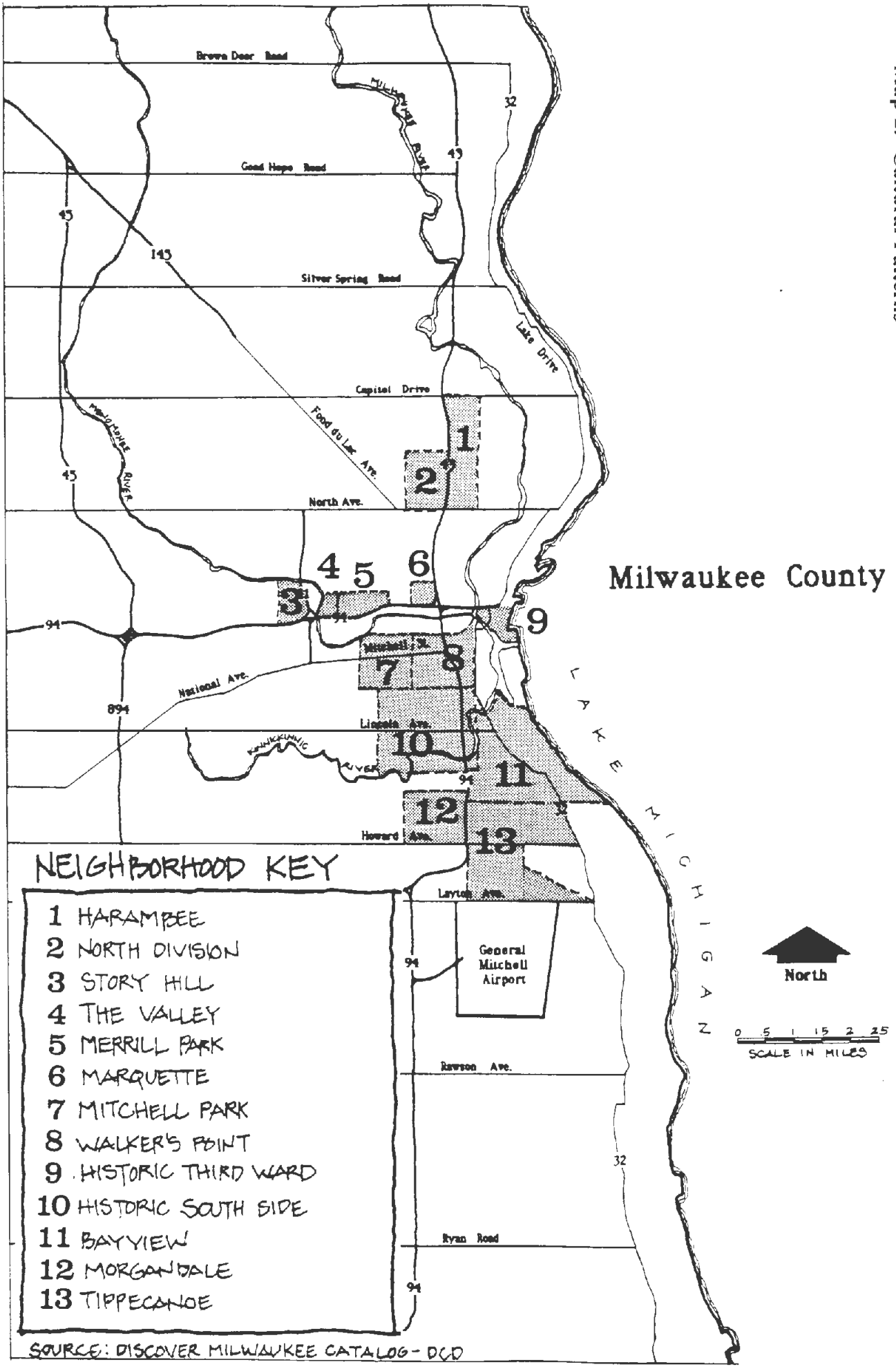
2) The "gate" to the city from the south created by the twin spires of St. Stanislaus Church on the west side of I-94 and the Allen-Bradley clock tower on the east side of I-94. Both of these structures are visual landmarks. Driving north, they provide a gateway to the downtown. Driving south, they mark the transition between the industrial heart of Milwaukee and its traditional neighborhoods.

3) The visually prominent dome of St. Josaphat Basilica. The scale and elegant design of this structure signify its importance as a cultural symbol and landmark.

4) The Milwaukee downtown area is a prominent feature when approached from all directions. The view is especially dramatic from the south on the highrise bridge over the Menomonee Valley.

Cultural Patterns

Cultural patterns and features refer to the location of traditional ethnic neighborhoods along the freeway corridor. This information can be used to extract location specific design characteristics which could be incorporated into the barrier design. One of the objectives of this study is to provide ideas on how to design noise barriers that better reflect the character of the neighborhoods in which they are located. Urban freeways occupy space formerly used for other uses, many of which contributed to the growth and livelihood of the city itself. Remnants of these earlier uses sometimes exist in areas adjacent to freeways.



Map 2: Cultural Patterns

Design Prototypes: Inventory and Analysis

Reflecting these in the design character of noise barriers provides both contextual and historical continuity in the physical environment. Map 2 identifies the historic neighborhoods located along the freeway system. Appendix A provides brief descriptions of each neighborhood and provides insight into significant design qualities which could be incorporated into noise barrier design.

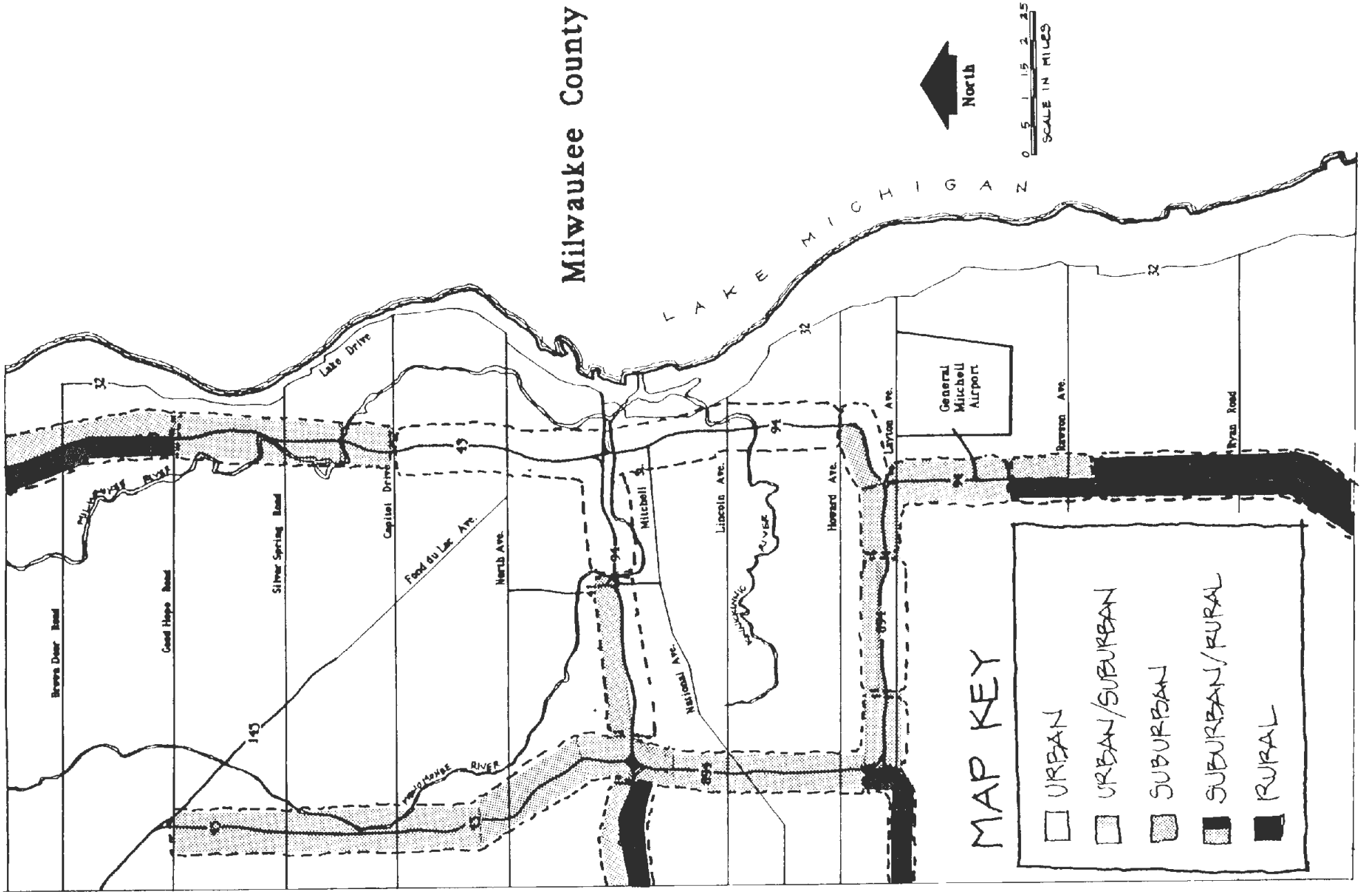
Land Use Patterns

The analysis also revealed patterns of use distinguished by adjacent development as viewed from the roadway. The density and age of development contribute significantly to the character of specific locations. Three general types of residential development were identified as a means to better define an area's character. Map 3 separates the county into zones based on the dominance of particular types of residential development as viewed from the roadway. Three distinct types of development could be observed along with areas that represent transitions between different types.

"Urban" character refers to older residential areas of the city. The freeway cuts through these established neighborhoods resulting in dense residential development immediately adjacent to the corridor. The design character of these areas is associated with man-made geometric forms, hard edges, hard surfaces, vertical lines, and contrast in forms. An appropriate barrier could be constructed of hard materials, using geometric configurations, with a varied top profile and vertical orientation. Plants are used to provide architectural enhancement, shadow patterns, accents, bold forms, and visual contrast.

"Suburban" character refers to areas of lower density and newer housing. The design character is associated with a mixture of geometric, man-made forms, horizontal lines, and amorphic, naturalistic forms. Older suburbs have a more dense, urban character while newer suburbs have retained wooded areas and lower density developments. An appropriate barrier could be constructed of a mix of materials from concrete to wood, using a mix of geometric and curvilinear configurations with a varied top profile. Plants are used primarily to blend, soften and reduce the scale of the wall.

Map 3: Typical Land Use Pattern as Viewed from Roadway.



Design Prototypes: Inventory and Analysis

"Rural" character refers to areas which appear to be undeveloped open space and/or low densities when viewed from the highway. It is unlikely that areas exhibiting actual rural character will be potential candidates for noise barriers. However, some suburban areas, notably Oak Creek and Brookfield, have maintained pockets of "rural" areas. The design character is associated with soft, flowing forms. An appropriate barrier could be constructed of natural materials (wood, stone), using curvilinear configurations and a definite horizontal emphasis. Plants are used to blend the wall with the landscape. Naturalistic planting designs using informal layouts, indigenous plants and muted color schemes would be most appropriate. Table 2 summarizes the relationship between the land use type and design considerations.

Design Prototypes: Inventory and Analysis

TABLE 2			
RELATIONSHIP OF LAND USE TYPE TO DESIGN CONSIDERATIONS			
	Urban	Suburban	Rural
Orientation	vertical	horizontal	horizontal
Lines	angular	mixed	curvilinear
Balance	symmetry	mixed	asymmetrical
Rhythm	regular	mixed	irregular

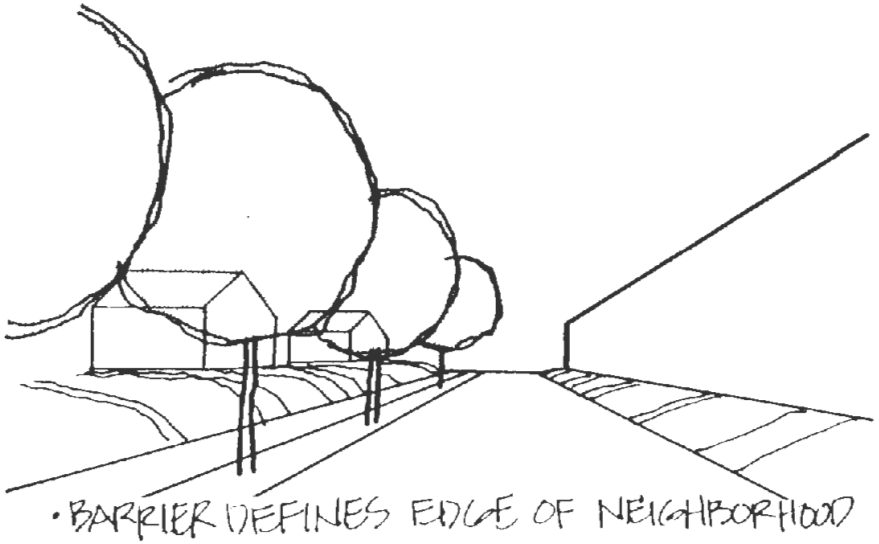
Design Prototypes: Neighborhood Side of Barriers

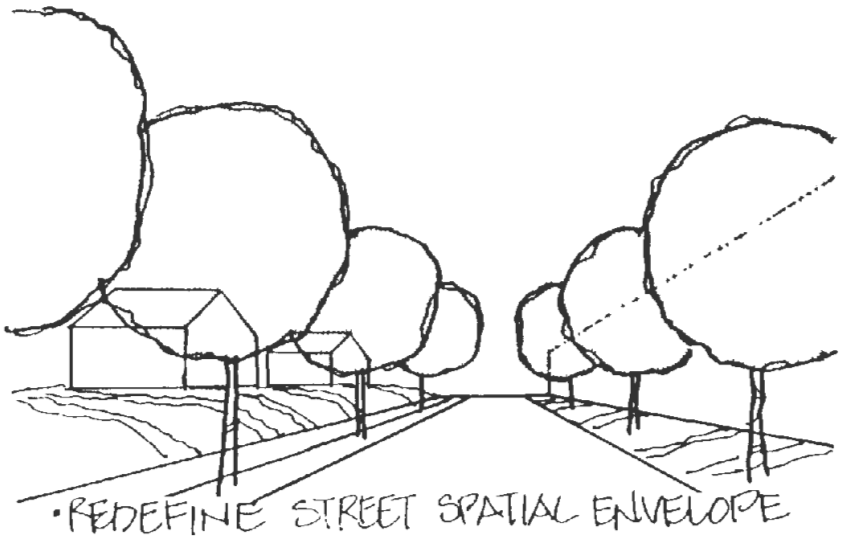
This section identifies common situations that are created where noise barriers are installed. Ideally, noise barriers should be designed to respond to their specific contexts. As such, the issues of how noise barriers impact both residential neighborhoods and the freeway corridor environment must be given consideration early in the design process. The following examples represent common situations relative to barrier locations. These examples are intended to provide insight into how barriers could be designed to respond to specific locations.

The impact of noise barriers in residential neighborhoods is directly related to their location within the neighborhood. Barriers may be located across the street from residences, at the end of perpendicular local streets, immediately adjacent to private backyards, or next to "left-over" right-of-way.

In situations where barriers are located across the street from residential development, the barrier becomes the edge of the neighborhood. The primary objective should be to retain the traditional scale and character of a residential street (Figure 27). A traditional residential street is commonly characterized by trees lining both sides of the street. The tree canopies create a spatial "envelope" that becomes part of the neighborhood. When a barrier is erected, it often replaces the traditional elements (street trees and houses) that made up one side of the spatial envelope. The barrier becomes the physical edge of the neighborhood, but does not appear as part of the neighborhood because the residential scale of the street edge is lost. Planting street trees along the barrier is a simple way to recreate the spatial envelope of the street and redefine the street as a spatial part of the neighborhood.

Figure 27: Barrier Across Street





Design Prototypes: Neighborhood Side of Barriers

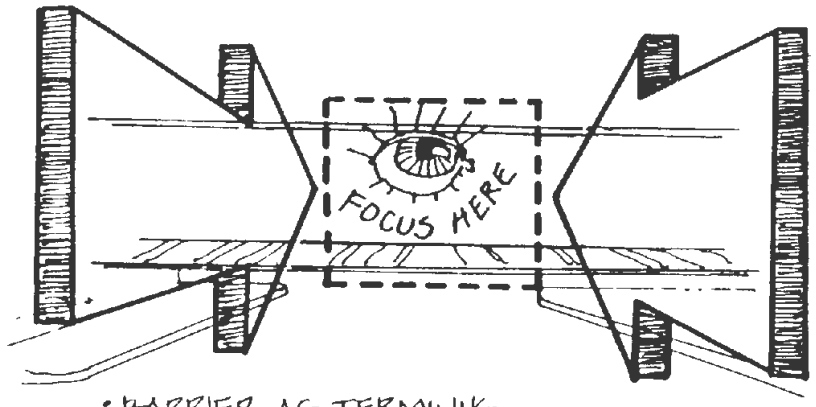
In many neighborhoods, existing local streets are terminated by freeways. In these situations, the opportunity exists to make the noise barriers a focal point (Figure 28). This could be achieved in several ways including: 1) using the barrier as a backdrop for outdoor sculpture; 2) installing special ornamental plantings in the focal area; and 3) using the barrier as a canvas for wall graphics which provide directional cues and/or neighborhood identity.

Barriers may also be located immediately adjacent to the backyards of private residences. In some older neighborhoods, where lot sizes are relatively small, barriers are located quite close to the houses. In essence, the barrier becomes the backyard fence. However, because of its height and opacity it appears overpowering and out of scale. In some situations residents have tried to personalize the barrier walls, attaching miscellaneous ornaments to them (e.g. butterflies, flower pots, and flags) (Figure 29).

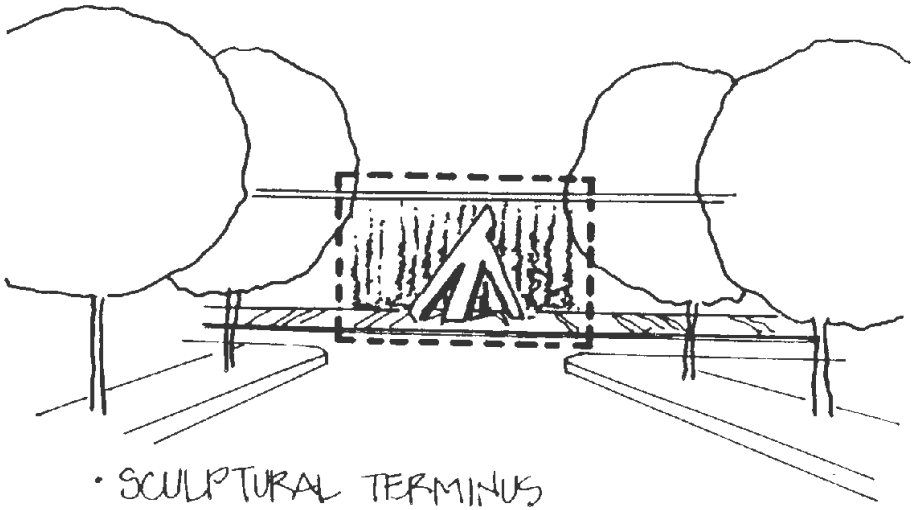
Planting a hedge of medium to tall shrubs and/or trees along the barrier wall would give it a more residential scale and also discourage people from vandalizing or attaching personal ornaments to the wall. Where possible, the barrier should be located to allow a minimum five foot wide planting strip along the wall within the right-of-way. Where space is extremely limited an arrangement might be negotiated with the abutting residents such that WDOT would provide landscaping on the residents' property, which the residents agree to maintain.

In some areas the alignment of the freeway corridor, as it cut through existing neighborhoods, resulted in the creation of "left-over" parcels of land too small to be used for residential lots. In these situations the opportunity exists to create small, neighborhood "vest-pocket" parks (Figure 30). These might provide amenities such as sitting benches, picnic tables, flower gardens and children's play equipment. However, in creating an unofficial "park" for use by persons other than the property owners, two key issues must be addressed and resolved. First, questions of liability, in case someone were injured while using the "park," would have to be formally worked out with the municipalities, park system, or neighborhood; and secondly, maintenance responsibilities would have to be defined.

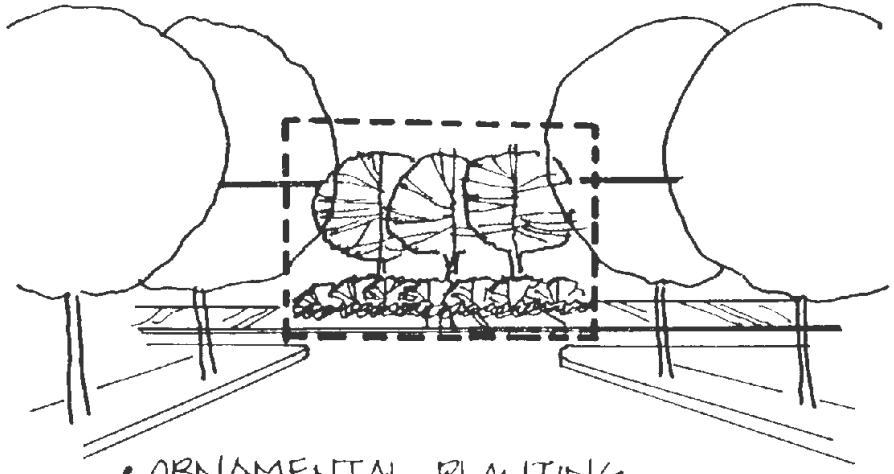
Figure 28: Barrier at End of Street



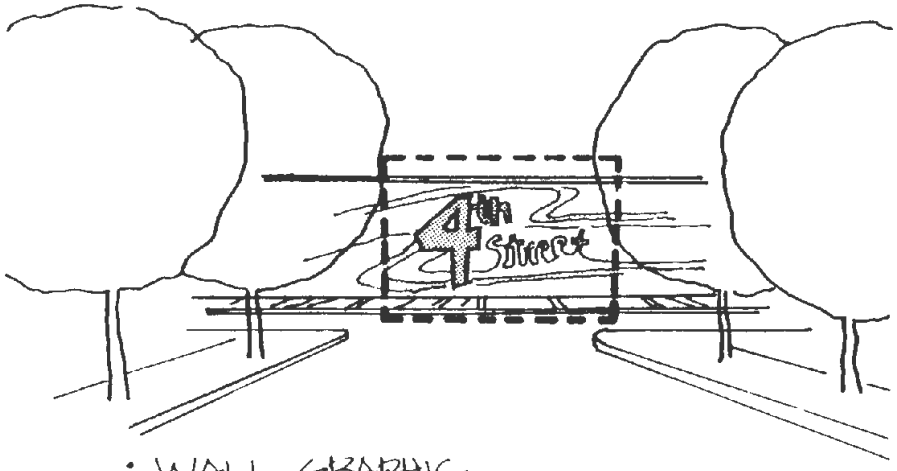
• BARRIER AS TERMINUS



• SCULPTURAL TERMINUS



• ORNAMENTAL PLANTING



• WALL GRAPHIC

Figure 29: Barrier in Background

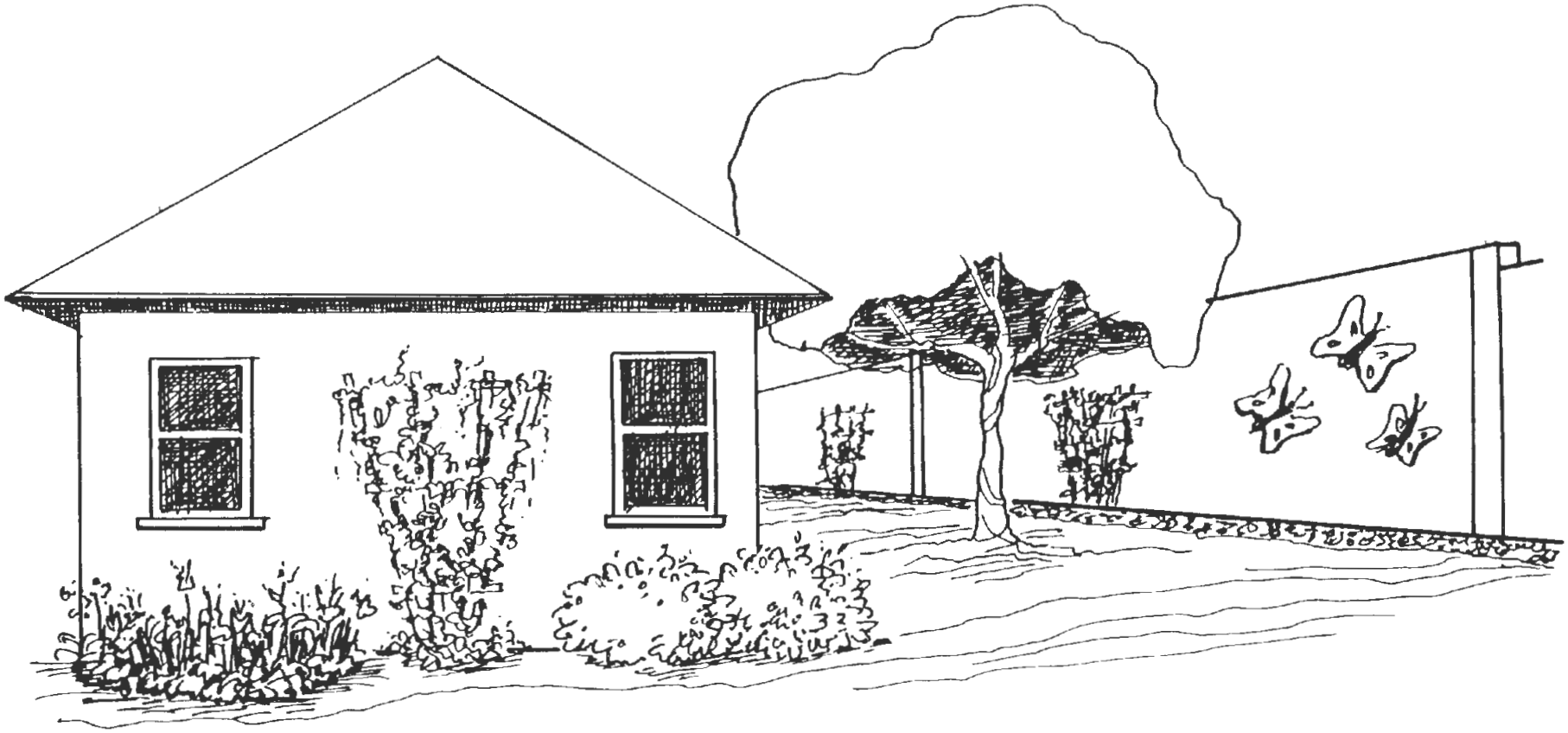
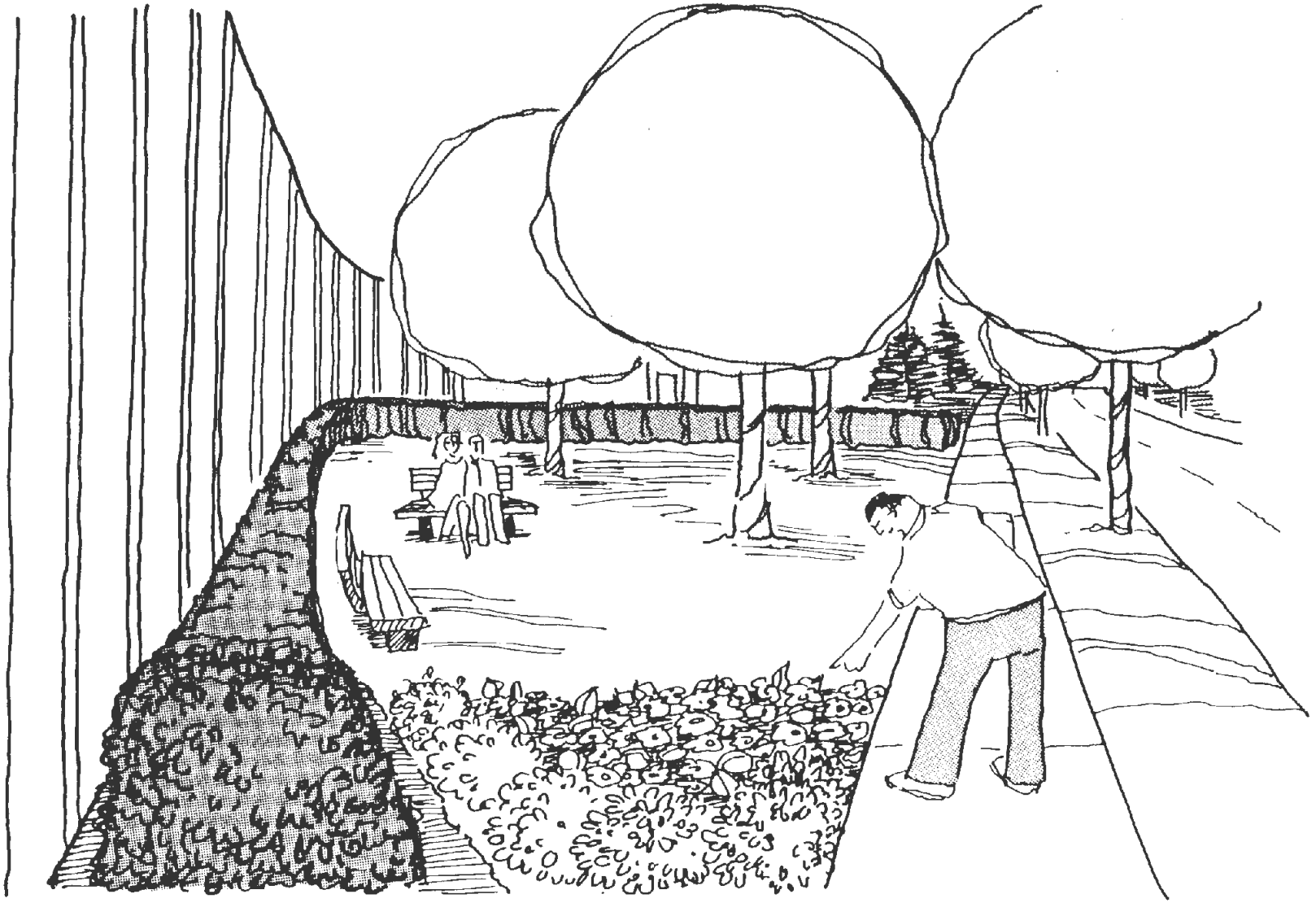


Figure 30: "Leftover" Right-of-Way

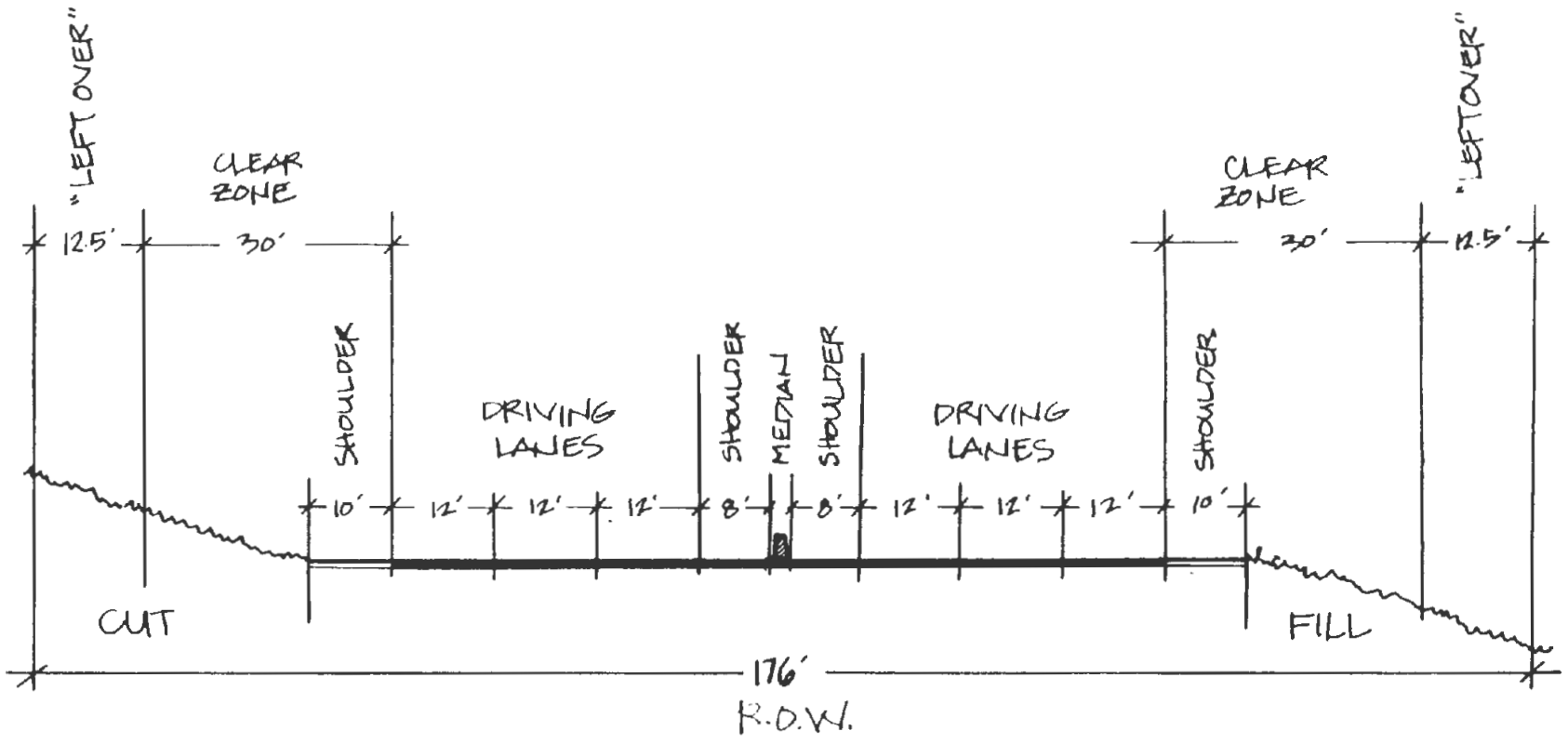


Design Prototypes: Freeway Side of Barriers

The installation of noise barriers along urban freeway corridors can significantly affect the driver's experience and the image of the city. If insensitively designed, noise barriers can result in freeway corridors that are both monotonous and anonymous. Design objectives should include: reducing monotony and improving corridor aesthetics; reducing the tunnel effect created by long expanses of identical barrier walls; and capitalizing on opportunities to develop a sense of place within the corridor.

How these objectives are accomplished depends, to some degree, on the physical constraints posed by the highway situation -- whether it is located on fill, at grade, or in a cut situation. The typical urban freeway corridor occupies a 176' wide right-of-way, as a minimum. This typically accommodates six 12' traffic lanes, a 3' center median flanked by two 8' inside shoulders, two 10' outside shoulders, and 20 to 35 feet of open space on either side of the roadway (Figure 31).

Figure 31: Typical Urban Freeway Cross-section



*NOTE: DRAWING NTS

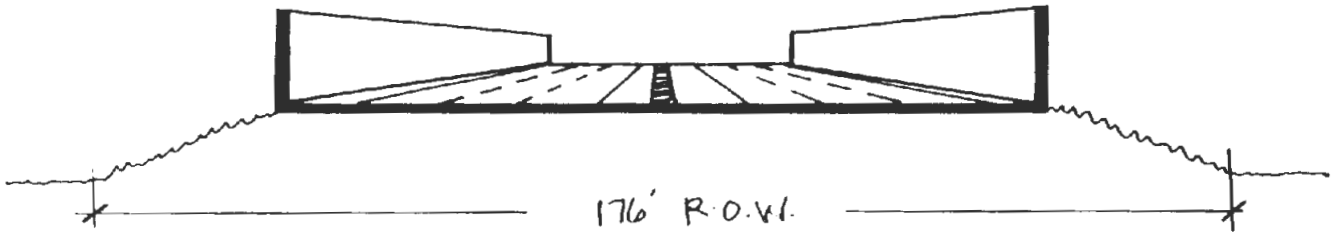
Design Prototypes: Freeway Side of Barriers

Barriers are located where they will provide maximum noise reduction. Specific barrier locations, relative to the travelled roadway, vary according to the highway situation (Figure 32). In fill situations the barrier is most effective at the edge of the outside shoulder -- as close to the noise source (traffic lanes) as possible. This is also true where the highway is at grade. Where the highway is in cut the barrier is most effective at the top of the cut slope. Obviously, design constraints are most severe in fill situations which offer very limited space for landscaping and/or varying the horizontal configuration of the barrier wall.

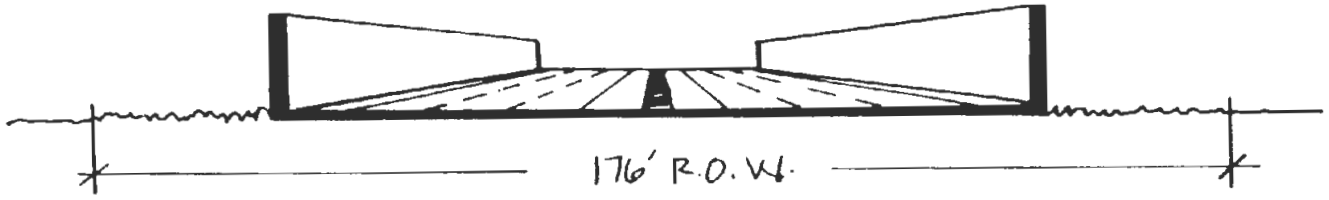
Clear zone requirements present another constraint affecting what can be done within the right-of-way. For safety purposes, areas free of obstacles are required next to highways to accommodate errant vehicles. The design speed and traffic volume on urban freeways typically requires that a clear zone of at least 30' be maintained from the edge of the outside traffic lane. In cut situations the distance may be reduced to 16'-20' because the rising back slope functions to slow down and contain errant vehicles. On the other hand, sections of roadway that are identified as "accident prone" may require more space or additional protection devices. While existing stationary objects within the clear zone are left intact if they are protected by barriers or have a break away design, installation of new fixed obstacles within the clear zone is not permitted unless protected. In some situations, low barriers may be located next to the shoulder to contain or redirect errant vehicles.

Figure 32: Roadway Situation and Barrier Location

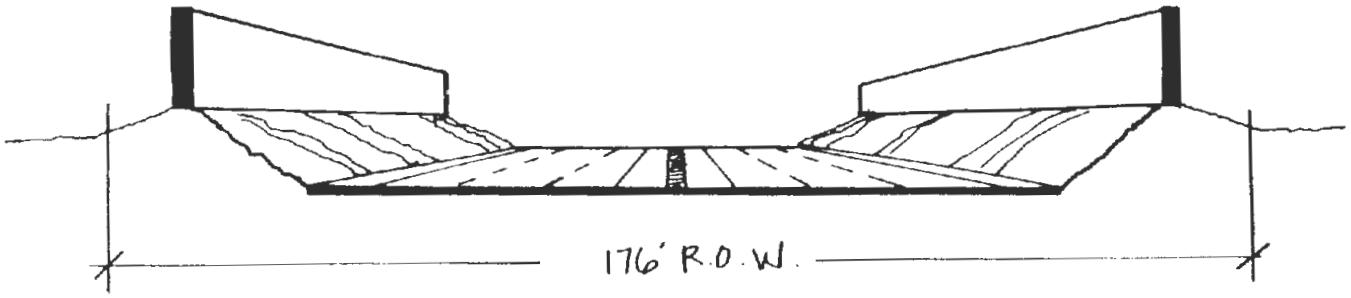
• FILL



• AT GRADE



• CUT



Design Prototypes: Freeway Side of Barriers

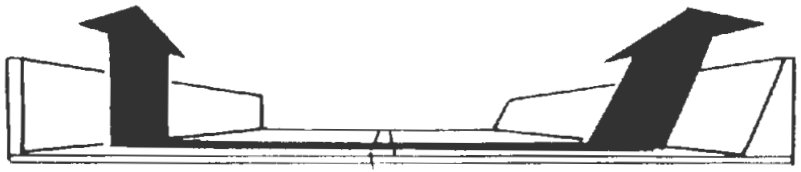
Important design objectives for barriers are to reduce monotony, reduce the tunnel effect, and to increase aesthetics. It should be noted that actions taken to accommodate one objective may also positively affect another. For example, Figure 33a illustrates several ideas for reducing the tunnel effect by reducing the visual height of the barrier walls. In situations where landscaping is unpractical, variety can be achieved in the barrier design itself. Tilting the wall away from the roadway; changing the wall surface (color, texture, pattern); and stepping the wall back from the roadway can all be used to create variety. These same design ideas may reduce monotony by providing variety.

Figure 33b illustrates several ways landscaping can be used to soften the barrier wall, making it more attractive. These techniques also function to reduce both monotony and the tunnel effect. In situations where space is extremely limited for landscaping, the opportunity might exist to utilize landscaping on the opposite side of the barrier wall to soften the freeway side.

Figure 33: Tunnel Effect and Monotony

a. Reduce visual height of wall

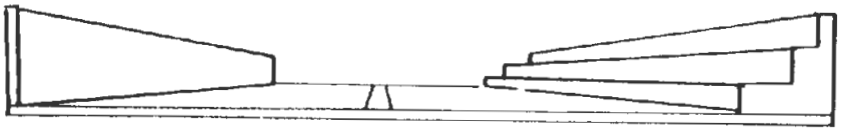
1. SPACE LIMITED



2. SPACE LIMITED

• CHANGE MATERIALS & COLOR
- USE LIGHTER COLOR ON TOP

3. NO SPACE LIMITATION



• STEP WALL BACK FROM ROADWAY

b. Soften wall

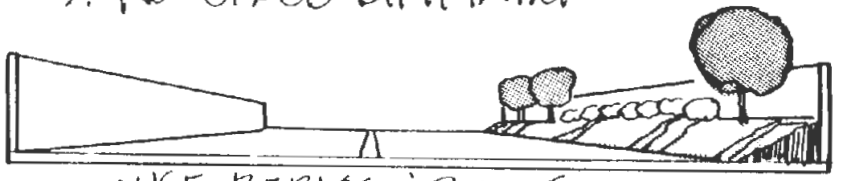
1. NO SPACE

• PLANT ON RESIDENTIAL SIDE

2. SPACE LIMITED

• USE VINES

3. NO SPACE LIMITATION

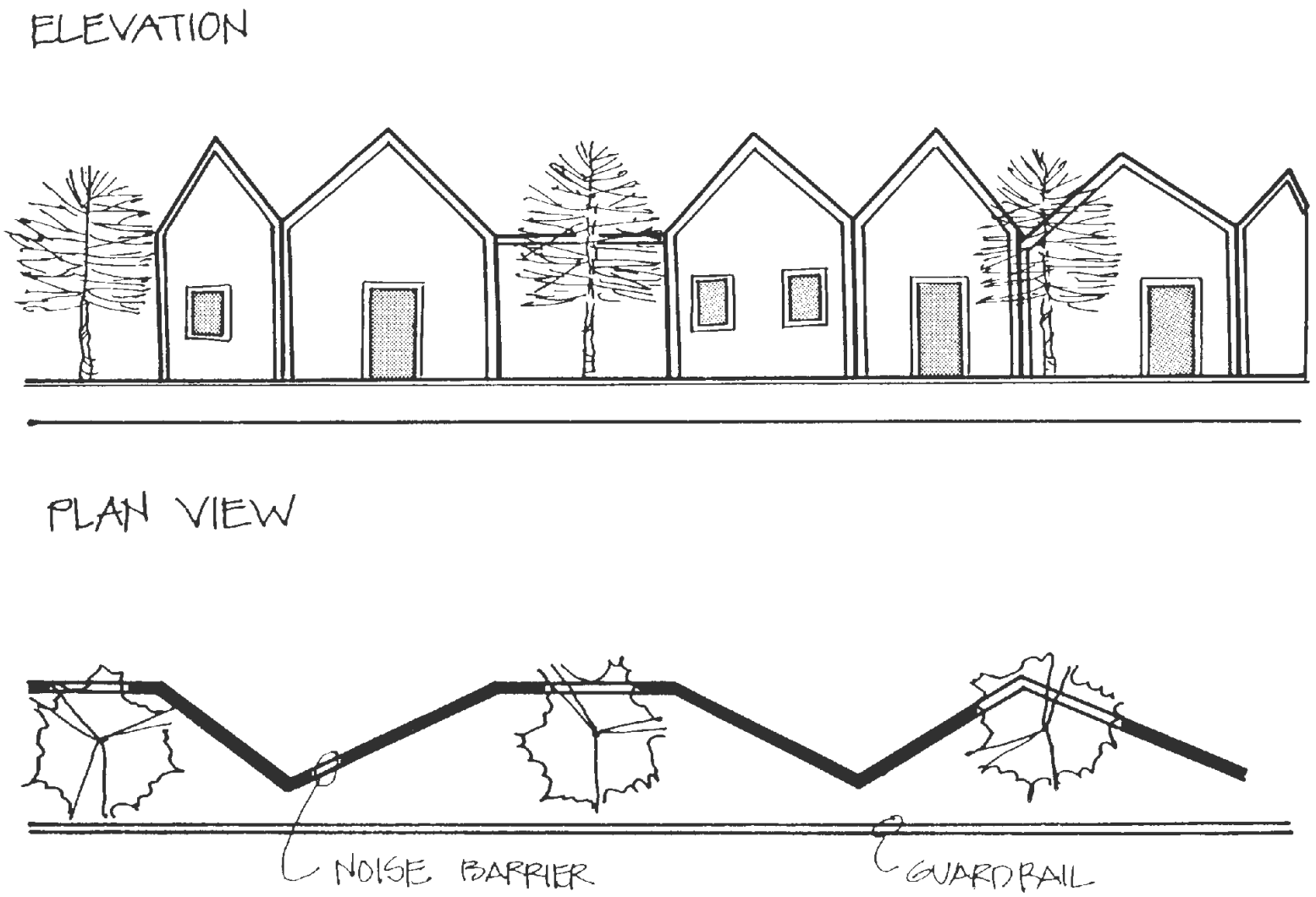


• USE BERMS & PLANTS

Design Prototypes: Freeway Side of Barriers

Designing noise barriers to create a sense of place can be achieved in several ways. The inventory and analysis completed provide information relative to the physical, cultural, and use patterns present throughout Milwaukee County. This information can be used to extract location specific characteristics that can be incorporated into the barrier design. For example, a barrier in a low density suburban area may be designed to look like a residential fence, while a barrier in a dense, urban area may be designed to reflect the residential skyline (Figure 34). Similarly, some areas may have distinguishing historical characteristics that could be incorporated into the barrier design to serve as locational cues.

Figure 34: Urban Rowhouse Motif

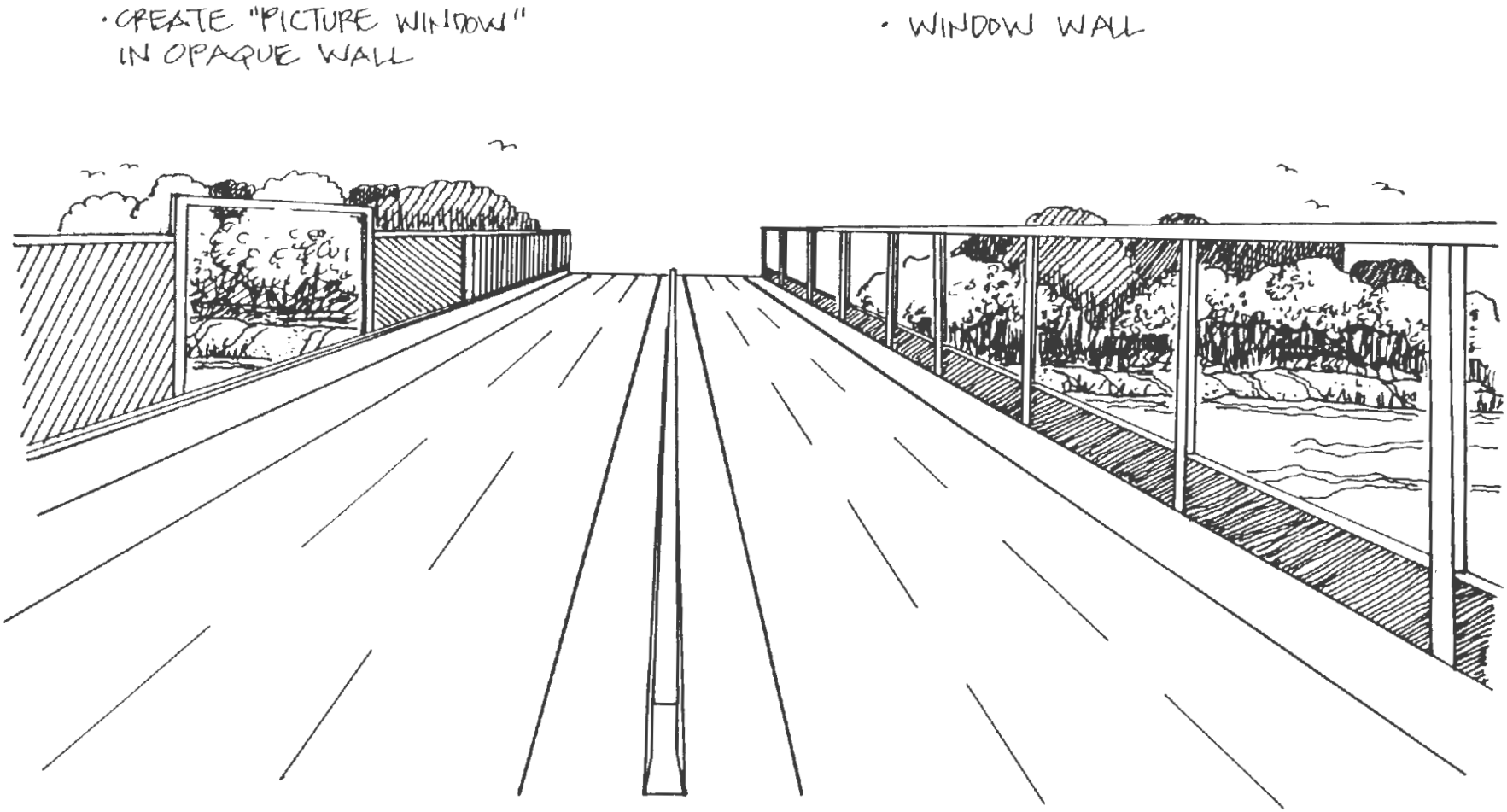


Design Prototypes: Freeway Side of Barriers

Barriers may also be designed in a more literal sense to provide directional and locational cues. Barriers along entry/exit ramps could be designed as gateways to neighborhoods, incorporating location specific forms and symbols. In select areas the wall itself might become a graphic. However, controlling this usage could pose a problem and result in walls becoming billboards. Transparent materials could be used to create windows in walls (Figure 35). Strategically placed, such windows could function as locational cues. In addition, windows could be placed to ensure preservation of significant views (see Map 1). Using clear materials has some disadvantages. The material tends to scratch and get cloudy requiring more frequent replacement. In addition, birds and other flying creatures may be prone to fly into clear panels. However, installing decals of prey birds may reduce this problem.

To assist noise barrier designers in the early stages of the design process, a site inventory analysis checklist was developed (Appendix E). The checklist is intended to be used as a tool to encourage thorough and comprehensive site inventories and analyses. While all of the items listed may not be pertinent to all barrier candidate locations, designers are advised to take them into consideration and develop as many design alternatives as possible. What information may at first appear insignificant could actually contribute significantly to the final design.

Figure 35: Use of Transparent Materials to Create Windows



Design Concept Alternatives:

Prototypical designs were generated to illustrate the application of the design guidelines and ideas presented in previous sections. Five sites along the stretch of I-94 between Ryan Road and downtown Milwaukee were selected to represent prototypical situations. This stretch also acts as a gateway between the airport and downtown. Additionally, a short segment of I-43, where it passes Chambers Street, was selected to represent an example of an "historical ghost."

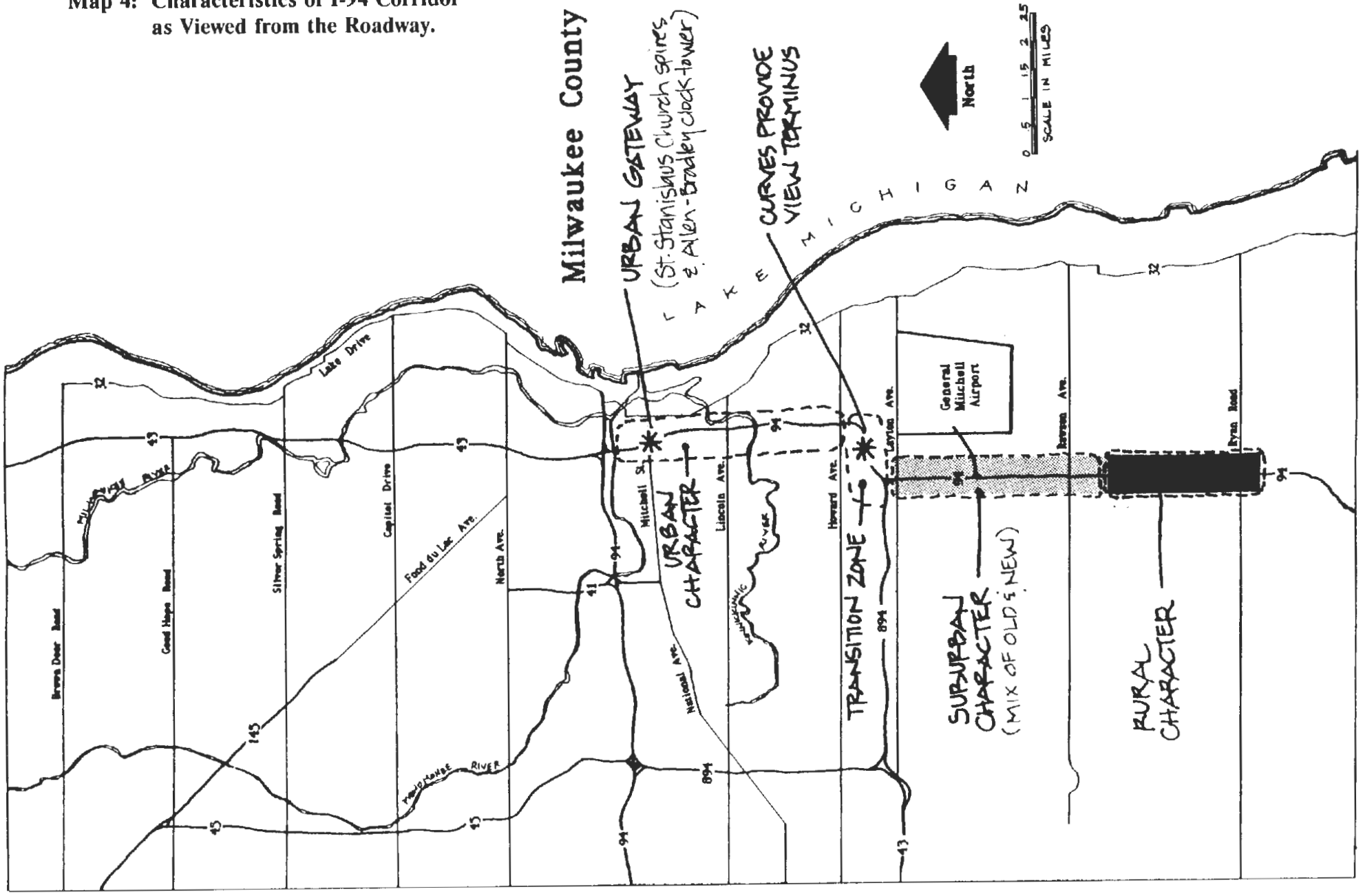
Before selecting the specific sites a windshield analysis was completed to determine unique characteristics of this corridor section. Map 4 identifies the major observations. The following discussion describes characteristics of the corridor in more detail.

The area between Ryan Road and College Avenue is still quite rural in character. It gives way to newer suburban development as movement proceeds north, toward the airport interchange. A mix of new and older suburban development occurs between the airport interchange and the junction of I-94 with I-894. The junction of the two freeways provides a definite pivot point as development just north of it becomes quite urban in character. North of the junction houses are quite close to the freeway. They are also older and more closely spaced. The two sharp curves in this area provide the opportunity to take advantage of straight-on views of the noise barriers.

North of these curves the freeway cuts through older, established urban neighborhoods. Local landmarks, particularly church spires, are prominent on the skyline. Some locations show evidence of earlier freeway landscaping projects which have grown into mature plantings. Efforts should be taken to minimize destruction of these plantings if new barriers are constructed.

At the intersection of I-94 and Mitchell Street a gateway is formed by the twin spires of St. Stanislaus Church and the Allen-Bradley clock tower. The visual image of a gateway to downtown should be reinforced since just beyond this location, the freeway crosses the Menomonee Valley which opens an expansive view to downtown Milwaukee.

Map 4: Characteristics of I-94 Corridor as Viewed from the Roadway.



Design Concept Alternatives:

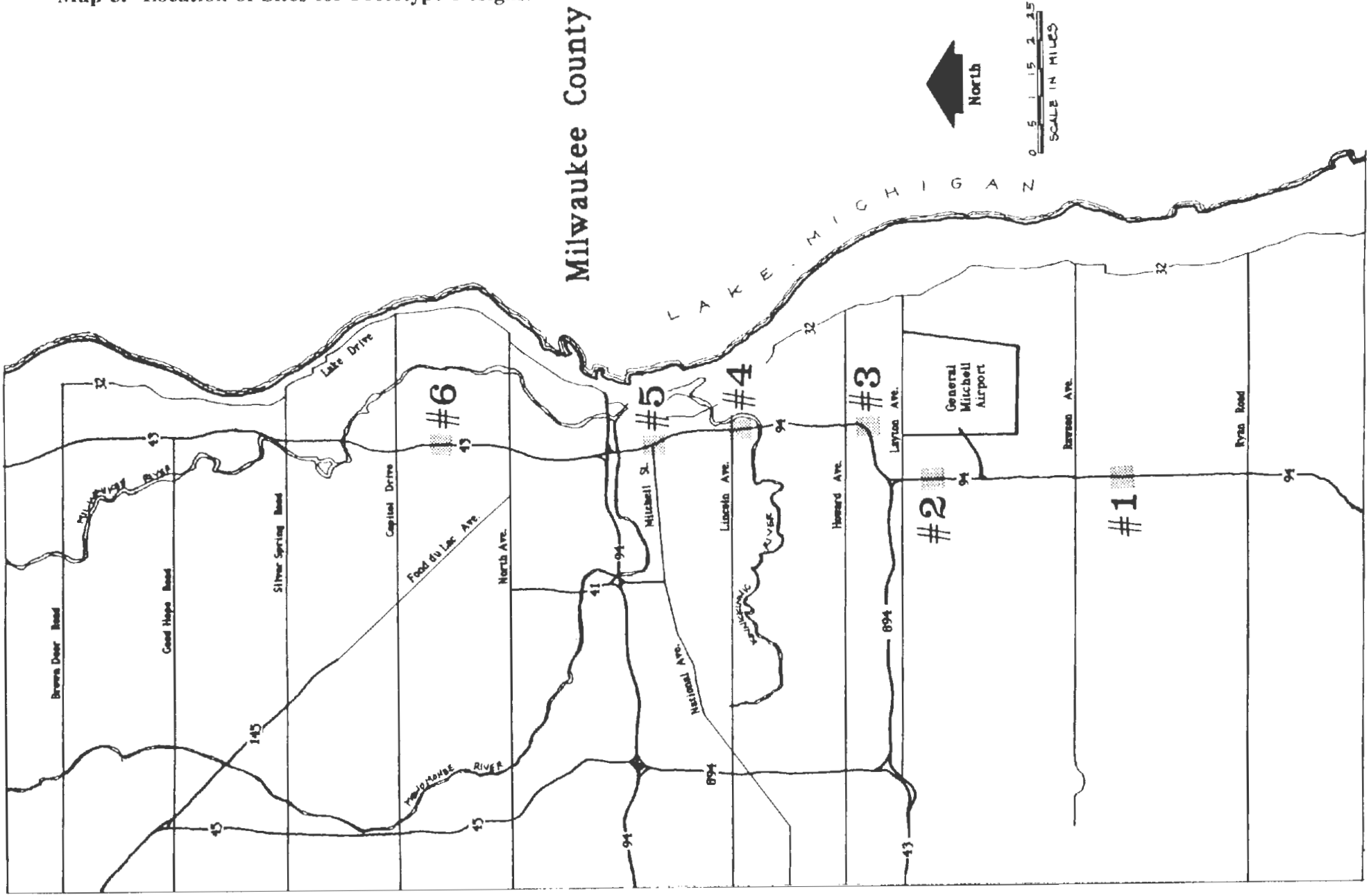
A series of "before" and "after" sketches are were made of several sites along I-94 to illustrate how noise barriers and landscaping can be used to accentuate the characteristics of specific areas in order to create a more aesthetically pleasing and coherent freeway corridor environment. The design intent of each design solution is briefly described below. They are presented in a sequence from the south to represent views a motorist would have while travelling north to the city center. The locations of the sketches are indicated on Map 5.

- **Site #1 -- Rural Character**

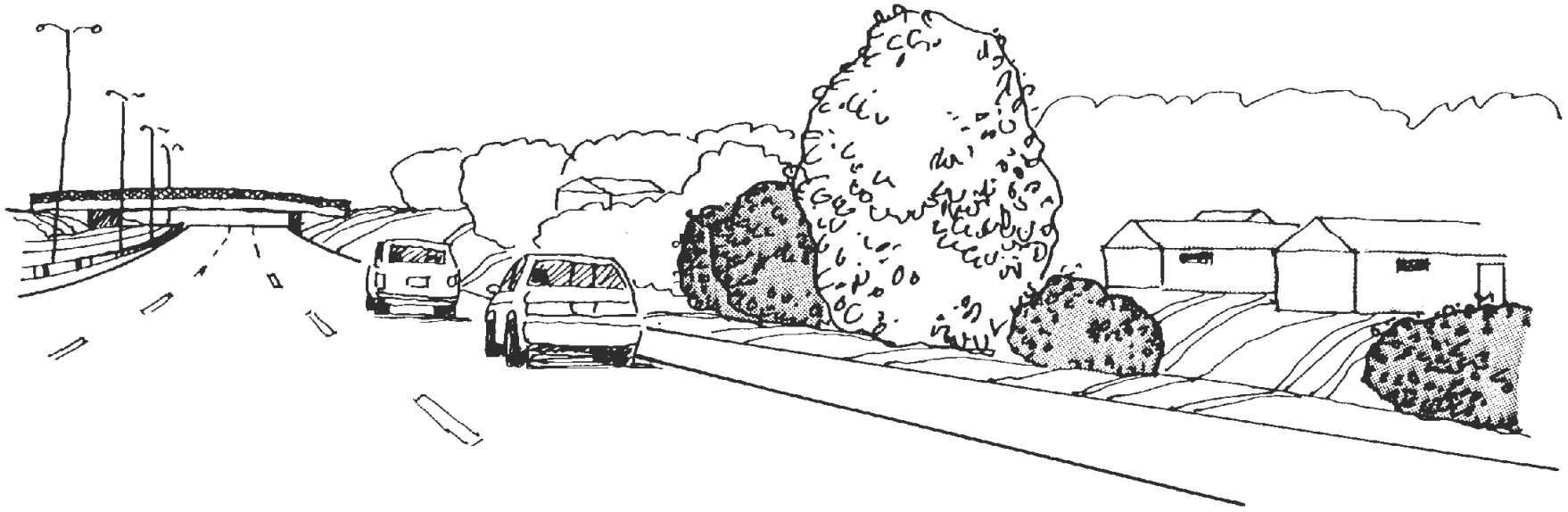
This site is located just south of the Rawson Avenue interchange. It is currently relatively undeveloped; however, some low density residential development has occurred. The area is characterized by patches of development interspersed with farm fields, meadows, and woodlands. Historically, this area supported several truck farming and greenhouse operations. Much of its original rural/farm character remains intact.

Noise barriers in this area should be designed to reflect this rural character. Design characteristics of rustic, residential and utilitarian fences could be adapted to the barrier wall design. The barrier wall could be constructed of rough sawn wood, placed in a somewhat loose pattern to resemble grape stakes. The top of the wall (ends of the wood stakes) should be left jagged and uneven. The wall could be placed in a zigzag configuration, reminiscent of a split-rail fence. Landscaping should consist of naturalistic drifts of native grasses and wild flowers. Piles of field stones placed at irregular intervals at the base of the wall would add contrast and visual interest. The extent of landscaping depends on the amount of space available on either side of the wall.

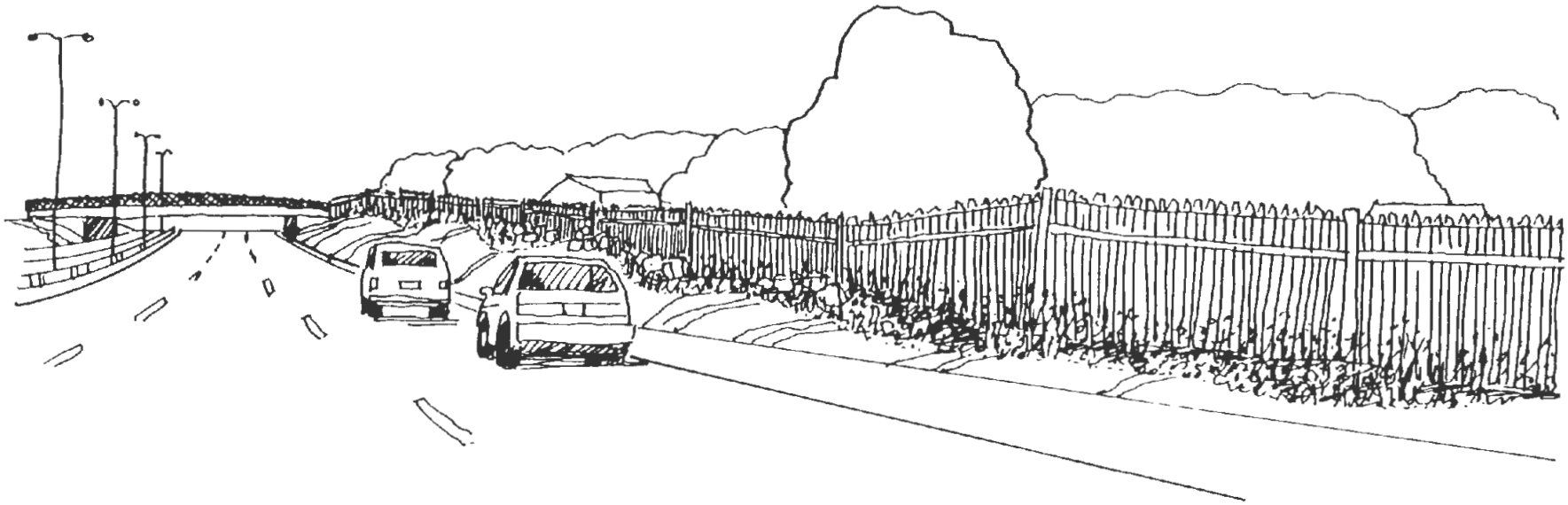
Map 5: Location of Sites for Prototype Designs.



Site #1: Rural Character -- "Before"



Site #1: Rural Character -- "After"



Design Concept Alternatives:

- **Site #2 -- Suburban**

This site is located near the airport. The area is characterized by low to medium density residential development. This stretch of the freeway is in a slight cut, with gently undulating side slopes along its edge. A significant amount of vegetation has been retained along the top of the side slopes, possibly in the backyards of abutting residences. In this situation a primary objective would be to design the barrier to resemble a residential fence. The fence could be designed with panels evenly separated by posts. A strong horizontal texture or pattern on the surface of the panels would help to visually reduce the height of the wall by reinforcing the horizontal line of the landform. A wood barrier would blend nicely into the landscape; however, concrete, brick and metal could also be used to create the same basic result.

Landscaping should consist of informal mass plantings of trees and shrubs on both sides of the barrier. The barrier should appear to meander in and out of "the woods." Consideration should also be given to adding berms so that the height of the wall could be reduced. Berms would also further accentuate the existing land undulations.

- **Site #3 -- Urban Focal Point**

This site is located along the east side of the freeway at the curve just south of Howard Avenue. The sharp curve presents a situation where motorists' views are naturally focussed straight ahead to a potential barrier location. The opportunity exists to capitalize on this situation and create focal points.

This site is located in the Bayview neighborhood which began as an iron and steel company town. Barriers in this area could be constructed of metal to acknowledge the local historical roots. Designs made of metal tracery work could provide focal interest. The design solution proposed suggests attaching decorative metal tracery screens to smooth metal wall panels. Some space should be left between the tracery screen and the wall panel to create depth and shadow patterns. In addition, the wall panel should be light in color to ensure that

shadow patterns are visible. To retain their focal impact and contextual uniqueness, decorative panels of this type should be used sparingly. Adjacent wall sections should be rather simple to avoid visual distraction and confusion. Dark colored adjacent wall sections would be appropriate to provide contrast.

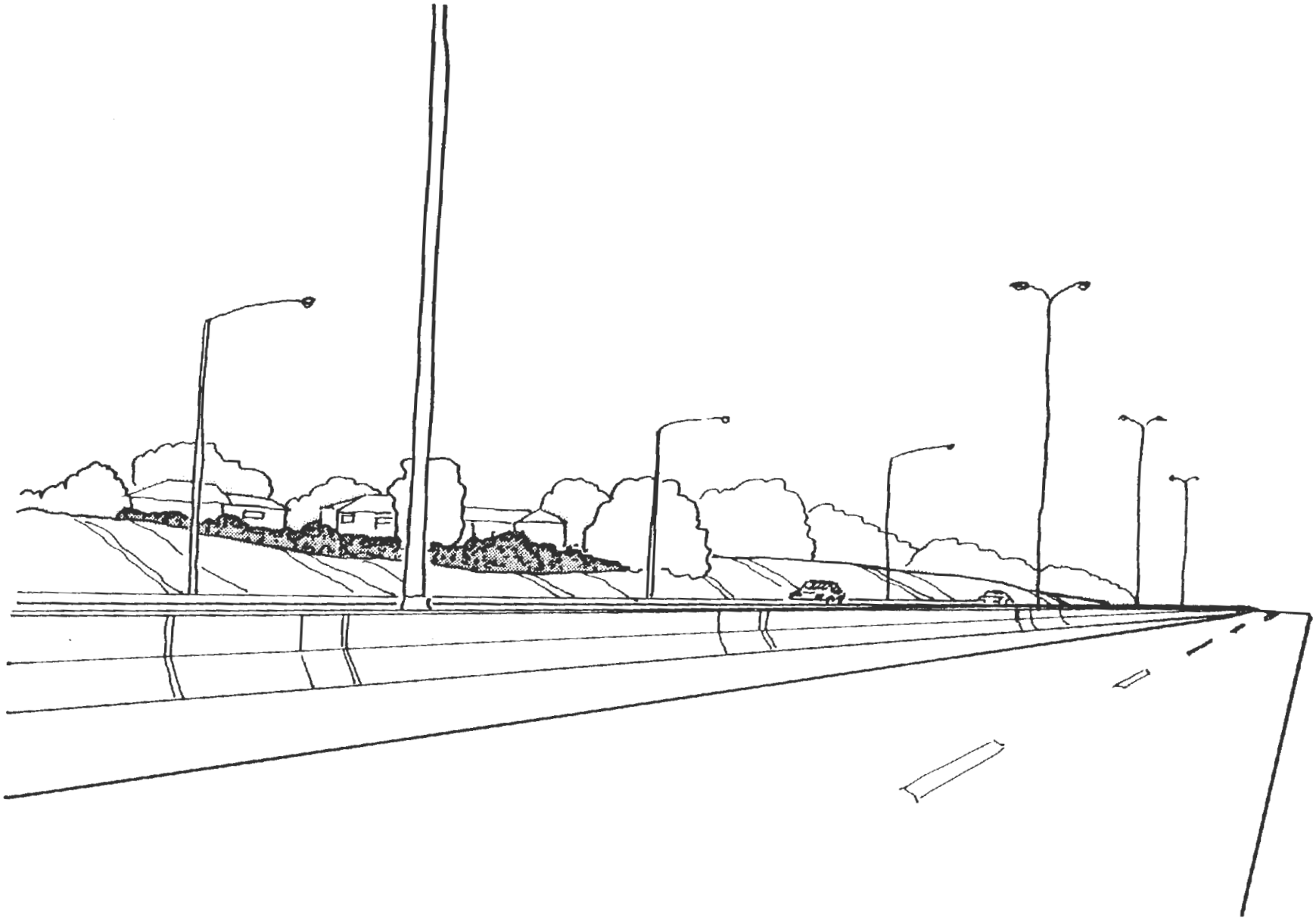
No landscaping is required along the decorative panels, since the barrier itself is visually attractive. Landscaping along the adjacent wall sections should also be simple. In this example, an existing row of trees was retained on the freeway side of the barrier. The area consists of a dense urban residential development. The row of trees lends a simple, urban character -- resembling a residential streetscape.

- **Site #4 -- Urban Neighborhood**

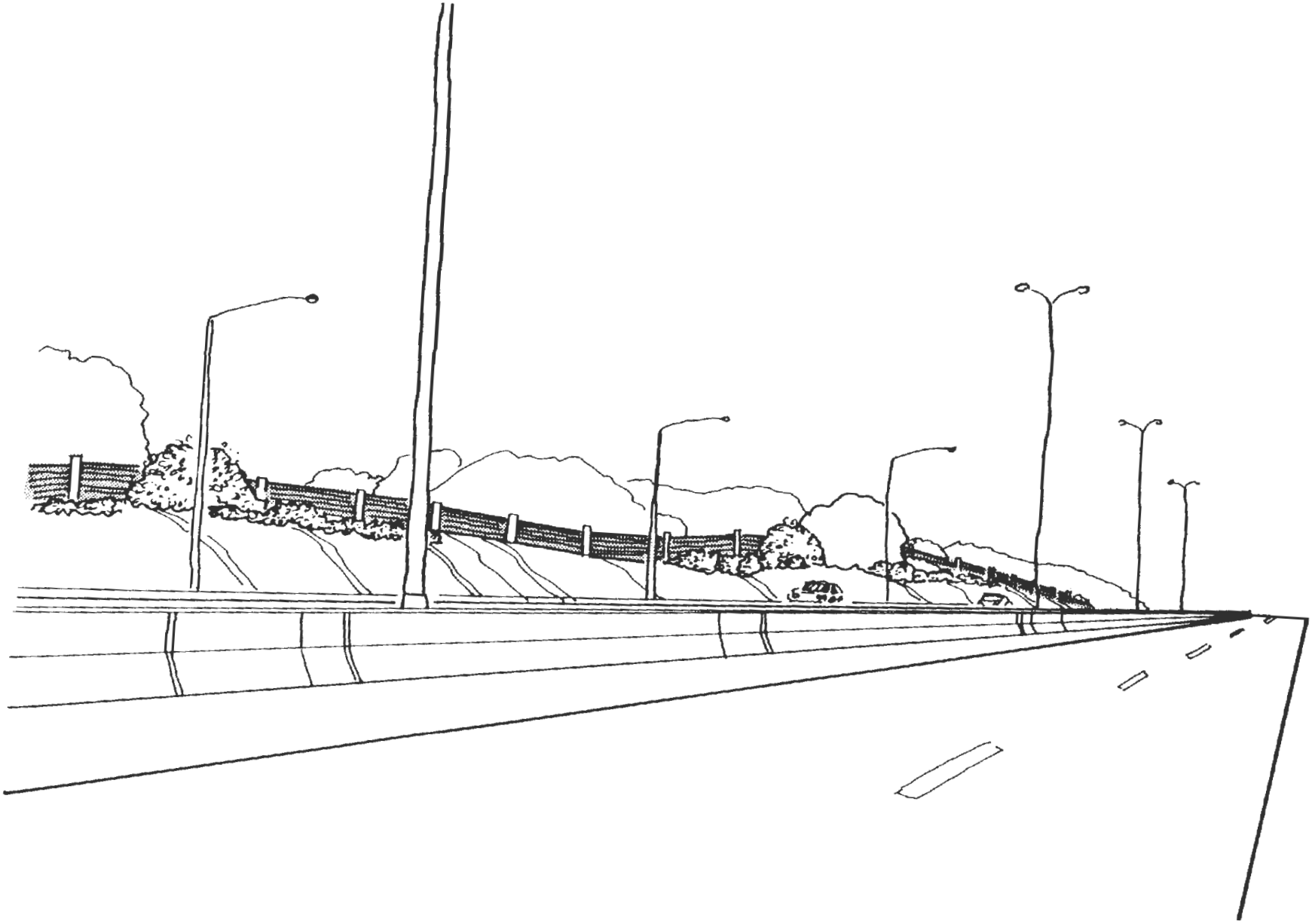
This site is located near Lincoln Avenue in a densely developed, old urban neighborhood. The site contains two significant attributes: a dense row of healthy, mature vegetation, and a prominent local landmark, the dome of St. Josaphat Basilica, an historic church, as a backdrop. The barrier should be designed to accommodate both of these assets. The solution proposed is relatively simple in design. The wall should be designed to have a finished, more refined, urban character. Pillars could be placed at regular intervals between spans of wall panels. In this example, the shape of the pillar is designed to reflect the Basilica's dome. They are light colored to provide contrast. The wall panels should be relatively dark in color, so they visually recede into the landscape plantings. A contrasting (light colored) cap provides a finishing touch to the top of the wall.

Special care should be used when siting and constructing the barrier in order to save and utilize as much of the existing vegetation as possible. Ideally, the barrier should appear to weave through the landscaping. Some additional landscaping might be necessary to blend the overall design into the existing landscape.

Site #2: Suburban Character -- "Before"

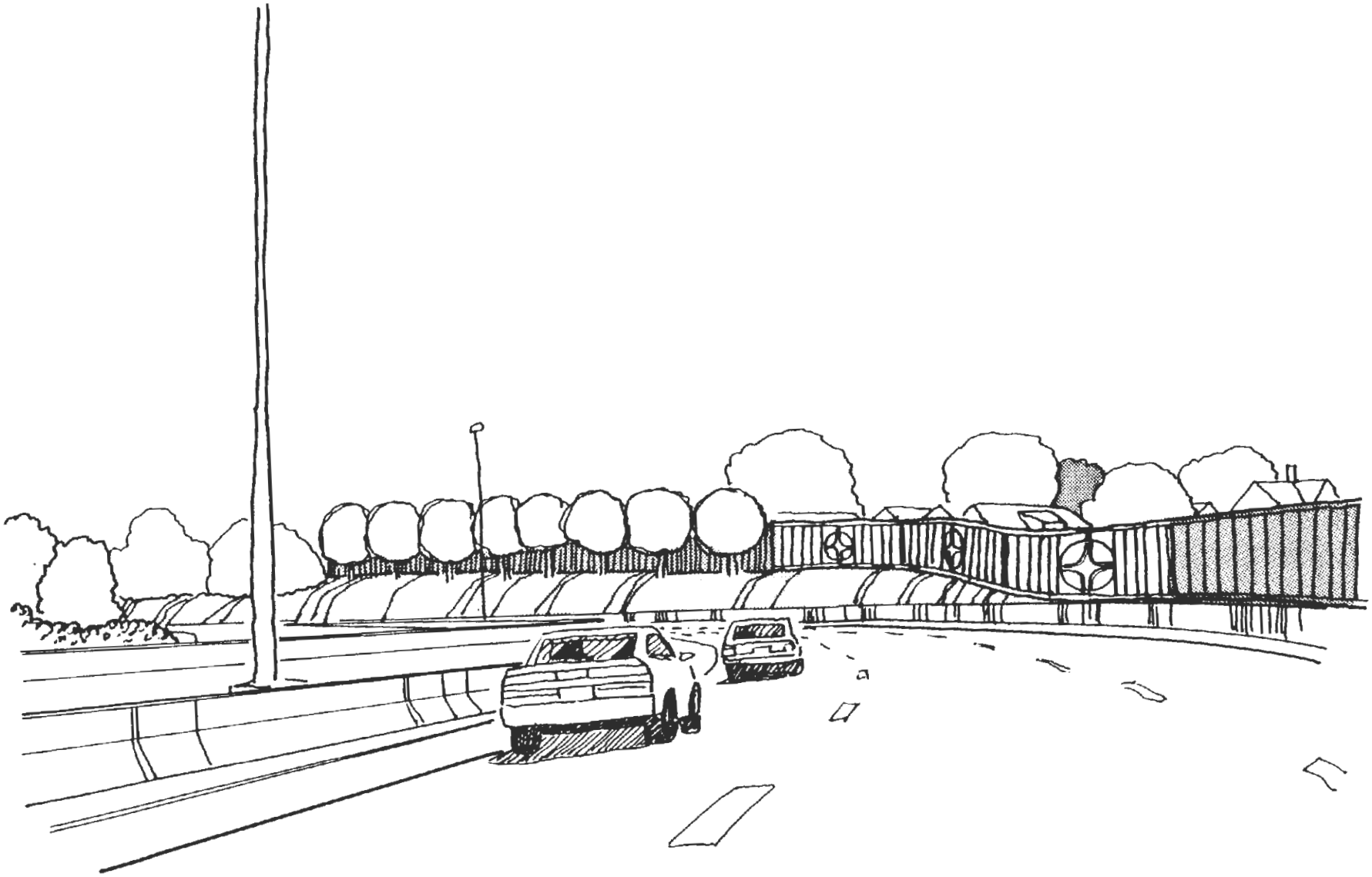


Site #2: Suburban Character -- "After"

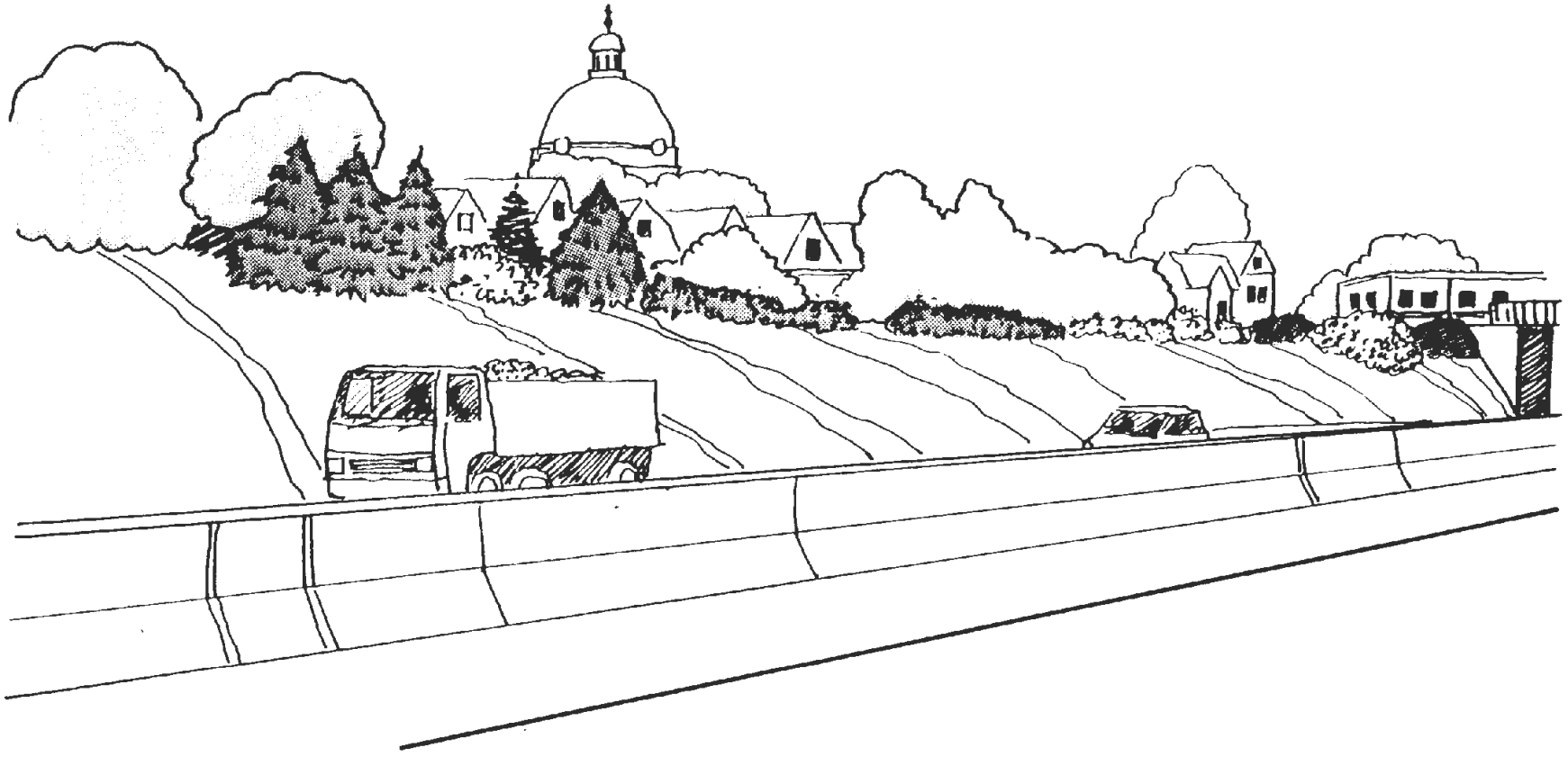


Site #3: Urban Focal Point -- "Before"

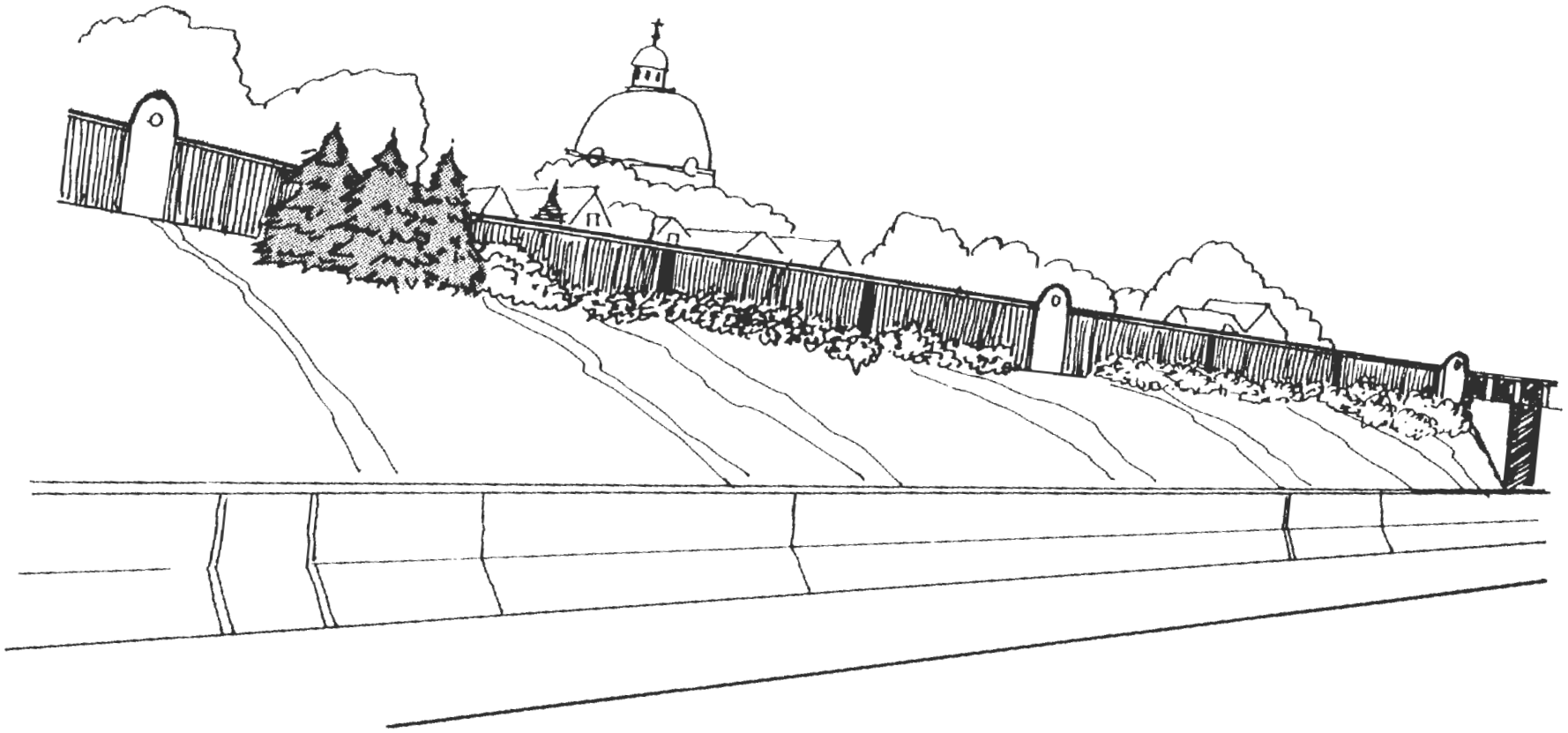
Site #3: Urban Focal Point -- "After"



Site #4: Urban Neighborhood -- "Before"



Site #4: Urban Neighborhood -- "After"



Design Concept Alternatives:

- **Site #5 -- Urban Gateway**

This site is located near the downtown along the Mitchell Street interchange. A sense of gateway is created by two visually prominent vertical structures located on either side of the roadway. The twin spires of St. Stanislaus Church and the Allen-Bradley clock tower are prominent Milwaukee landmarks located along the seam where the industrial heart of the city meets its oldest residential neighborhoods. Because of their visual prominence and juxtaposition to each other, and to downtown, they create a gateway signalling either the entrance to or exist from the heart of the city (downtown).

A noise barrier on this site could be designed to reinforce the gateway image. As proposed, the top profile of the walls are stepped to emphasize an upward movement. The walls are tied to the existing bridge structure by vertical pillars. These pillars create a more literal gateway, making reference to the implied gateway created by the two prominent buildings in the background. Concrete wall panels are used to express the very urban character of the site. Vertical posts between wall panels accentuate the upward movement toward the pillars and the verticality of the surrounding architecture. The vertical elements, end pillars and panel posts, should be darker in color than the wall panels to make them visually dominant.

The landscape treatment suggested consists of vines planted on the residential side of the wall that are allowed to cascade over the top, softening the horizontal line of the wall panels. This wall could also be designed to incorporate a planter along the top which could be planted with brightly colored annual flowers. This would give reference to the landscaped boulevards which have become a Milwaukee trademark.

- **Site #6 -- Historical Ghost**

This site is located where I-94 crosses Chambers Street. It is the former site of Borchert Field which served as the major athletic field for Milwaukee baseball teams during the first

Design Concept Alternatives:

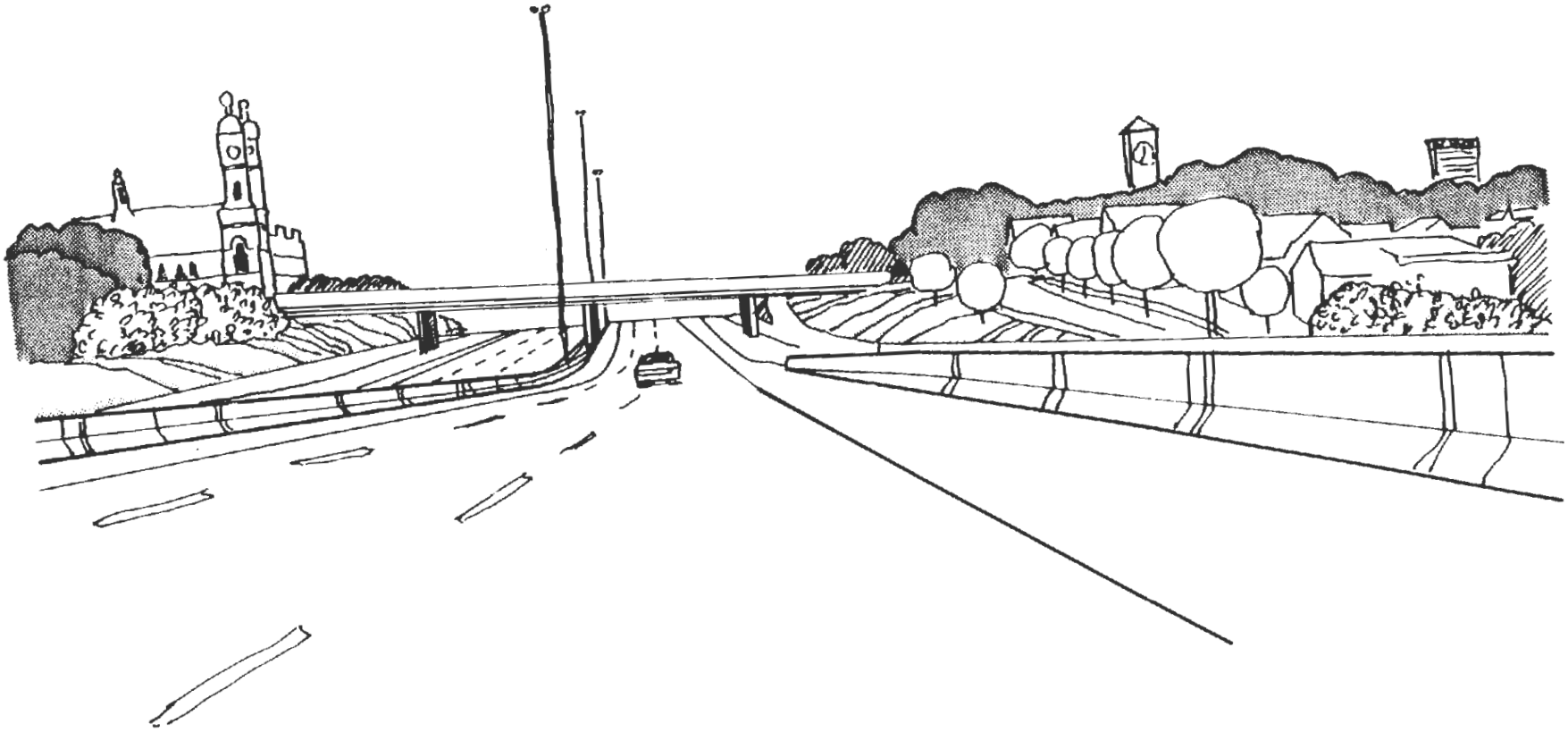
half of the century until the opening of Milwaukee County Stadium in 1953. In the same year, Borchert Field was demolished to make way for construction of I-43. To reflect this cultural relic, the barrier walls could be designed using a baseball theme.

To avoid being overly sentimental (and distractive), the design should be simple and uncluttered. The solution proposed involves the integration of a backstop into the barrier on the west side of the freeway. Home base would be constructed of an appropriately shaped slab of white concrete or marble. The dimensions of the base would have to be exaggerated somewhat to increase its visibility. The base would be placed within a bed of reddish colored gravel to provide heightened contrast. The existing slope of the cut bank could be utilized to make the base more visible by tilting it toward the roadway.

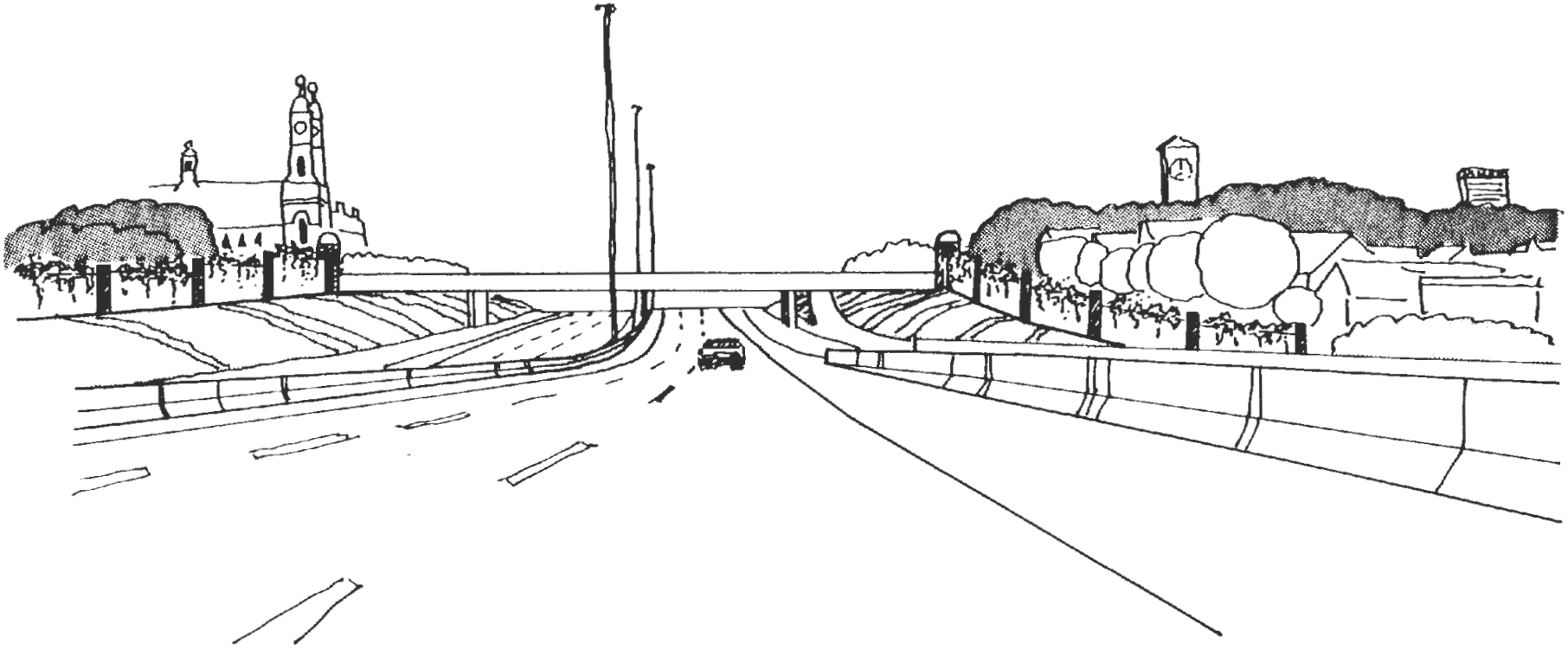
Borchert Field stadium was a wooden structure. Similarly, the barrier walls should be constructed of wood boards, preferably with a weathered finish, placed vertically, side by side. The wooden walls should only extend about 200' beyond the backstop, being of equal length on both sides of the freeway, alluding to the size of a baseball stadium. Numbers stenciled on the east side barrier signify field length. Vertical poles symbolize foul line markers. A change of materials would clearly signal that this area is distinct. The design proposed suggests that the barrier material change should not occur abruptly. Instead, over the distance of three wall panel segments the materials could be integrated by attaching wood panels, in graduating heights, forming a stepped pattern, to the surface of the adjacent barrier. Concrete would be an appropriate choice of material for the adjacent barrier because it would provide color contrast and could be given a vertical surface texture to complement the wood barrier design.

Landscaping on the freeway side would be minimal. Vines could be planted to grow on or over the wall. Conceptually, the cut slope should be planted with turf grass. At the point where the barrier material changes, the landscape treatment should also change. The area immediately adjacent to the turf should be planted with a taller ground cover to clearly delineate the edge of the historic "ball field."

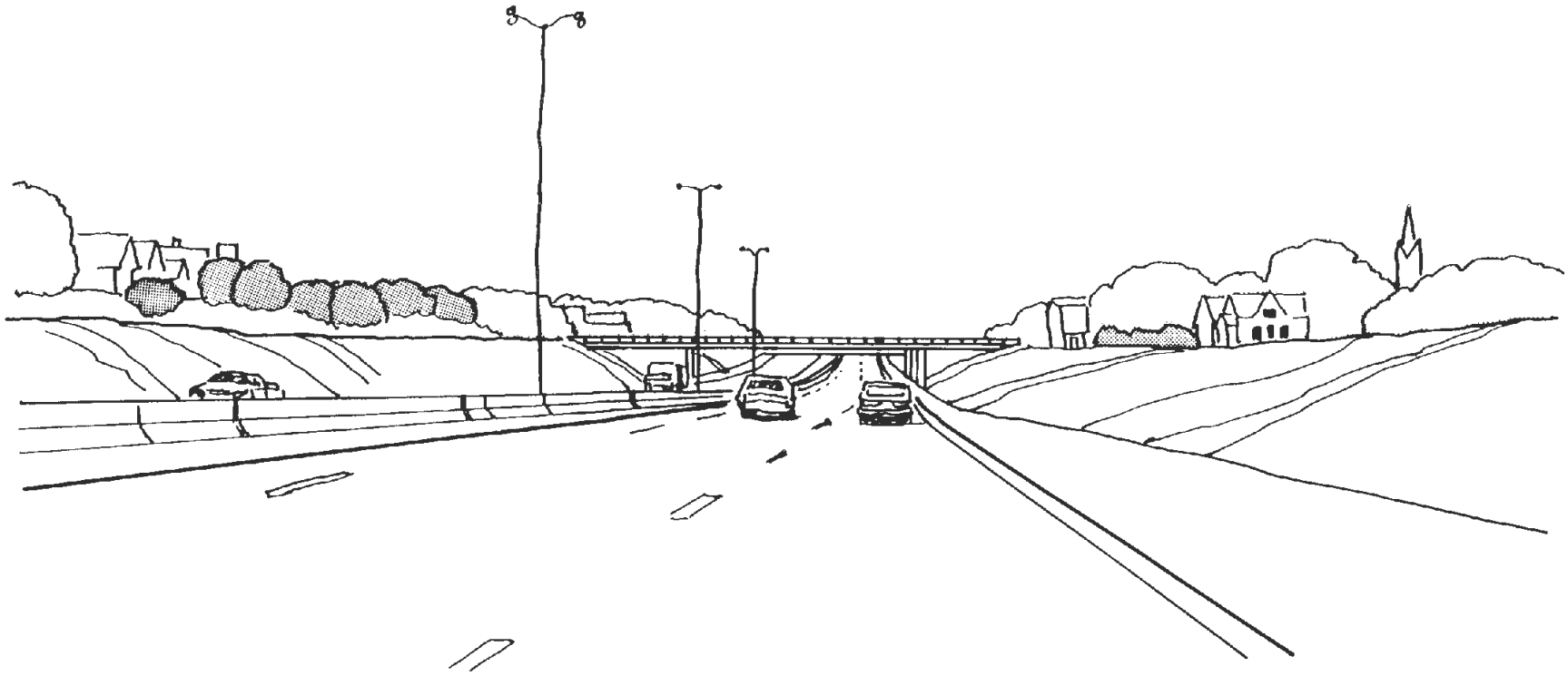
Site #5: Urban Gateway -- "Before"



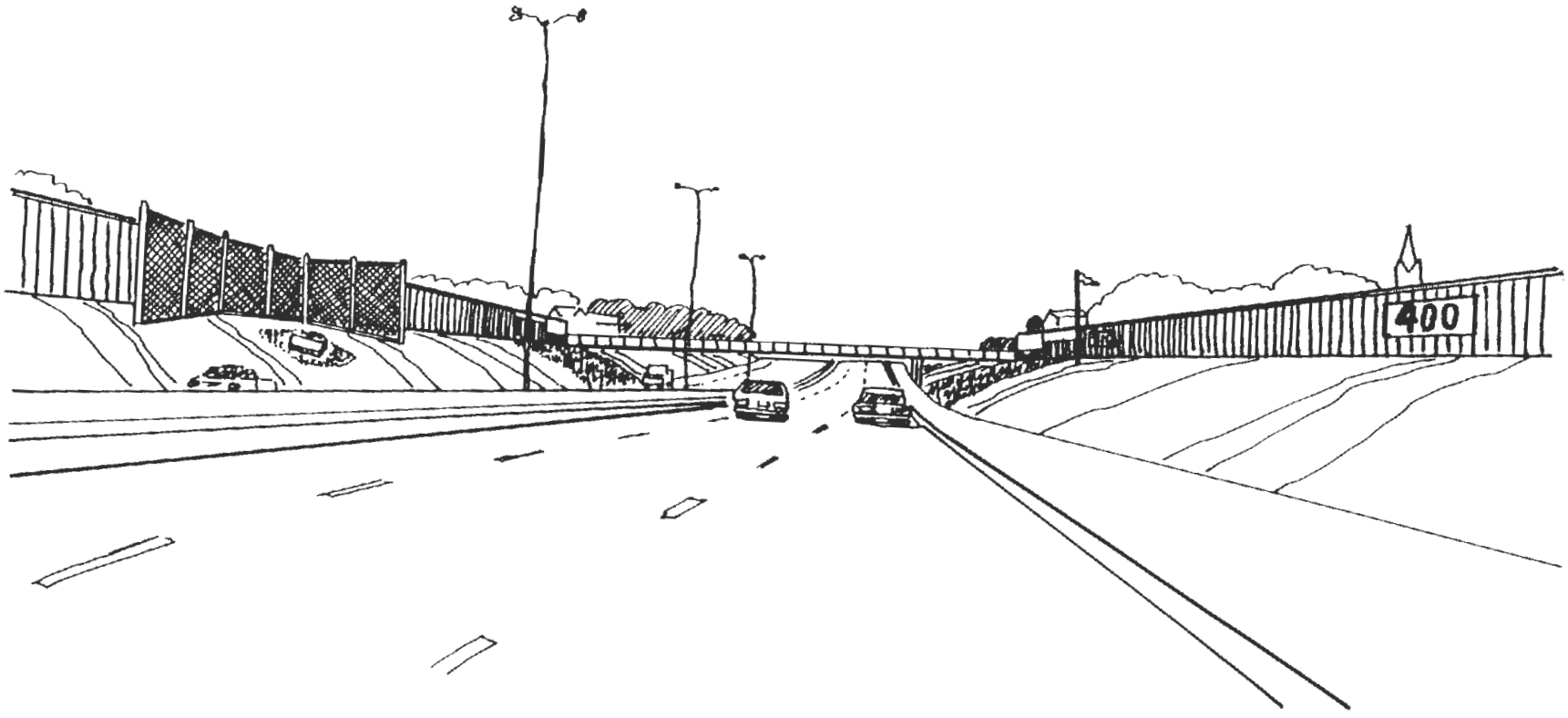
Site #5: Urban Gateway -- "After"



Site #6: Historical Ghost -- "Before"



Site #6: Historical Ghost -- "After"



Conclusions

This report has been developed to provide information and tools that can be used to enhance the visual and aesthetic quality of freeway noise barriers. Noise barriers can be effective in reducing unwanted sound from highway sources in residential neighborhoods. However, they also can have a substantial effect on the visual environment of a highway and surrounding neighborhoods. They can significantly change the view from the road creating monolithic tunnels of walls and by blocking views of changing urban scenery. They can also change the view towards the road for the surrounding community by creating barriers to other areas and developing a sense of isolation. What is needed is a way to provide the benefits of sound reduction from noise barriers while at the same time creating a positive visual image for road users and the surrounding communities. This report provides suggestions as to how this can be done.

Key Concepts

An attractive and efficient system for freeway noise control can be developed if the following principles are followed.

Diversity: Variety in the placement, materials, texture and landscaping can enhance the aesthetic characteristics of noise barriers. Urban landscapes are diverse mixtures of buildings, plants, streets and sidewalks; there should be no hesitancy to incorporate this diversity into noise barriers.

Integrate Barriers and Landscaping: Noise barriers and landscaping should be viewed as an integrated, complementary system. Choices of materials, textures, profile, and location should be done in such a way that the various elements fit together into an integrated whole. A balance should be struck between wall decoration and landscaping so that they do not conflict or complete with each other.

Reflect Neighborhood Characteristics: The physical, cultural and historical characteristics of urban neighborhoods should be incorporated into the design of noise barrier/landscaping systems. Noise barriers should reflect the basic land uses and the heritage of the areas through which the highways pass. Noise barrier design should include efforts to understand

urban areas through careful inventories of physical, visual, cultural, ethnic, historical, and land use characteristics of different neighborhoods. These factors should be used to shape design themes as well as details. Specific views should be reinforced and enhanced. Gateways should be identified and accentuated.

Options: Decisions about barriers and landscaping should be made in consultation with neighborhood groups, elected officials and others. A broad range of options should be provided including materials, profile, and configuration of barriers and type, location and configuration of landscaping. Tradeoffs should be provided between wall materials and landscaping so that an acceptable balance can be reached.

Creative Process: Finally, a process should be used which maximizes the opportunity for creative design of noise barrier/landscaping systems. This process would include careful inventories of neighborhood characteristics, selection of design themes, preparation of alternative designs, community involvement, and selection of designs that balance the various tradeoffs of cost, aesthetics and noise reduction. Through such a process systems can be developed that enhance the quality of the environment that is seen as well as heard along freeways.

Sound good/look good.

Bibliography

We would like to thank members of the TRB Noise Committee who supplied information for this study through correspondence of noise barrier design in Michigan, New York, New Jersey, Minnesota, Maryland, California and other states.

Blum, Randolph F., A Guide to Visual Quality in Noise Barrier Design, Implementation Package 77-12, U. S. Department of Transportation, Federal Highway Administration, December, 1976.

Fichier D'Écrans Acoustiques, Center D'Études des Transports Urbains, March, 1987.

Gurda, John, Discover Milwaukee Catalog, City of Milwaukee, Department of City Development, 1986, reprinted 1988.

Keegan, Kent Mitchell, The Integration of the Highway and Landform, Center for Architectural and Urban Planning Research, School of Architecture and Urban Planning, University of Wisconsin--Milwaukee, 1989.

Minnesota Department of Highways, Office of Environmental Services, Metro Noise Abatement Program, February, 1976.

Ritzner, James, "The What and Why of Natural Roadsides," in Public Works, March, 1970, pp. 49-53.

Roadside Design Guide, Chapter 3: Roadside Topography and Drainage Features; American Association of State Highway and Transportation Officials, Inc., Washington, D. C., 1989.

Springer, Michael, "Vegetative Lärmschutzwand aus Weidenflechtwerk" ("Vegetative Noise Barriers from Willowtwigs"), Neue Landschaft, Fachzeitschrift für Garten-, Landschafts-, Spiel- und Sportplatzbau, Patzer Verlag GmbH u. Co. KG, Hannover, Berlin, West Germany, June, 1987, pp. 287-389.

Wisconsin Department of Transportation, Chapter Trans 405, Register, August 1989, No. 404, pp. 562-565, 562-567.

_____, Facilities Development Manual; Procedure 11-15-1, January 31, 1990.

_____, Maintenance Manual, Supplemental Policy 11.01, October 1, 1988.

Appendices

A: Noise Barrier Materials

B: Plant Materials

C: Landscape Cost Comparisons

D: Ethnic Neighborhood Descriptions

E: Freeway Noise Barrier Site Inventory Analysis Checklist

APPENDIX A: NOISE BARRIER MATERIAL COSTS

Average Cost Comparisons for Three Common Barrier Materials

	Unit Costs*			
Material	$/mile	$/LF	$/SF	$ per Abutting Unit**
Metal	1,278,964	242	13.54	14,329-37,034
Wood	1,916,852	363	19.72	62,733
Concrete	2,119,624	401	21.58	22,604-35,294

* Figures represent costs for 1984 projects in Milwaukee County in 1988 dollars. All costs include 15% Engineering and Contingencies.

** Figures from 1984 projects. Cost difference for same material partially due to density of abutting development. Higher densities yield lower costs per abutting unit.

*** Costs for "retrofit" barriers are from 20 to 30 percent greater than "new" barriers due to incidental and miscellaneous quantities, including traffic control; removals; excavation and finishing; drainage, lighting and sign modifications; and access restricting.

Commonly available surface textures on precast concrete panels:

- rough grooved
- applied stone
- brick and post
- cast barn wood
- grape stakes
- stucco
- rough raked
- cast cedar siding
- brick

Source: WDOT District 2.

Appendix B: Plant Materials

Deciduous Trees		Design Attributes			Character		Potential Use			
Plant Name	**Form***	**Flowers**	**Fall Color**	**Winter Color**	**Formal**	**Informal**	**General**	**Accent**	**Massing**	**Screen**
Norway Maple (Acer platanoides)	R	X	yellow		X	X	X			
European Horsechestnut (Aesculus hippocastanum)	R	X			X		X			
Cockspur Hawthorn (Crataegus crus-galli)	R	X				X	X	X		
Russian Olive (Elaegnus angustafolia)	R/I					X		X	X	X
White Ash (Fraxinus americana)	O		purple/ yellow							
Green Ash (Fraxinus pennsylvanica)	O		yellow		X	X	X			
Honeylocust (Gleditsia triacanthos)	I				X	X	X	X		

*Form Key: O = oval, R = round, C = columnar, P = pyramidal, W = weeping, I = irregular, V = vase.

Appendix B: Plant Materials

Deciduous Trees		Design Attributes			Character		Potential Use			
Plant Name	Form*	Flowers	Fall Color	Winter Color	Formal	Informal	General	Accent	Massing	Screen
Poplar (variety) (Populus spp.)	C				X	X		X		X
White Oak (Quercus alba)	R/I			X		X	X	X	X	
Bur Oak (Quercus macrocarpa)	R/I						X	X		
Black Locust (Robina pseudoacacia)										
Golden Weeping Willow (Salix alba 'Trista')	W			yellow						
Tamarack (variety) (Tamarix spp.)	P		yellow							

*Form Key: O = oval, R = round, C = columnar, P = pyramidal, W = weeping, I = irregular, V = vase.

Appendix B: Plant Materials

Evergreen Trees		Character		Potential Use			
Plant Name	**Form***	**Formal**	**Informal**	**General**	**Accent**	**Massing**	**Screen**
Eastern Red Cedar (Juniperus virginiaua)	C/P		X	X		X	X
Black Hills Spruce (Picea glauce 'Densata')	P	X			X		X
Colorado Blue Spruce (Picea pungens 'Glauca')	P	X			X		X
Mugho Pine (Pinus mugho)	R/I	X	X	X		X	
Austrian Pine (Pinus nigra)	I		X				X

*Form Key: O = oval, R = round, C = columnar, P = pyramidal, W = weeping, I = irregular, V = vase.

Appendix B: Plant Materials

Deciduous Shrubs		Design Attributes			Character		Potential Use			
Plant Name	Form*	Flowers	Fall Color	Winter Color	Formal	Informal	Accent	Hedge/ Screen	Massing	Ground Cover
Siberian Peashrub (Caragana arborescens)	E/R	X			X	X		X	X	
Dwarf Bush Honeysuckle (Dierville lonicera)	M	X			X	X			X	X
Mockorange (Philadelpus spp.)	R/O	X			X	X	X		X	
Jackman Potentilla (Potentilla fruiticosa 'Jackman')	M	X			X	X	X		X	
Buckthorn (variety) (Rhamnus spp.)	E/R				X	X		X		
Fragrant Sumac (Rhus aromatica)	M					X			X	
Smooth Sumac (Rhus glabra)	U/F		X			X			X	
Staghorn Sumac (Rhus typhina)	U/F		X			X			X	

*Form Key: R/O = round/oval, M = mounded, E/R = erect/rectangular, T = trailing, H/C = horizontal/creeping, C/P = conical/pyramidal, U/F = umbrella/fan.

Appendix B: Plant Materials

Deciduous Shrubs		**Design Attributes**			**Character**		**Potential Use**			
Plant Name	**Form***	**Flowers**	**Fall Color**	**Winter Color**	**Formal**	**Informal**	**Accent**	**Hedge/ Screen**	**Massing**	**Ground Cover**
Alpine Currant (Ribes alpinum)	E/R				X	X		X	X	
Rugosa Rose (Rosa rugosa)	M	X			X	X	X		X	
Buffaloberry (Shepcrdia argentea)	R					X		X	X	
Snowberry (Symphoricarpos alba)	R	X								

*Form Key: R/O = round/oval, M = mounded, E/R = erect/rectangular, T = trailing, H/C = horizontal/creeping, C/P = conical/pyramidal, U/F = umbrella/fan.

Appendix B: Plant Materials

Evergreen Shrubs		Design Attributes	Character		Potential Use			
Plant Name	Form*	Winter Color	Formal	Informal	Accent	Soften	Massing	Ground Cover
Pfitzer Juniper (Juniperus chinensis 'Pfitzerana')	H	X				X	X	X
Hughe's Juniper (Juniperus horizontalis 'Hughes')	H	X				X	X	X

Vines and Ground Covers	Design Attributes			Character	
Plant Name	Flowers	Fall Color	Winter Color	Formal	Informal
Crown Vetch (Coronilla varia)	X				X
Virginia Creeper (Parthenosis quinquefolia)		X			X
Fleeceflower (Polygonium reynoutria)	X				X

*Form Key: O = oval, R = round, C = columnar, P = pyramidal, W = weeping, I = irregular, V = vase.

Appendix B: Plant Materials for Natural Landscaping

Native Grasses	Design Attributes			Habitat**				
Plant Name	**Color**	**Bloom**	**Height**	**Wet**	**WM**	**Mesic**	**DM**	**Dry**
Little Bluestem (Andropogon scoparius)	copper	July	2 ft.			X	X	X
Side-oats Grama (Bouteloua curtipendula)	orange	July	2 ft.				X	X
Blue Grama Grass* (Bouteloua gracillis)	white	July	3-6 in.				X	X
Buffalo Grass* (Buchloe datyloides)	yellow	July	6 in.				X	X
Canada Wild Rye* (Elymus canadensis)	straw	September	4 ft.			X	X	
Indiangrass (Sorghastrum mutans)	straw	August	4-5 ft.		X	X	X	
Prairie Cordgrass (Spartina pectinata)	straw	August	4-5 ft.	X	X			

*Salt tolerant grasses can be seeded immediately adjacent to the shoulder (1 machine width approximately 8') and parallel with the roadway.

**Habitat key: WM = wet to mesic, DM = dry to mesic. Mesic is a medium moisture condition.

Appendix B: Plant Materials for Natural Landscaping

Prairie Plants: Wild Flowers	**Design Attributes**			**Habitat**				
Plant Name	**Color**	**Bloom**	**Height**	**Wet**	**WM**	**Mesic**	**DM**	**Dry**
Heath Aster (Aster ericoides)	white	September	2-3 ft.			X	X	
Prairie Bushclover (Lespeseza capitata)	white	August	3 ft.			X	X	X
Lupine (Lupine perennis)	blue	May	2 ft.					
Bergamot (Monorda fistulosa)	pink	June	2 ft.			X	X	
Purple Prairie Clover (Petalostemum purpureum)	magenta	July	2 ft.			X	X	X
Black Eyed Susan (Rudbeckia hirta)	yellow	June	1-2 ft.		X	X	X	
Spiderwort (Tradescantia ohiensis)	blue	June	2 ft.		X	X	X	
Leadplant (Amorpha canescens)	violet	June	3 ft.			X	X	
Thimbleweed (Anemone cylindrica)	white	May	12 in.			X	X	X
Canada Anemone (Anemone canadensis)	white	May	6-12 in.		X	X		
Swamp Milkweed (Asclepias incarnata)	red	June	2-3 ft.	X	X			

Appendix B: Plant Materials for Natural Landscaping

Prairie Plants: Wild Flowers	**Design Attributes**			**Habitat**				
Plant Name	**Color**	**Bloom**	**Height**	**Wet**	**WM**	**Mesic**	**DM**	**Dry**
Butterfly Milkweed (Asclepias tuberosa)	orange	June	2-3 ft.			X	X	X
Sky Blue Aster (Aster azureus)	blue	September	2 ft.		X	X	X	
Smooth Aster (Aster laevis)	blue	August	2-3 ft.		X	X	X	
Stiff Coreopsis (Coreopsis palmata)	yellow	July	2-3 ft.			X	X	X
Pale Purple Coneflower (Echinacae pallida)	magenta	June	2-3 ft.			X	X	
Flowering Spurge (Euphorbia corollata)	white	July	2 ft.			X	X	
Western Sunflower (Helianthus occidentalis)	yellow	July	2 ft.			X	X	X
Rough Blazingstar (Liatrus aspera)	magenta	August	2 ft.			X	X	
White Prairie Clover (Petalostemum candidum)	white	June	2 ft.			X	X	
Dotted Mint (Monarda punctata)	pink	May	1 ft.		X	X	X	
Smooth Beardstongue Foxglove (Penstemon digitalis)	white	June	3-4 ft.			X	X	

Appendix B: Plant Materials for Natural Landscaping

Prairie Plants: Wild Flowers	**Design Attributes**			**Habitat**				
Plant Name	**Color**	**Bloom**	**Height**	**Wet**	**WM**	**Mesic**	**DM**	**Dry**
Large Beardstongue (Penstemon grandiflorus)	lavender	May	2 ft.			X	X	
Meadow Rose (Rosa carolina)	pink	May	18 in.			X	X	
Grayheaded Coneflower (Ratibida pinnata)	yellow	July	3 ft.		X	X	X	
Sweet Black Eyed Susan (Rudbickia subtomentosa)	yellow	August	4-5 ft.		X	X		
Gray Goldenrod (Solidago nemoralis)	yellow	August	1-2 ft.				X	X
Stiff Goldenrod (Solidago rigida)	yellow	August	3 ft.			X	X	
Showy Goldenrod (Solidago spectosa)	yellow	August	3 ft.			X	X	
Joe-Pye-Weed (Eupatorium purpurelm)	purple	August	6 ft.	X	X			
Wild Iris (Iris shrevei)	violet	June	2-3 ft.	X	X			
Ironweed (Verononia fasciculata)	red	July	2-5 ft.		X	X		

Sources: WDOT Project 1161-06-62, USH 51 Columbia--Portage County Line; Prairie Seed Catalog, Prairie Seed Source, North Lake, Wisconsin; Native Wildflowers, Grasses, Plants and Seeds, Prairie Nursery, Westfield, Wisconsin.

Appendix C: Relative Cost Comparison for Landscape Treatment Combined with Barrier Material.

Landscape Treatment**	Barrier Material*					
	Metal		Wood		Concrete	
Limited (1)	Barrier Landscape Total	1.00 .05 1.05	Barrier Landscape Total	1.50 .05 1.55	Barrier Landscape Total	1.66 .05 1.71
Average (2)	Barrier Landscape Total	1.00 .08 1.08	Barrier Landscape Total	1.50 .08 1.58	Barrier Landscape Total	1.66 .08 1.74
Extensive (3)	Barrier Landscape Total	1.00 .22 1.22	Barrier Landscape Total	1.50 .22 1.72	Barrier Landscape Total	1.66 .22 1.88

Notes:

Multipliers are given using least expensive noise abatement, metal wall alone, as base. Base = 1.0. These estimates are approximate. Actual costs will depend upon the exact nature of the design, site conditions and maintenance concerns.

* Costs for barrier materials based on average unit cost ($/linear foot) from Appendix A.

** Landscape treatment cost based on landscaping along 100 linear feet of barrier and extending 15' into R.O.W. from barrier.

(1) Limited landscaping includes a continuous, single row hedge planted along barrier wall with remainder of landscape area (15' x 100') seeded with wild flower/grass mixture.

(2) Average landscaping includes a multi-row/mass planting of shrubs of various heights and occasional overstory trees (i.e. 3 per 100 linear feet). Remainder of landscape area (10' x 100') seeded with wild flower/grass mixture.

(3) Extensive landscaping includes 3' retaining wall extending partial length of barrier segment (i.e. 40'-50'); multi-row/mass planting of shrubs of various heights and occasional ornamental trees (i.e. 3 per 100 linear feet). Remainder of landscape area (10' x 100') seeded with wild flower/grass mixture.

APPENDIX D

ETHNIC NEIGHBORHOOD DESCRIPTIONS

The following information was derived from the Discover Milwaukee Catalog and the neighborhood poster series, both published by the City Department of City Development. Map 2 references the location of the neighborhoods identified below by the numbers in parenthesis.

- Near North Side (Harambee (1) and North Division (2))

This area was initially settled by Germans. Other ethnic groups represented include Polish, Dutch, Jewish, and Black. After WWII the Black population grew steadily, outnumbering the Germans by 1960. Today this area has become one of the most integrated sections of Milwaukee.

* This neighborhood was home to Borchert Field. Built in 1902, Borchert Field functioned as Milwaukee's major sports stadium until the construction of County Stadium in the early 1950's made it obsolete. It was located on 8th and Chambers, directly int he path of the I-43 freeway corridor. In 1952 the site was cleared for freeway construction.

- Far Northwest Side (Old Town of Granville)

Until the 1950's Granville was a major center for dairying and truck farming. The area was predominantly German, but many Irish also settled there. Today the area remains a mix of rural farmland, large lot old suburban, and newer, higher density suburban development.

* The interchange at Mill Road and Highway 45 is the site of old West Granville's "downtown".

- West Side (The Valley (4); Merrill Park (5); Marquette (6))

The area just west of downtown contains a mix of social classes and ethnicity. Many of the very wealthy families built large homes along Grand Avenue (Wisconsin Avenue) while members of the working class tended to locate directly to the west, toward the Menomonee Valley.

In 1880, Sherburn S. Merrill located his railroad shops in the Menomonee Valley. The railroad industry soon grew to be the largest employer in Milwaukee. Workers came from many ethnic backgrounds, but the Irish clearly dominated the working class Merrill Park neighborhood. In the Valley, sometimes referred to as "Pigsville", livestock farming and slaughterhouses provided much of the local employment. This neighborhood was physically removed from areas on top of the bluff, resulting in the creation of an isolated and independent neighborhood dominated by Germans and Slovaks.

- Far West Side (Story Hill (3))

The area west of the Menomonee River began to develop in the late 1920's as access was provided by the Interurban Railway. The area didn't experience rapid development until after WWII when demand for suburban development was very high. As such, this area is characterized as a post-WWII suburb.

- Near South Side (Walker's Point (9); Historic South Side (10))

The neighborhood just south of downtown exhibit a small scale, solid urban residential character. This character is reflected in the small scale of the numerous neighborhood businesses, e.g. corner stores, taverns and restaurants. There are few tall buildings and the skyline is distinguished by a profusion of church spires.

Industry became increasingly important in the area after the Civil War. Proximity to Lake Michigan and the Menomonee and Kinnickinnic Rivers gave this area strategic advantages. The Allen-Bradley clock tower remains both a neighborhood and city recognized landmark.

Walker's Point is recognized as Milwaukee's oldest neighborhood. It has always existed as an ethnically mixed neighborhood. Many Polish families initially settled here and are responsible for the construction of many of the prominent churches. A sizeable influx of Mexicans and Puerto Ricans since the 1940's has resulted in Walker's Point becoming the center of Wisconsin's largest Hispanic community.

The Historic South Side is less ethnically mixed than Walker's Point, being predominantly Polish. Likewise, many visually prominent churches were built in this neighborhood, notably St. Josaphat Basilica.

- South East Side (Bayview (11) and Tippecanoe (13))

Bayview began as a company town. The Milwaukee Iron Company, and iron and steel rolling mill, was opened by Eber Ward in 1868. Because of the need for skilled metal workers, many were imported from Great Britain. This area developed as the most distinct British community in Milwaukee.

Tippecanoe was settled by farmers. The extension of streetcar service to the area in the 1890's spurred some development. John Saveland, who owned large tracts of land in the area, had planned on developing the area as an upper income suburban residential community. However, his plans never materialized and the area became populated with mostly blue-collar workers. The name Tippecanoe is derived from a Republican party rally call and was chosen by Saveland, an outspoken local Republican.

- Far South Side (Morgandale (12))

This area consisted of productive farmland, woodland, and wetlands. Truck farming and greenhouses, many specializing in flowers, became the livelihood for the predominantly German and Polish settlers.

Mitchell Airport was developed on wet and marshy land. Construction began in 1926. Today the area is a mix of old and new suburban development. Much of the area south of College Avenue has remained in low density development, retaining much of its original rural/farm character.

APPENDIX E

FREEWAY NOISE BARRIER SITE INVENTORY ANALYSIS CHECKLIST

A. Barrier Location

Hwy. _____ between _____ and _____
Side of roadway: north/south/east/west
predominant sun exposure: front/back/side
entry/exit ramp
width: _____ material: _____

B. Predominant Land Use: _____

C. General Context: Urban/Rural/Suburban

D. Specific Context

1. Neighborhood Character

- old/new; homogeneous/diverse; describe: _____

- density: high/medium/low; describe: _____

- predominant building materials (color, texture, etc.): _____

_____

- predominant landscape materials: _____

_____

- existing nearby barriers? no/yes; describe: _____

_____

- existing nearby structures (bridges, retaining walls): _____

_____

- significant views? no/yes; good/bad; describe: _____

_____

- significant landscape/neighborhood features? no/yes; describe: _____

_____

- location of barrier relative to housing (across street; at end of street; in back yard): _____

_____

2. Barrier Site (R.O.W.)

- highway elevation: cut/fill/at grade: _____

- available space (r.o.w. width): _____

- existing topography: _____

- existing landscape materials and condition: _____

E. Historical/Cultural Significance

- ethnic heritage: _____

- historic activity: _____

- industrial base: _____

F. Other Significant Characteristics or Issues: _____

_____

_____

_____

_____

*U.S. GOVERNMENT PRINTING OFFICE: 1990--717-000/27198