Landscape and Aesthetics Design Manual

August 2024

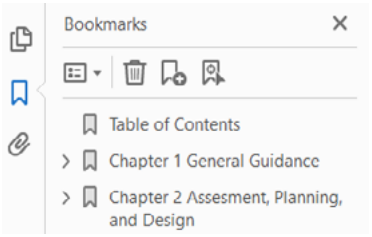
Texas Department of Transportation

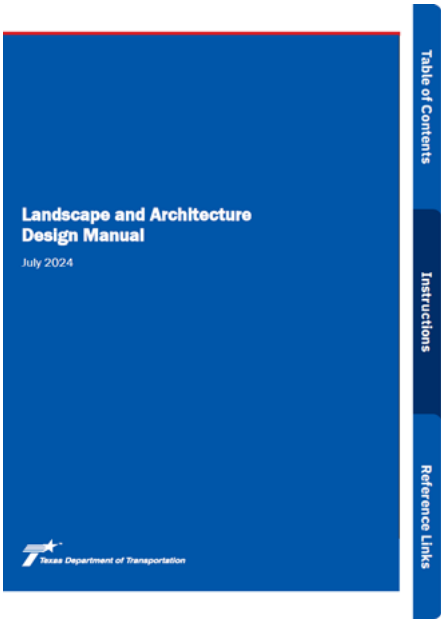
Tips for Using Your eBinder

Quick Navigation

Navigate the ebinder by clicking on the tabs to the right. Jump to each chapter and its subchaptures using the Table of Contents tab.

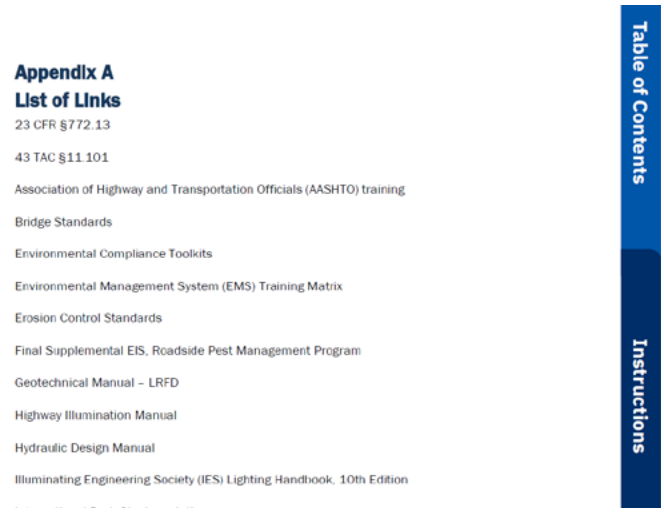
You can also explore the ebinder by clicking on the bookmark icon on the left sidebar to navigate using bookmarks in the manual.





Reference Links

All external links will link to the Reference Appendix in this eBinder. The Reference Appendix houses all external links in order of appearnce. Clicking each link in the Reference Appendix will take you to the external destination.



Manual Notice:	2024-1
From:	Jason Pike, P.E., Director, Design Division
Manual:	*Landscape and Aesthetics Design Manual*
Effective Date:	August 16, 2024

Purpose

The Landscape and Aesthetics Design Manual is being completely revised:

- To reflect improved business practices;
- To reorganize the content in a more logical sequence and to aggregate subject matter together per chapter; and
- To update photos and references to internal and external resources, and to best reflect TxDOT current standards and built projects.

Content

- Chapter 1 has been revised to introduce additional roadway context classifications, facility types, and ecoregions.
- Chapter 2 has been revised to modify the Landscape and Aesthetics Assessment and the Landscape and Aesthetics Master Plan Development Process.
- Chapter 3 has been revised to include design conditions and landscape/softscape material selection for projects.
- Chapter 4 has been revised to include hardscape, lighting, and public art design guidance.
- Chapter 5 has been revised to list reference materials.
- Appendix A has been added to provide a list of links to resource materials.

Supersedes

The revised manual supersedes prior versions of the manual.

Instructions

The Landscape and Aesthetics Design Manual applies to all projects requiring landscape architecture beginning with the November 2024 Letting. The Districts and Divisions are encouraged to use this manual prior to this date.

Contact

Mark Baker, Supervisor, Landscape Architecture Branch
Design Division, Mark.Baker@TxDOT.gov, (512) 496-9972

Archives

Past manual notices are available in a PDF archive link.

Contents

Chapter 1
General Guidance

1.1 Overview

Landscape Architects have a long history with TxDOT, dating back to the hiring of Jacobus 'Jac' L. Gubbels as the first 'Landscape Engineer' in 1933. His philosophy that a completed highway design should be "in harmony with the surrounding landscape" and avoid "angular stiff …sharp lines and corners" since these posed a "mental hazard" to the driver still holds true today.

Just as TxDOT has grown, this aesthetic has expanded; today Landscape Architects are charged with visually and physically integrating highways and transportation facilities into the fabric of the surrounding landscape, providing visual relief, and improving the safety and function of the entire transportation network. The public is increasingly demanding aesthetic enhancements to existing and proposed transportation facilities.

The first consideration of landscape and aesthetics master planning and design is to improve the safety and function of the transportation network. This means that aesthetics planning is a process that occurs at every stage of design, construction, and maintenance. In most cases, meeting basic safety, operational, and design goals will be sufficient to meet most landscape and aesthetics goals. However, in special cases, meeting aesthetics goals may require going beyond these basic needs, without compromising the safety of the facility.

The goal of this manual is to provide the tools and resources Landscape Architects require to create the best possible designs, furthering TxDOT's mission of 'Connecting You to Texas'.

1.2 Roadway Context/Design Philosophy

The landscape design aesthetic of the roadway works hand in hand with the perceived density, scale, and complexity of the roadway contexts. The appropriate design response for each context recognizes the role color, form, and massing play to preserve views and sight lines and to enhance safety.

The five context classifications shown in **Figure 1-1** are discussed in greater detail in TxDOT's **Roadway Design Manual** (RDM). The following descriptions provide a landscape design response to each context.

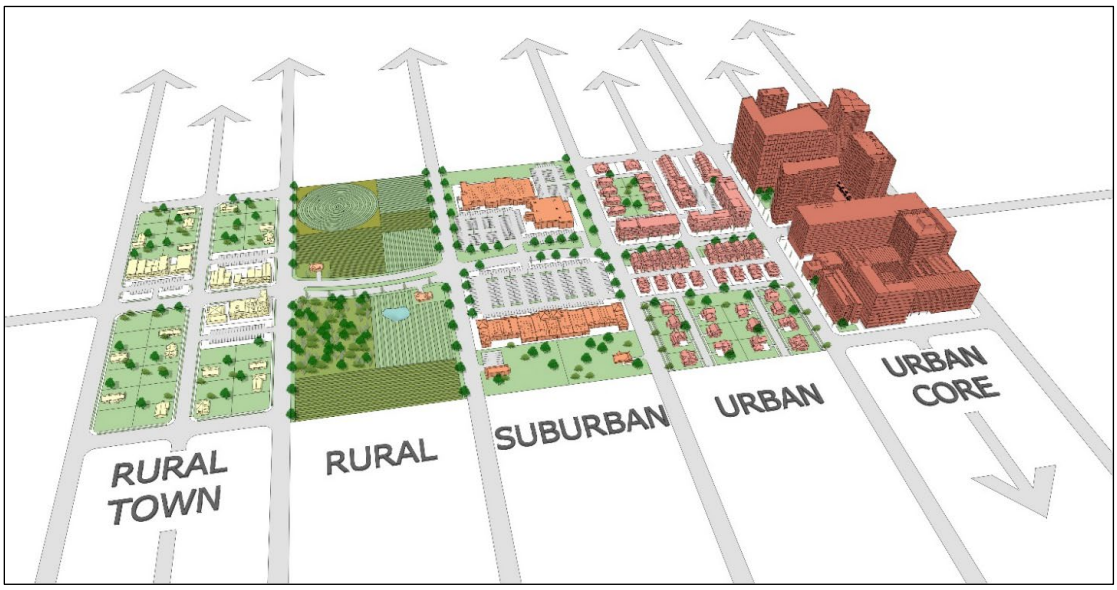


Figure 1-1: TxDOT's Context Classification System

1.2.1 Rural Town Context

These are areas with low development density but diverse land uses with commercial main street character, potential for on-street parking and sidewalks, and small setbacks. This is a transition zone, with density changes signaling an increase in vehicular activity and landscape complexity, usually found at community and town entries. A visual transition also occurs due to the smaller setbacks, bringing the focus inward to the community.

Since travel speed and setback distance have lessened, less dramatic color and form contrast may be used to achieve the desired results as shown in **Figure 1-2**. To create effective design features with the rural town context, landscape strategies should reinforce the transition edge, while focusing the driver's attention on increased activity:

- Colors should draw attention to key views;

- Form and texture changes effectively identify community entrances; and
- Plant material massing may be used to enhance specific views and to screen others.

Figure 1-2: Rural Town Context

1.2.2 Rural Context

These are areas with the lowest development density, few houses or structures, and usually large setbacks. The extent and expansive view of the natural landscape is dominant and takes precedence over the perceived scale of the highway as shown in **Figure 1-3**. Since speeds are higher, the forms, colors, and textures tend to blur. To draw attention to design features along rural roads, the designer must provide a dramatic contrast:

- Utilize colors that contrast with the background, creating the greatest impact;
- Implement forms that break the horizon line/tree line, drawing visual interest; and
- Plant material massing and density to reinforce view sight lines.

Figure 1-3: Rural Context

1.2.3 Suburban Context

These are areas with medium development density, mixed land uses within and among structures, and varied setbacks. This is a moderately active zone, with residential and commercial development, multiple lanes with or without medians, and an increasingly complex built environment as shown in **Figure 1-4**. The design philosophy combines elements of rural and urban contexts:

- Consistent use of color changes in planting and building materials creates community identity and connectivity;
- Form and surface texture changes should be bold for visibility; and
- Plant material massing, especially within medians and at entries, should allow a clear, unobstructed view.

Figure 1-4: Suburban Context

1.2.4 Urban Context

These are areas with high density development, mixed land uses and prominent destinations, potential for some on-street parking and sidewalks, high levels of pedestrian and bike activity, and mixed building setbacks as shown in **Figure 1-5**. This is an active zone, with signage, driveways, and entries competing for attention. The design must create navigable and safe corridors for pedestrians and cyclists, while maintaining sight lines and minimizing driver distractions:

- Use plant material massing to control sequences of views and to screen undesirable views; and
- Forms may be used to reduce noise and light spill from roadways.

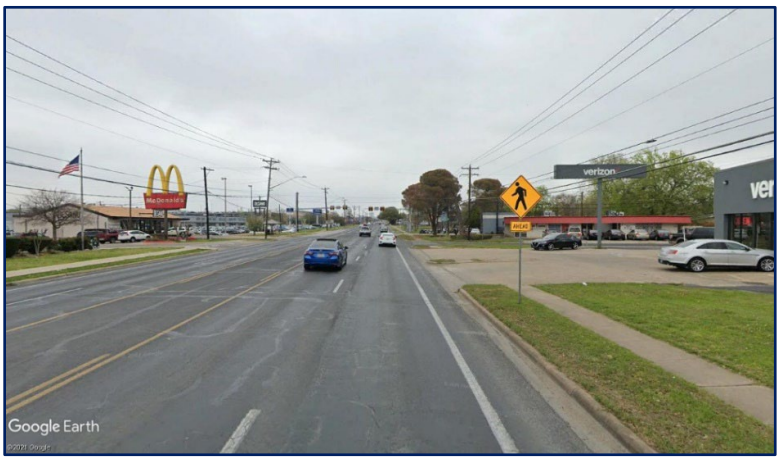


Figure 1-5: Urban Context

1.2.5 Urban Core Context

These are areas with the highest development density, mixed land uses within and among predominately high-rise structures, and limited setbacks as shown in **Figure 1-6**. This is the most active zone, with vehicular, pedestrian, and bicycle traffic accommodated within the right of way (ROW). Additional layers of social, historical, and cultural landmarks may need to be factored into design decisions. Visual complexity should be minimized, and clear sight lines maintained:

- Color choices and material textures should relate to the surrounding structures; and
- Plant material often provides the 'green relief' in these areas. Maintain the upper canopy and ground plane massing, leaving views clear in the middle zone.

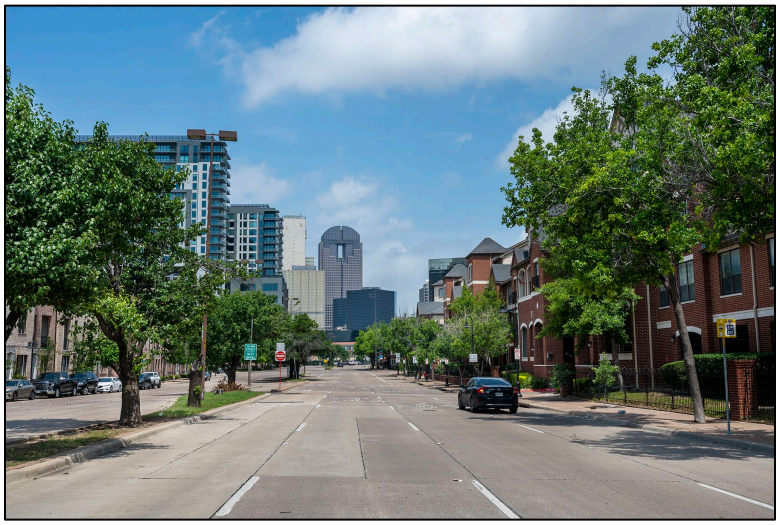


Figure 1-6: Urban Core Context

Regarding discussion throughout the remainder of the manual, references to "rural" include Rural Town and Rural contexts. References to "urban" include Suburban, Urban and Urban Core contexts.

1.3 Facilities

TxDOT's public ROW are in a unique position to conserve and protect natural resources by physically and visually integrating sites into the surrounding landscape by employing creative design solutions including, but not limited to green infrastructure (**Section 3.7.1**), rainwater harvesting (**Section 3.5.3**), habitat creation (**Section 3.4.7.3**), and xeric plant materials (**Section 3.5.4**).

These innovative design opportunities, in conjunction with the roadway context design principles, promote public awareness of TxDOT's commitment to the long-term sustainability of the state's transportation system.

TxDOT properties are not only comprised of ROW, but also include facilities such as Headquarters, District Offices, Area Offices, Maintenance Offices, Ferry Landings, Travel Information Centers, Roadside Parks, Safety Rest Areas, and State Entry Signs. Regardless of size, the appropriate landscape design response for any TxDOT property should visually and physically integrate the built elements into the landscape in a way that complements the natural surroundings. This integration is best represented when linked to the routine and function of the building site.

1.4 Ecoregions

The landscape design aesthetic of TxDOT facilities and roadways should be in keeping with the character of the individual TxDOT District, as well as the more specific individual character of each District's Ecoregion and plant hardiness zones.

1.4.1 Texas Parks and Wildlife Texas Ecoregions

Texas is divided into 10 natural regions or ecoregions: the Piney Woods, the Gulf Prairies and marshes, the Post Oak Savannah, the Blackland Prairies, the Cross Timbers, the South Texas Plains, the Edwards Plateau, the Rolling Plains, the High Plains, and the Trans-Pecos as shown in **Figure 1-7**.

Figure 1-7: Texas Parks and Wildlife Ecoregions

1.4.2 USDA Plant Hardiness

USDA Plant Hardiness Zone Map is the standard by which landscape architects can determine which plants are most likely to thrive at a location (see **Figure 1-8**).

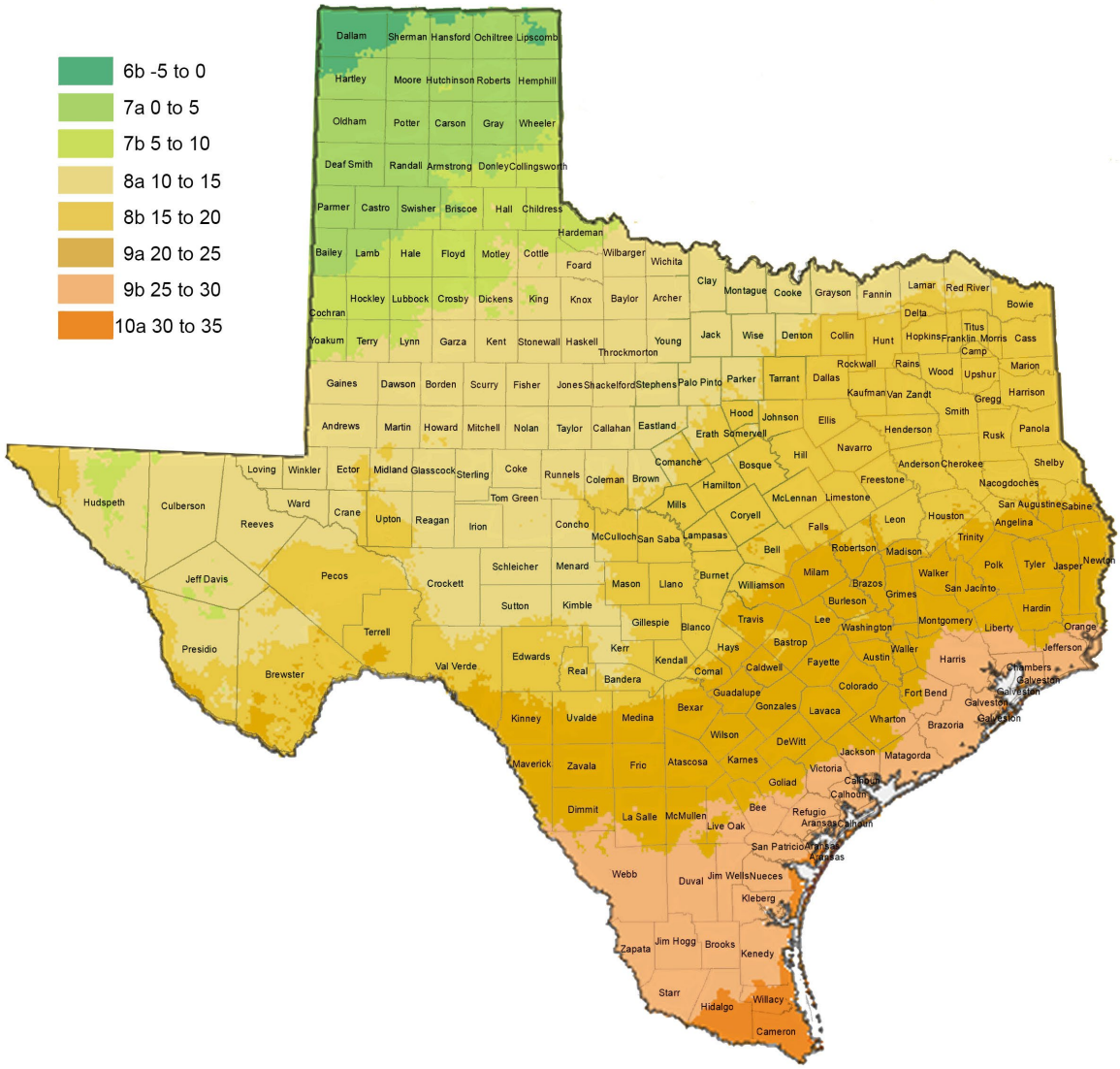


Figure 1-8: USDA Plant Hardiness Zone Map

1.4.3 Texas Rivers, Creeks, and Watersheds

The 13 major river basins of Texas vary greatly in size, shape, and stream patterns as shown in **Figure 1-9**. Although the river basins share many common features, each is unique. River basins reflect the climate, geology, topography, and vegetation of an area. Annual rainfall rates and watersheds are major factors to be considered in the selection of vegetation types.

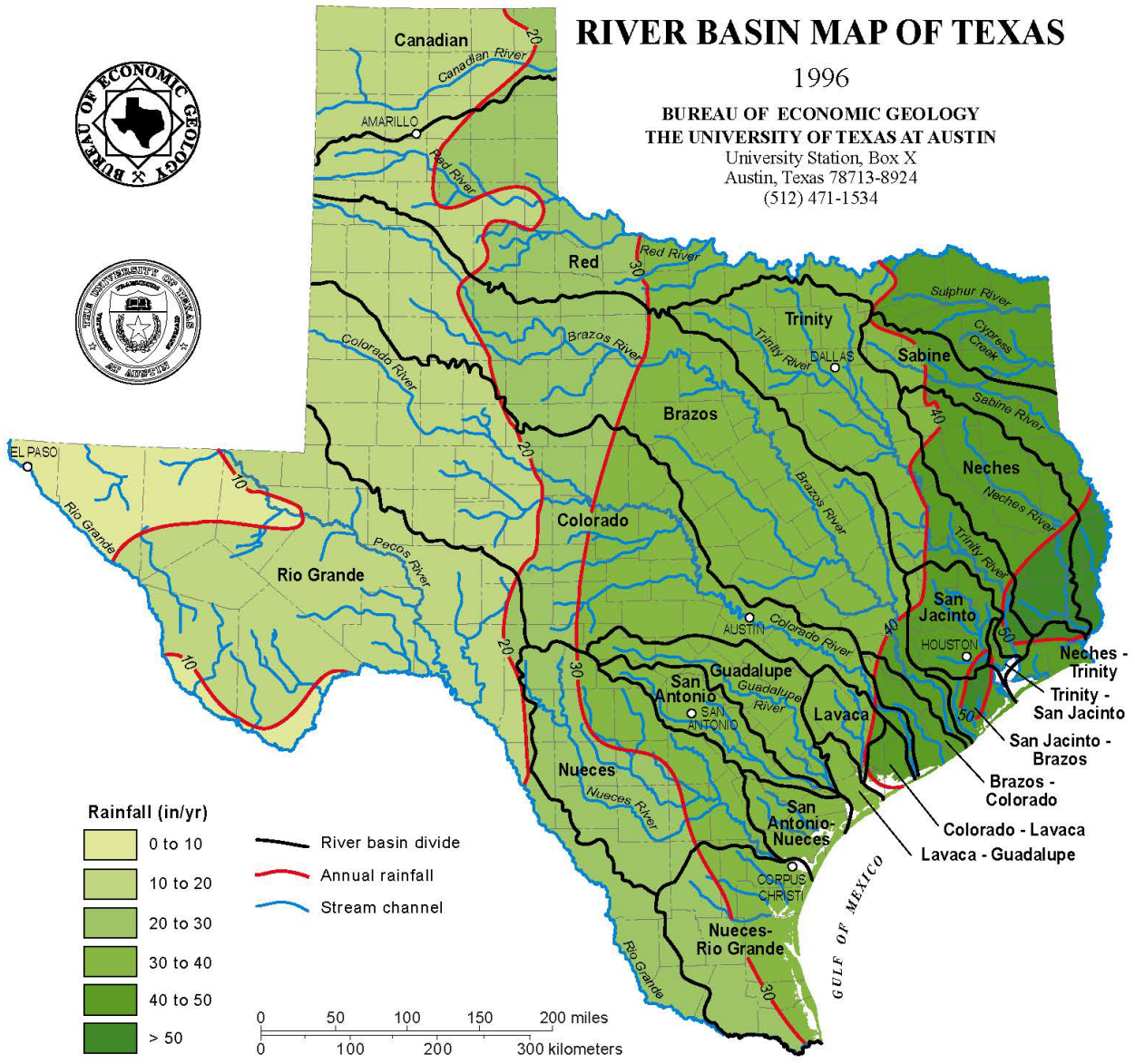


Figure 1-9: Texas River Basins/Rainfall

Chapter 2
Assessment, Planning, and Design

2.1 Overview

The Landscape and Aesthetics Assessment (LAA) is a tool for identifying landscape and aesthetic Opportunities and Constraints associated with a specific highway corridor segment. The procedure involves field observation and participation in the public engagement process.

2.2 Landscape and Aesthetics Assessment

The objectives of the LAA are to identify opportunities and constraints within the corridor, especially as they pertain to the following:

- Recognizing landscape and aesthetic issues that will impact the character, cost, and/or sustainability of a transportation project;
- Ensuring that the landscape and aesthetic qualities of a corridor have been considered as required by law;
- Distinguishing items related to the character of architectural features and details;
- Categorizing elements that relate to the selection of materials, colors, and color schemes;
- Ascertaining regionally appropriate design themes;
- Informing entities about the opportunities for cost sharing; and
- Gathering information that will assist in estimating development costs.

2.2.1 LAA Development Process

Table 2-1 lists steps in the LAA development process. These steps are explained in further detail following Table 2-2.

Table 2-1: LAA Development Process Steps

Step Number	Tasks
Step 1	Identify the highway corridor segment
Step 2	Inventory the corridor
Step 3	Identify opportunities and constraints

Step 4	Assess the sensitivity of the corridor to construction and change
Step 5	Develop a landscape and aesthetics assessment statement

Step 1: Identify the Highway Corridor Segment

A highway or transportation corridor does not usually correspond to the exact physical limits of a project. To ensure visual and aesthetic continuity, it is important to fit project-related aesthetic design decisions into a recognized corridor segment. A corridor is a section of highway possessing significant tangible boundaries. Characteristics that usually impact the perception of boundaries are physical features, significant intersections or bridge crossings, historic districts, or neighborhoods, commercial or institutional centers, or distinctive scenery or open space. **The key to corridor definition is identifying beginning and ending points that are meaningful to local residents**. See **Figure 2-1**.

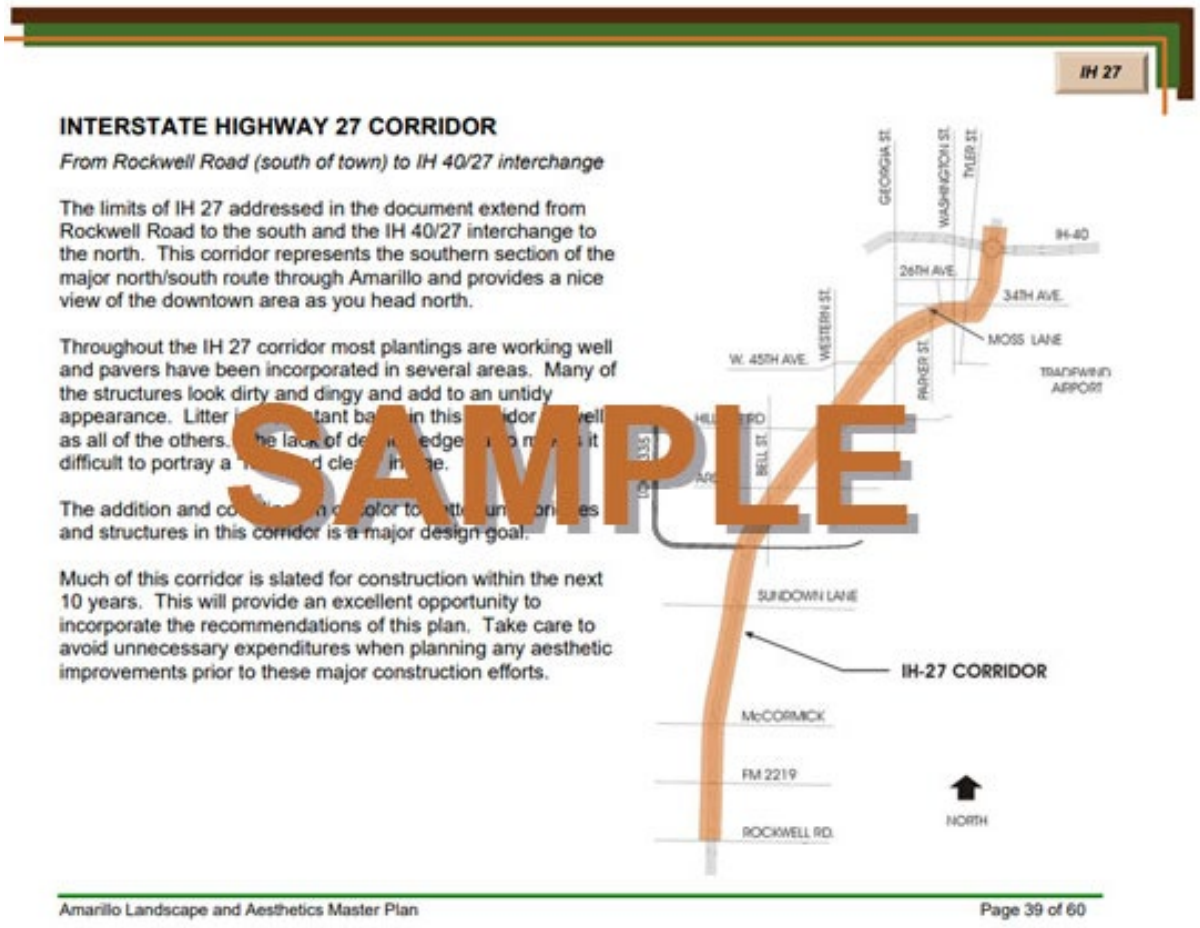


Figure 2-1: Example of Corridor Segment (SAMPLE)

Step 2: Inventory the Corridor

The LAA inventory involves collecting data and documenting a variety of existing physical and contextual surroundings, while anticipating the proposed corridor impact.

Corridor Geometry - Physical surroundings

Be aware of the potential for significant change created by proposed geometry or alignment; drastic character changes can cause adverse public reactions. Rural and urban landforms are impacted differently by highway corridors. For example, in most urban areas, projects to expand the number of lanes within an existing ROW will require the use of numerous retaining walls and/or sound walls which will change the views, character, and feel of the existing highway.

In a rural, natural landscape with high topographic relief, the cuts and fills of proposed corridor development result in sharp visual contrast with the natural forms of the topography as shown in **Figure 2-2**.

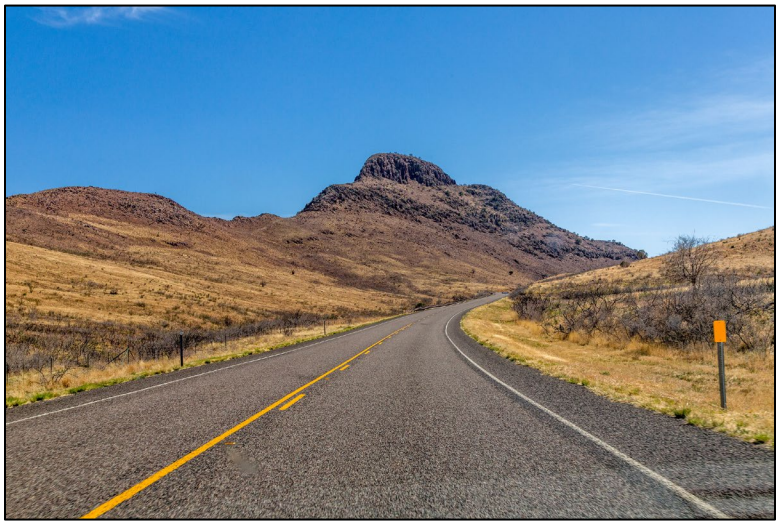


Figure 2-2: Topography/Rural Landforms

In urban areas, the highway corridors can become concrete canyons or tunnels in the urban skyline as shown in **Figure 2-3**. It is important that the potential impact be recognized and that any potential adverse public reaction to this impact be recognized early in the process. (See also discussion on topography and grading in **Section 3.6**)

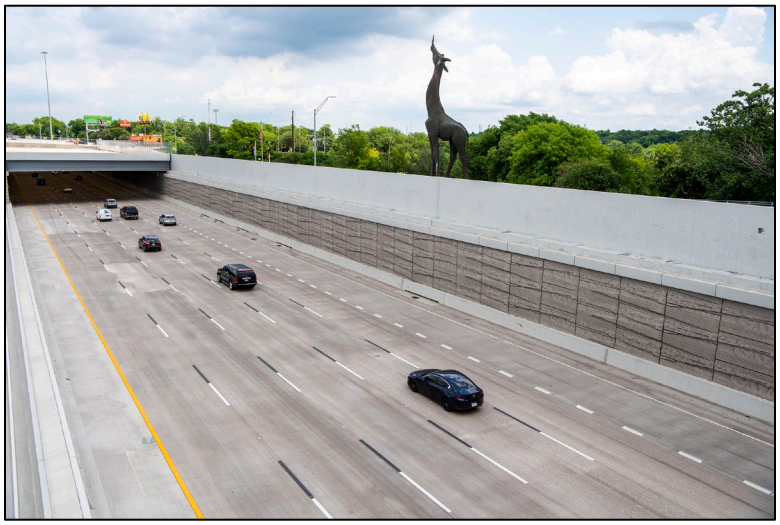


Figure 2-3: Attention to textures and colors in deep cuts can keep areas from being a negative driving experience.

Corridor Geometry - Contextual surroundings

Where the public is concerned, the neighborhood context is the most important part of the landscape and aesthetics assessment. Residents, businesses, and institutions that border a transportation corridor have a vested interest in the overall design. Studying the neighborhood context and identifying public concerns are vital to the success of the project. This requires participation in the public engagement process and careful attention to comments that relate to landscape and aesthetics design.

The cultural properties of a corridor relate to the historical and regulatory framework that may overlay a project. Ephemeral properties (i.e., the characteristics of a site that change with time, such as the progression of seasons or play of light and shadow) apply to a LAA. Designers must be aware of these influences, since they are often difficult, or impossible to see, yet evoke very strong emotional ties within a community. Elements such as a local reverence for a seemingly insignificant church building or the seasonal bloom of regionally prized trees can cause significant delays in a project if the value to the community is not recognized early in the design process.

Step 3: Identify Opportunities and Constraints

Based on the material gathered in the inventory, identify the corridor's visual and aesthetic opportunities and constraints. The objective of this step in the assessment is to be broad.

Consider all the possibilities and reduce the focus on details.

Opportunities

The goal in the LAA is to identify anything that could be considered an opportunity or an asset to the design process, no matter how it might be used in a final design recommendation. Opportunities are any physical or contextual characteristics that would allow enhancement of the visual, scenic, and environmental qualities of the highway corridor as shown in **Figure 2-4**. This may be related to alignment, landform, adjacent property conditions, or vegetation as well as the ephemeral properties of a community. The availability of ROW also provides very important opportunities that should not be overlooked.

Communities that have an interest in partnering with TxDOT for landscape and aesthetics improvements, exhibited by a willingness to assume responsibility for long-term maintenance, should be actively recruited.

Figure 2-4: Landmarks as Orientation Elements

Constraints

Constraints may include physical landscape limitations as well as potential conflicts with adjacent property owners or communities that will make project design difficult. Significant physical conflicts are usually obvious.

Much less obvious are the conflicts that arise because of public perceptions of a project or conflicts that arise out of the cultural context of place. These are most often related to the history of a place or local customs and traditions.

Step 4: Assess the Sensitivity of the Corridor to Construction and Change

The sensitivity of a corridor to development and change must be judged based on the opportunities and constraints identified. It is difficult to suggest any specific guidelines or tools that would be helpful in making this judgement. However, if each area of the inventory is addressed and reviewed in terms of the opportunities and constraints, the relative sensitivity to the corridor development will generally be evident. Examples of land uses that tend to have high sensitivity to development are:

- Established residential neighborhoods;
- Historic areas/districts;
- Regional parks, including areas of botanical interest and special habitats;
- Special districts, medical facilities, retail centers;
- Areas of high scenic quality, mountain, ocean or water views, panoramas, etc.;
- Wetlands and aquifer recharge zones;
- Developed urban freeway corridors;
- Churches/burial sites; and
- Stormwater management and green infrastructure.

When any of these types of land uses are encountered, special attention should be given to the documentation process, as well as the public engagement process. These are the primary initial opportunities to identify the critical issues within the corridor boundaries. The information assembled and documented during this step informs the detailed design process, which in turn should ensure that the proposed project does not negatively impact the surrounding areas as shown in **Figure 2-5**. Collaboration and coordination with TxDOT environmental staff are often required during this step.

Figure 2-5: Example of Project Documentation

Step 5: Develop an LAA Statement

The purpose of the LAA Statement is to document the aesthetic issues that need to be addressed in the detailed design process. The statement should frame issues in a way that encourages a positive design response. For example, if a new corridor alignment endangers a stand of prized trees in a neighborhood, the assessment should identify the tree species and location and indicate what actions may be necessary to protect and save the trees. Or, if the corridor alignment cannot occur without damaging the trees, what measures would be appropriate, such as relocation/mitigation. Similarly, where neighborhood concerns such as objectionable views are evident, the assessment should state the issue and present design options that could be cost effective in mitigating the problem. The goal of the LAA Statement is to identify the issues and provide suggestions that maximize design flexibility.

2.2.2 LAA Statement Outline

The following elements should be included in the LAA Statement outline:

Project Scope

- Physical location and description of work (e.g., Widening of IH-45 from 610 south to IH 69)

Inventory of Corridor

- Identification of corridor (indicate whether corridor design runs beyond physical project construction limits);
- Inventory of physical properties;
- Physical surroundings; and
- Contextual surrounding issues arising from public engagement process.

Design Considerations

- Discuss specific landscape and aesthetics design issues that should be addressed in the detailed design process;
- Present options rather than individual or specific design solutions; and
- Couch the proposed project statement in terms that relate to the language of public engagement.

2.3 Landscape and Aesthetics Master Plan

The Landscape and Aesthetics Master Plan (LAMP) is a tool for managing the aesthetic qualities of a highway segment and for communicating TxDOT's plans for aesthetic improvements to state maintained ROW to the public.

The objectives of the LAMP are to:

- Control the level and complexity of landscape development to ensure sustainability within departmental resources;
- Demonstrate that the landscape and aesthetic qualities of a corridor have been considered and actions are appropriate, as required by law;
- Coordinate architectural features and details;
- Coordinate materials palettes;
- Coordinate colors and color schemes;
- Establish regionally appropriate design themes;
- Provide a method for developing cost sharing agreements; and
- Provide a method of estimating development and maintenance costs.

2.3.1 LAMP Development Process

This section describes the process of developing a LAMP, establishes the elements of the plan, and provides an example that can be used to develop plans for urban and rural corridors. **Table 2-2** shows the steps in developing a LAMP. The steps are explained in detail below.

Table 2-2: LAMP Development Process Steps

Step Number	Task
Step 1	Use LAA Statement developed during LAA
Step 2	Develop design guidelines to guide development of the corridor
Step 3	Divide the corridor into development zones

Step 1: Utilizing the LAA

The LAA provides a comprehensive picture of the existing land uses facing the designer. No matter the scope of the project or the stage of the design process, an assessment of some

type must be performed to ensure that important issues are not overlooked. In this step, the designer uses the LAA to address key design considerations identified within the corridor. This may include (but not be limited to):

- Views to be preserved;
- Significant landscape/trees to be preserved;
- Areas to be screened;
- Best locations for sound walls;
- Best locations for landscape plantings;
- Problem maintenance areas;
- Key off-site relationships and interactions; and
- Sites requiring environmental mitigation or protection.

Once a designer has determined the best approach for meeting specific design goals, the process proceeds to the development of design refinement in Step 2.

Step 2: Develop Design Guidelines for the Corridor

The simplest form of a LAMP is a list of design detail palettes. These guidelines provide maximum design flexibility while ensuring harmony among the basic design elements described in other sections of this manual.

To guide the design of a transportation facility with respect to its landscape and aesthetics properties, there are five palettes within a basic LAMP Tool Kit:

- Materials color palette;
- Materials finish palette;
- Signage and fixtures palette;
- Structural systems and details palette; and
- Plant materials palette.

A materials table organizes the selections made from the five palettes listed above.

Materials Color Palette

Standard building materials are typically neutral in hues, though not all hues are complimentary. It is very important to coordinate the colors of materials used within a project. In so far as possible, all structures placed on the roadside or incorporated into the pavement surface, signage, and other appurtenances should take advantage of natural color and avoid the use of any finish requiring routine maintenance or replacement.

For example, painted surfaces should be avoided wherever possible. The color palette within the guidelines should list the material along with the source and the color name provided by that source (if available).

Materials Finish Palette

Finishes are also related to the natural color of the material. In the context of landscape and aesthetics design, finish has to do with the textural quality of the surface or any special surface treatment, such as vandal resistant finishes or sandblasting.

Signage and Fixtures Palette

The palette would include, but not be limited to fencing, sign supports, guardrail supports, hardscape finishes below guardrails, delineators, crash barriers, rail terminators, luminaires, poles, and signals. These are small items but should coordinate with the major design components to ensure a harmonious composition.

Structural Systems and Elements Palette

This palette catalogues the elements that will be used for a variety of structures. It lists the considerations that would not necessarily be covered in the Materials Color palette, Materials Finish palette, or the Signage and Fixtures palette. For example, there are a variety of panel shapes that can be used for reinforced earth retaining walls as well as for the wall cap and termination. Likewise, the finish on materials such as concrete masonry units (CMU), segmented retaining wall (SRW) blocks, and walks can vary widely. Other elements that might be included are bent shapes and reveals, beam reveals, bent ends and connection types, special bridge rails and CTB, head and end wall railings, pedestrian separation railings, treatment of median voids, under bridge surfaces, and traffic channelization islands.

This section of the corridor plan requires a great deal of coordination between bridge, roadway, signs and signals, and environmental personnel. This section could be a simple table or may involve a more detailed catalog of design options based on the appropriate development zone. The concept of development zone is elaborated in Step 3.

Materials Table

A materials table organizes the selections made from the four palettes discussed above. A materials table may be used to view many different elements at one time and allows the designer to consider aesthetics issues for the corridor as a whole, rather than on a piece-by-piece basis. The list of elements shown in the materials table (MATTBL) is for example purposes.

The final list will vary with the project. The list should include as many elements as possible even if the element will be a generic type. This prompts comparison between these and elements that might be treated specially. In addition to the items already listed, other elements for consideration might include:

- Delineators;
- Crash barrier;
- Rail terminator;
- Signals and supports;
- Signs and sign supports;
- Bridge types;
- Abutment protection;
- Bent ends;
- Reinforced earth walls and cap;
- Medians and gores;
- Medians w/drainage section;
- Bridge rails;
- Guard rails;
- Noise walls;
- Sign bridge, vertical and horizontal;
- Sign mounting hardware; and
- Riprap.

See **Figure 2-6** for a description of different bridge components.

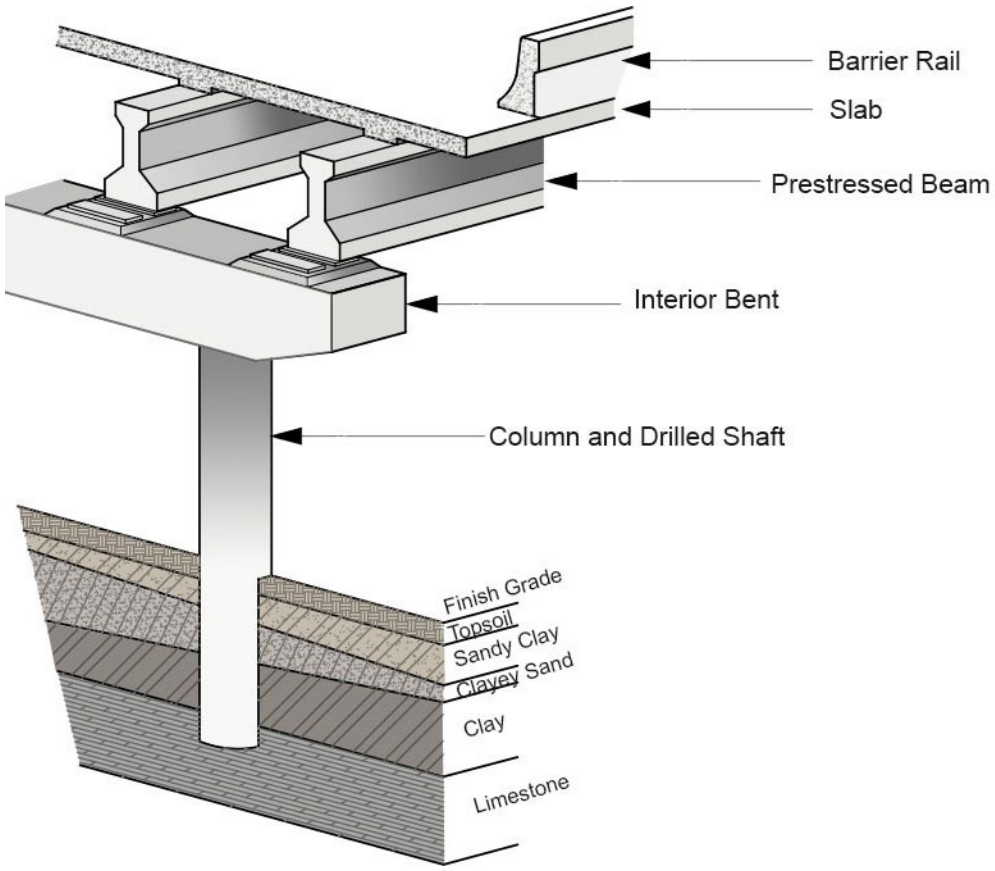


Figure 2-6: Bridge Aesthetic Components

Plant Materials Palette

Plant materials should be divided into two sections. The first section would have recommendations for basic erosion control as well as appropriate landscape enhancements for the purpose of minimizing maintenance and ensuring a safe, sustainable roadside. The second section should specify proposed plant materials for ornamental purposes in cases where special interests or adjacent communities wish to partner with TxDOT for long term maintenance.

Step 3: Divide the Corridor into Development Zones

The application of the corridor LAMP will coordinate development to satisfy landscape and aesthetic concerns and ensure coordination with the natural and built elements of the highway. **This development zone concept is a key to ensuring the long-term sustainability of a highway corridor**. A development zone is a classification of the highway corridor that reflects the anticipated levels of intensity and character of landscape development. This includes all structures, pavement, and planted ROW maintained by TxDOT. After issues of

safety have been addressed, the primary consideration as to the ultimate feasibility of a project will be the level of maintenance it will require to function as it is intended. The level of development is related directly to the department resources required for long-term maintenance, a combination of available funds and the pool of expertise available through the contracting and inspection process.

Three zone types are defined, which represent three different levels of development (see **Table 2-3**). This is an element-based approach that uses the estimated development and maintenance considerations of structures, planting, surface treatment, mowing, and access to classify the project. The first two zones include ornamental landscape enhancements and require a community partner to assume responsibility for long-term maintenance. Zone III has no ornamental enhancements. All planting and other materials are used to reestablish native or adapted vegetation associations to achieve long-term erosion control and sustainability of the corridor.

This approach does not precisely quantify maintenance costs but does enable the designer to recommend preliminary resource allocation regarding maintenance levels and maintenance locations. The calculation of more accurate maintenance costs for any specific project will be performed as part of the site-design process.

Zone I – High Maintenance

Zone I has intensive development requiring frequent or intense landscape maintenance. Almost any type of structure and/or surface treatments may be in a Zone I development. All Zone I development is limited to projects where a public entity contracts with TxDOT to assume responsibility for all maintenance, except the pavement and associated structures.

Zone I development is generally discouraged on all state ROW due to the extreme maintenance requirements. Before a public entity is allowed to develop a ROW to this level, TxDOT should be satisfied that the entity seeking the partnership has the experience and wherewithal to maintain the development at an appropriate level and that the proposed development will in no way threaten the public health or safety.

- **Structures:** Zone I development usually involves an interchange or intersection. For this reason, there are often bridges, channelization islands, signs, lighting standards, and other types of structures that must be considered as part of the project.
- **Plant material:** Projects will have a significant budget devoted to the installation of ornamental plant materials (shrubs, groundcover, annuals, and perennials) and a

percentage of the non-paved areas devoted to ornamental planting. These areas also contain large quantities of prepared soil and mulch, require mechanical weed removal and/or the use of selective herbicides, and irrigation.

- **Plant bed areas:** In Zone I projects, bed areas are subject to weed and grass invasion. Maintenance of the beds requires frequent edging.
- **Irrigation:** Any landscape development that requires continuous/scheduled irrigation of plant materials is a Zone I development.
- **Mowing:** Zone I includes any project requiring frequent mowing cycles to maintain a manicured appearance, or projects with irregular shapes that require the use of small push-type or riding mowing machinery.
- **Access:** Access may be limited, and special equipment may be needed to remove refuse or to maintain plants.

Zone II – Medium Maintenance

This zone limits the types and placement of plant material and the length of time in which routine maintenance will be required. Maintenance activities for plants in this zone may be intermittent, perhaps only once per year or two years.

- **Bed preparation:** No bed planting which requires the wholesale disturbance of the soil, either in tilling or the adding of soil amendments, except under special circumstances, (such as mass reforestation tree planting) shall be included in Zone II. Shrubs used in rows or as mass plantings shall be planted in individual planting pits. Preparation of planting areas shall be limited to mowing or herbicide application of existing vegetation.
- **Plant material:** Trees and shrubs used in Zone II shall be those with significantly low maintenance requirements and must be placed in areas where their full mature size can be attained without pruning. Shrubs shall be those species which are rapid growers, evergreen or fast-growing perennials that are greater than 4 ft tall and are able to effectively shade out weed seedlings beneath them once established. No plant in Zone II will require pruning to maintain a specific shape or character. Plants requiring routine insect control or fertilization beyond establishment should not be used.
- **Weed control:** Weeding required in Zone II (after the plant establishment period) shall be limited to the use of mechanical or herbicide treatments of structure edges or tree-wells only. No hand weeding shall be required.

- **Irrigation:** Irrigation shall be limited to drip or bubbler systems with automatic controllers. Temporary irrigation systems with shrub risers are allowed. No turf irrigation shall be used.

Zone III – Low Maintenance

This zone includes landscape elements or treatments that require little or no long-term increase in maintenance.

- **Plant material:** Plant material in Zone III shall be limited to the use of tree plantings within areas not included in regular mowing cycles. Shrubs shall be used primarily to reduce or improve maintenance within a site. Only those plant species of demonstrated hardiness for the roadside shall be used. No insect control, supplemental fertilization, or pruning is anticipated for the life of the project.
- **Weed control:** Weeding required in Zone III shall be limited to the use of herbicide treatments of tree-wells or shrub plantings for a short period only to enhance establishment. No later weed control is anticipated for the life of the planting.
- **Irrigation:** Irrigation shall be limited to the use of truck irrigation only. No continuous, long-term irrigation is anticipated after the establishment period.
- **Access:** Planting included in Zone III shall not be placed near any structures or obstacles in such a way that normal mowing operations shall be affected.

2.3.2 The Development Zone Chart

Table 2-3 provides a graphic description of how the zones are organized. A project's zone classification is determined by which of the highlighted areas are expected to occur in the project. This table is a summary of the development characteristics of the various development zones.

For instance, if a project is expected to require continuous hand-weeding after establishment, it is considered to be a Zone I landscape. Likewise, any project that can be mowed only by push mowers is also rated as a Zone I.

The zones are necessarily vague since many specific design decisions affecting maintenance are yet to be made at the site-design level. TxDOT will make the final determination of the level of management.

Table 2-3: Development Zone Chart

Components	Zones		
	I	II	III
Prepared Beds			
Ground level	●	-	-
Raised bed	●	-	-
Groundcovers			
Perennials	●	-	-
Shrubs			
Deciduous	●	●	-
Evergreen	●	●	●
Ornamental grasses	●	-	-
Trees on Slopes			
Slopes 4:1 or steeper	-	●	●
Slopes flatter than 4:1	●	●	●
Mowing			
Frequent	●	-	-
Infrequent, 1 – 2 times per year	-	●	-
Weed Control			
Hand-weeding	●	-	-
Herbicide application	●	●	●
Mechanical (trimmers)	●	●	-
Irrigation			
Turf - below ground drip	●	-	-
Drip or bubbler systems	●	●	
Truck irrigation	-	-	●

2.3.3 Partnering Opportunities

TxDOT resources are generally not sufficient to maintain a Zone I or Zone II project. These types of development require a high degree of maintenance. TxDOT will consider these types of developments when local community or civic groups formally agree to provide the necessary maintenance.

2.4 Adjacent Properties

2.4.1 Overview

The visual relationship between a transportation corridor and the adjacent properties is critical when making landscape and aesthetics decisions. The aesthetic quality of a transportation facility and adjacent structures must be considered from the viewpoint of the vehicle operator and adjacent property users. Regardless of the land use, the objective is to achieve an appropriate visual fit between the transportation facility and its surroundings.

Aesthetic design decisions should be based on information from two primary sources. The first consideration is the character of the existing properties adjacent to the corridor. Base information should be gathered in the field such as dominant colors, materials, and scale. The second source of information is the public participation process. Very often public objections, particularly regarding expansion projects, relate to aesthetic concerns. It is essential that the public participation process be used to identify these concerns and, to the extent possible, address them in making landscape and aesthetics decisions.

In most cases, aesthetic issues will involve one of the following design objectives:

- Blend the highway with the surrounding landscape;
- Contrast the highway with the surrounding landscape; and
- Screen the highway from the adjoining properties.

2.4.2 Blend the Highway

The goal of context sensitive design is to visually blend the highway with adjacent properties, as in **Figure 2-7**. This option is generally the least expensive and simply requires attention to detail, landform, and issues of scale. Several design tools can be used to accomplish this objective:

- **Employ materials similar to those in the adjacent landscape**. This is particularly important in urban centers where the built landscape is dominant. For example, if the adjacent neighborhood is single-family brick veneer houses, brick or pavers will help blend structures into the setting.
- **Use similar colors**. Quite often it is impractical to use or attempt to match the materials of the adjacent landscape. In these cases, color becomes the single most important tool.
- **Use similar plant materials to blend the landscape**. In the rural setting, landscape materials can be used to supplement and link existing landscape features.

Considerations of cost and maintenance prevent more large-scale changes to the dominant landscape. In urban centers, use plants to accent and visually connect with other landscape elements near the highway. For example, if there are street trees adjacent to the ROW, repeat the same trees to help blend the highway setting.

- **Be sensitive to the visual character of the landform**. Landform can be a dominant element of the roadway, particularly in hilly or mountainous terrain. Exposed rock faces, steep cut slopes, and high fills can be dramatic in scale but are often objectionable if they bisect existing landscape features considered visually pleasant or socially significant. It is important to consider the landform in the alignment stage of the design process and be sure that there will be no adverse reaction to the resulting landform. Cuts through white limestone or tall cut slopes that are silhouetted against the skyline will contrast sharply with the surrounding landscape and are usually objectionable from a visual standpoint. Dealing with these issues early in the design process will avoid costly aesthetic remediation activities later.
- **Use complementary street furniture**. The street furniture should be selected to blend with the architectural qualities of the adjacent properties. Remote regions tend to be less sensitive to the details of guardrails, traffic barriers, signs, light standards delineators etc. However, in urban areas there is often a need to develop details that will blend with surrounding architecture. This can be particularly important in sections of highway that go through special or historic districts of the city. In these situations, additional expense may be justified to achieve the desired results.

Figure 2-7: Appropriate architectural details complement the urban context and help blend the highway with its surroundings.

2.4.3 Contrast the Highway

There are occasions where the design objective is to have the highway contrast with its surroundings. There are cases where there is a lack of variety in the surrounding landscape, or the surroundings may be so visually confused that there are few redeeming qualities to the views from the road. In these cases, it may be desirable to manipulate the aesthetic qualities of the road so that it becomes the dominant visual feature. Tools that can be used to achieve this objective include the following:

- **Use curbs and concrete traffic barriers** to delineate the driving lanes visually and physically. This is particularly effective on urban streets. Where practical, use colors to achieve contrast. See **Figure 2-8** through **Figure 2-10** for examples.
- **Vegetated medians** offer excellent contrast to the travel lanes, making their edges clearer. Additionally, turf areas offer visual relief and glare reduction in large expanses of pavement in multilane highways. Medians with turf also hide small litter objects better than bare pavement, helping to keep the roadway neater in appearance.
- **Materials and textures** can be manipulated more economically on small, paved surfaces such as walks and drive aprons. Likewise, the colors and textures selected can be used to reinforce the contrast between the highway ROW and the surrounding properties.

Figure 2-8: Treated Gore Areas in Communities

Figure 2-9: Adding color to traffic islands improves visibility and delineates travel lanes.

2.4.4 Screen the Highway

Screening adjacent properties from view is usually the most expensive alternative depending on the length of the corridor that needs to be screened. Before the screening objective is adopted, be sure that the goal can be effectively met. Often, it is impossible to completely screen an objectionable view, and attempts to create a screen simply call more attention to the problem.

Keep in mind that the experience of a highway is a cumulative impression rather than an impression of a single point in time. In most cases, the most realistic screening scenarios are when the view of the highway needs to be screened from an adjacent property.

When screening is the design objective, the following design tools should be considered:

- **Place the screen material as close as possible to the viewer**. The closer the screen is to the viewer the greater the area screened from view.
- **Ensure that screens observe setback and sight triangle requirements**.
- **Use appropriate choices of structure and vegetation**. Architectural solutions such as walls and fences generally require less frequent maintenance than the use of plant materials. Established trees with natural understory have favorable maintenance properties after establishment (see **Figure 2-10**). However, this solution requires sufficient space and may not be acceptable in tight urban conditions.

- **Consider time constraints.** Where time is a consideration, architectural solutions give the most immediate results. Planting by itself will take time to develop but is more visually appealing when mature. Where possible, combining architectural features with planting will produce the most favorable long-term result.

Figure 2-10: Plants reduce the scale of walls and prevent long, continuous sections from becoming monotonous.

Chapter 3
Landscape Development

3.1 Overview

The performance criteria listed below provides the design conditions and material selections for projects and project conditions. Designs should be prepared and reviewed to ensure that these minimum standards are achieved for each category. The final determination of suitability of any development for Texas roadways rests with TxDOT. All proposals for development will include estimates of the extent, duration, and costs of future maintenance.

3.2 Clear Zones

The **RDM** provides detailed sight visibility and clear zone distances for each roadway context (see **Figure 3-1**). From an aesthetic standpoint, the landscape design of the corridor should support and reinforce these zones by:

- Preserving a clear 'recovery' area adjacent to roadways; and
- Utilizing vegetation that stabilizes the ground plane.

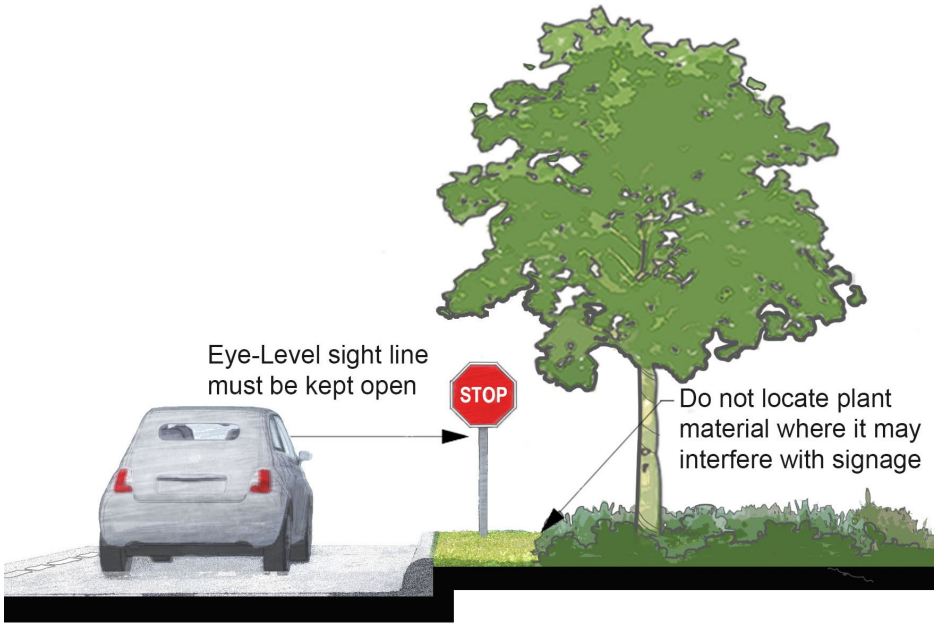


Figure 3-1: Clear Zone – Select and maintain plants at intersections that provide open visibility in all directions.

3.3 Sight Visibility Triangles

Visibility within intersections, also referred to as intersection sight distance, and at approach ramps must be considered during the design process. The sight visibility triangles (see **Figure 3-2**, **Figure 3-3**, and **Figure 3-4**) should allow a full view of traffic for all turning movements at intersections (including driveways and median turns)and merging movements at ramps. The exact dimensions of the sight visibility triangle are a function of highway function and speed. Refer to **RDM** Chapter 4, Section 4.11.4 for additional information regarding intersection sight distance. Materials used should:

- Maintain and enhance lines of sight through the intersection; and
- Focus the view on the intersection.

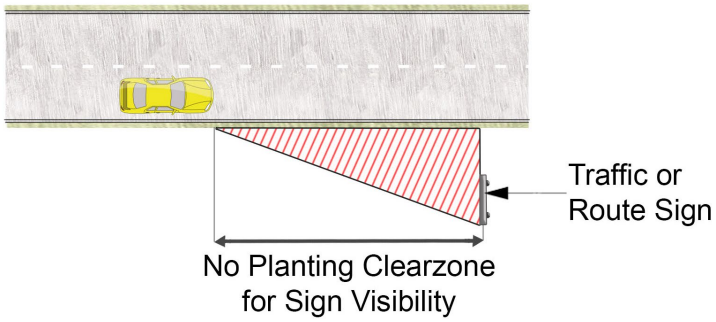


Figure 3-2: Site visibility triangles – Plants must not be placed where they may obstruct signage.

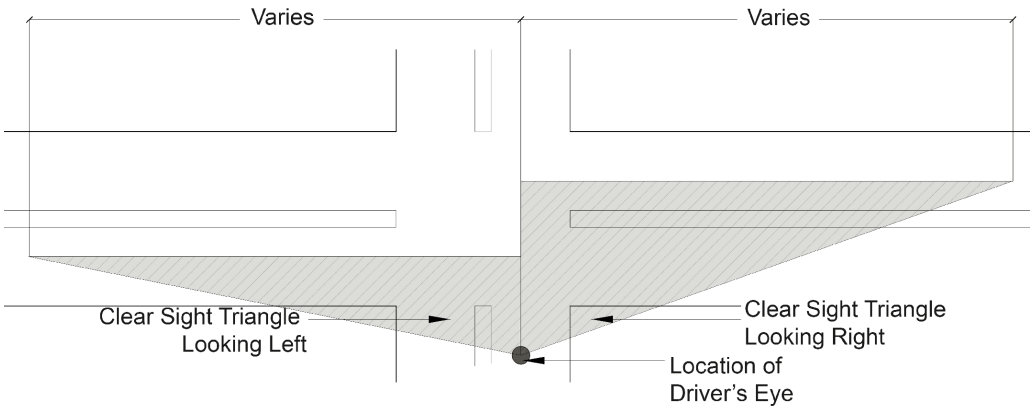


Figure 3-3: Site visibility triangles – Visibility within intersections is a primary goal. Plant material must be limited to low-growing varieties.

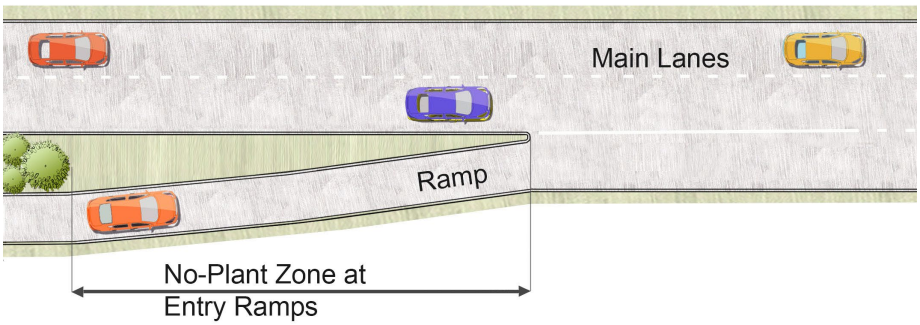


Figure 3-4: Site visibility triangles – Approach ramps require long, unobstructed sight lines.

Cone of Vision

The primary cone of vision (objects that compose the primary field of vision) is 60 degrees for a stationary observer. Research has shown that as an object begins to move, this cone begins to narrow. For most drivers, the vision cone is estimated to be 30 degrees. Objects 20 feet from the edge of the pavement and 120 feet from the viewer fall within this 30-degree cone of vision. Outside this vision cone, objects are perceived with peripheral vision; they are visible but not in sharp focus (see **Figure 3-5**).

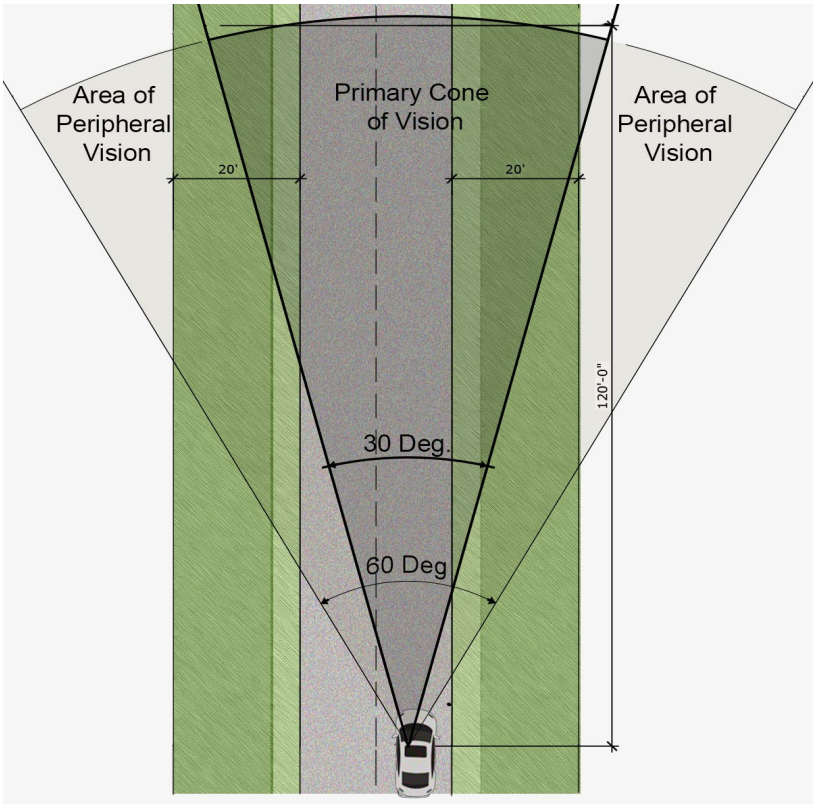


Figure 3-5: Cone of Vision

3.3.1 Aesthetics & Maintenance

Plants can be an important addition to the ROW as an aesthetic enhancement that blends highway structures with the surrounding environment. TxDOT is committed to use regionally appropriate vegetation within the roadways and on facility beautification projects. Whether in an urban context or a rural context, well-maintained projects enhance the community character and driver safety.

Roadside vegetation is maintained to accomplish specific goals:

- Sight-distance;
- Clear view of obstructions;
- Erosion control; and
- Aesthetics.

Design alternatives should be reviewed to be sure that minimum standards are met for each of these issues. Most roadways are kept mowed to a height that accomplishes the needs of these issues and meets with the public's expectations for the appearance of the roadside.

Public standards should be considered when developing aesthetic programs that affect roadside vegetation.

3.4 Plant Selection

General Requirements

TxDOT is required to use regionally appropriate plants, both native and adapted, in highway ROW beautification projects.

- **Maintainability:** Plants for the ROW must also be selected based on their anticipated maintenance needs and their adaptability to the roadside environment. The placement of plant material in the roadway is of critical importance because of its potential effect on driver safety. Plant placement will be discussed in a separate section.
    - Ornamental grasses as part of shrub or mass plantings may be unsuitable in most cases due to the extra maintenance required for cutting and removal of annual litter.
    - Select plants that are sufficiently hardy to maintain themselves without regular, supplemental irrigation once they have become established.
    - Trees will usually require weeding which can add significantly to the cost of maintenance of the project. The design should consider the alternative maintenance practices available and include estimates on the anticipated maintenance costs for this item.
    - Mass shrub plantings in the ROW are frequently used for erosion controls on slopes, filling areas that are difficult for mowers to access, and screening off site areas. Larger shrub varieties are preferred for these applications.
    - Beds and shrub plantings should be designed so that at the end of two complete growing seasons, the plants form a complete continuous canopy.
    - Low-growing evergreen shrubs are a better alternative for groundcovers for higher resistance to invasion by weeds and less need for specialized maintenance.
    - Avoid using plants that are known to attract and harbor damaging insects that are not easily controlled.
    - Do not use plants that are considered invasives in the regions of Texas.
    - Do not use plants requiring frequent pruning to look or perform well. No plant should be placed where pruning will be required in the future to maintain safe sight-distances.
- **Adaptability:** Plant lists should be short and composed of species that have demonstrated an ability not just to survive but to thrive in the roadside environment.

- Many ornamental plants that do well in residential or commercial settings do not perform well in the stressful conditions of the ROW. High winds, exhaust fumes, and intense sunlight and heat make establishment difficult for even the hardiest plants.
- While some native plants are suitable for the roadside, the roadside is very different compared to native environments. Roadside soils are subject to extremes of heat and cold due to the absence of tall grasses or litter layers present in most native plant communities. Many native plants will be able to adapt over time to some of these harsh conditions, but the fact they are native does not indicate any less need for carefully planned establishment programs.
- Some understory trees that are attractive in a forest setting will generally not perform as well in the exposed conditions of the roadside.
- Slopes that assure well-drained conditions for roadbeds and structures lead to hot, dry soils in the summer.

- **Perceptibility:** Plants in the roadside are generally viewed at high speeds and are often only part of the driver's peripheral vision. The variety of color and textures of complex, multi-species plantings is not appreciated by the viewer as it would be in residential or commercial applications.

3.4.1 Plant Sizing

General Requirements

- **Shrubs** should be minimum 3-gallon container.
- **Trees**:
  - 1 ½" to 3" caliper recommended sizes;
  - Typically, 15-gallon minimum size. In "mass tree plantings," 5-gallon minimum size is allowable; and
  - Trees with mature caliper of 4 inches or greater cannot be planted within clear zones.
- **Groundcovers and seasonal color**: Groundcovers and seasonal color are discouraged within the ROW due to the high costs of maintenance and replacement. Zone I is the only zone where groundcover and annuals are allowed. Preferred minimum sizing to be 1 gallon. See **Chapter 2** for Zone I landscape materials.

Plant theft is an occasional problem, particularly if the project is near residential areas. In such cases, select plant sizes that discourage theft and avoid the use of small shrubs.

3.4.2 Planting Location

Mature size of plant material should be considered in determining its placement. Plant material within the ROW should not obstruct clear sight lines, unyielding structures, or create maintenance difficulties. **Figure 3-6** through **Figure 3-9** show different planting examples.

- **Clear zones:** Plants may not be placed where they block the 'unobstructed, traversable area beyond the edge of the highway'. Refer to the **RDM** for specific linear distances.
- **Unyielding structures:** Plants must not obscure any unyielding structure within the clear zone (drainage culverts, etc.). Avoid landscape design situations that would require personnel and equipment to be on the driving lane side of guardrails and concrete barriers or on the shoulders of high-speed, main-lane traffic.
- **Signs:** Plant material with the potential to block any portion of the sign face should not be placed in front of the sign.
- **Medians:** Provide 3' minimum clear setbacks along the median edge for maintenance safety. Plant material height at the median nose should be 30" height maximum. Verify exact heights with specific District.
- **Adjacent to walls:** Concrete mow strips (minimum 12" width) should be installed immediately adjacent to the wall face. Plants should not be placed any closer to a wall structure than half the expected mature spread of the plant.
- **Elevated roadways:** Plants should not be placed where foliage may intrude to within 10 feet of the travel lane of elevated roadways and bridges.
- **Utilities:** Trees should not be located where the mature height or spread will interfere with utilities. Verify tree species with appropriate overhead utility agencies.

Figure 3-6: Median planting can add color and visual separation between driving lanes.

Figure 3-7: Plants are effective for visually softening tall retaining walls or noise walls.

Figure 3-8: Vegetation with low maintenance properties is a good choice for screening.

Figure 3-9: Street trees

3.4.3 Routine Maintenance Activities

Maintenance activities of one sort or another are constantly taking place within the ROW. These include but are not limited to litter pickup, mowing, trimming, structure inspections or repair, sign repair, guardrail repair, and herbicide application. Landscape development must

be undertaken so that access is provided for normal maintenance operations. Improvements must avoid the creation of unsafe conditions for motorists or maintenance personnel.

Project designs should accommodate the physical requirements of the mowing and trimming equipment; safe access and egress to the site, slope, turning radii, and mower width should all be considered in design layout. Areas with linear designs and no obstacles lead to a smooth flow of movement and may be mowed quickly with larger equipment. Limited access with obstacles requires smaller equipment and is less efficient.

3.4.3.1 Weed Control

Cost effective, long term weed control in shrub plantings is dependent on the rapid development of healthy plants. Therefore, intensive and timely procedures should be specified for the early stages of the project, particularly the 90-day establishment period.

Refer to TxDOT's **Roadside Vegetation Maintenance Manual** for recommended pre-emergent and post-emergent control of annual and perennial weeds.

Bark mulches may be used on slopes less than 4:1. They are not recommended for slopes greater than 4:1 because they are easily dislodged and will migrate to the bottom of the slope. TxDOT normally specifies mulch at 3" depth minimum.

3.4.3.2 Plant Bed Edging

Plant bed edging should be installed around beds to prevent grass and weed invasion. Bed configurations should be designed and specified with edge material sufficient to prevent weed invasion from adjacent vegetation (see **Figure 3-10**). Bed Edge Types are:

- **Concrete:** minimum 12" width x 5" depth, reinforced concrete, thick enough to withstand the weight of mowing equipment.
- **Steel edging:** not recommended. Use at District's discretion.

Figure 3-10: Concrete Landscape Edging

3.4.3.3 Specialized Maintenance

- Planting design along roadways with high-mast lights, signage, and other devices must consider the maintenance area needed for these items. Utility and maintenance vehicles must have a clear path of approach and a work radius around the area.
- Anticipate the capabilities of the contractors responsible for executing maintenance contracts. In some cases, projects may be maintained by public agencies outside TxDOT. In these instances, the design should be tailored to the maintenance capabilities of the local government organization (LG) involved.

3.4.4 Roadside Pest Management Program

Texas is divided into ten vegetation regions (see **Figure 1-7**) and the State is known for its biodiversity, but at least nine species have disappeared completely. TxDOT, through the **Final Supplemental EIS, Roadside Pest Management Program**, has identified candidate, threatened, and endangered species, as well as vegetation considered to be a targeted species for removal. As part of the aesthetic design, best practices would include:

- Inventory and identification of existing roadway vegetation species; and
- Designation of those areas to be preserved and possibly enhanced within the proposed design.

3.4.5 Xeriscape Planting Design Principles

Xeric planting refers to those materials that will thrive under low-water or no-water conditions. For aesthetic design within the roadway, multiple factors must be considered for vegetation to thrive:

- **Plan and design:** Base the design on zones with different water requirements.
- **Soil improvement:** Increase the amount of organic material within the soil profile.
- **Select appropriate plant material:** Use plant material native or naturalized to the region.
- **Reduce grass/lawn areas.**
- **Water conservation:** Avoid overwatering by utilizing drip irrigation.
- **Use mulch:** Cover the exposed soil to retain moisture.
- **Perform appropriate maintenance:** Maintain mulch layers, avoid over-mowing and over-fertilizing.

3.4.6 Non-mow Areas

'Non-mow' areas are defined as sections of the roadside landscape or TxDOT property that have been removed from regular mowing schedules and management practices. The 'Non-mow' designation is not naturalization, prairie replication, or habitat creation (**Section 3.4.7.6**). The following areas qualify for Non-mow status:

- Sites that are beyond the clear recovery zone;
- Difficult or dangerous to access, hidden from view, not affecting driver safety, and far removed from travel lanes; and
- All potential Non-mow candidate sites should be evaluated, since removal of regular mowing can have deleterious effects, rather than positive. Invasive species may be allowed to proliferate within the roadway landscape and spread to adjacent properties.

3.4.7 Special Environmental Considerations

The use of the roadside for specialized environmental goals should be carefully considered to be sure that the safety, sustainability, and life-cycle costs of the project meet department goals and resources. The establishment of specialized environmental areas in the roadway will often entail specialized management techniques and scheduling that may require special specification and contracting procedures. These needs should be carefully considered in determining the appropriate use and design of these features. These areas of environmental focus are defined below.

3.4.7.1 Restoration

Restoring a site to the topographic shape, hydrologic function, and plant community that existed in historical times before disturbance by man.

This practice is expensive and requires detailed knowledge and constant management.

3.4.7.2 Urban Reforestation

For several decades TxDOT has encouraged urban reforestation on its state highway system. One example of this is through the **Green Ribbon Program**. Funds for the Green Ribbon Program, as described in **43 TAC §11.101**, are allocated for Districts with non-attainment counties to plant and establish trees that help mitigate the effects of air pollution.

3.4.7.3 Habitat Creation

This is the designing and managing of plant communities for use as habitat by birds, mammals, reptiles, or insects.

Habitat creation involves providing one or all of cover, food, or water to a targeted species and requires detailed planning and development funding.

Where general habitat for wildlife is a goal, the preservation of existing sites is preferable to the development of new habitat.

3.4.7.4 Naturalized Areas

The preservation or establishment of native plant communities either as an aesthetic program or as part of habitat creation.

Naturalization seeks to promote or re-introduce native plants to minimize maintenance or improve the aesthetics of the roadside.

This involves the seeding or planting of desirable plants and periodic management to assist in their survival, or it may focus on preserving threatened or endangered species.

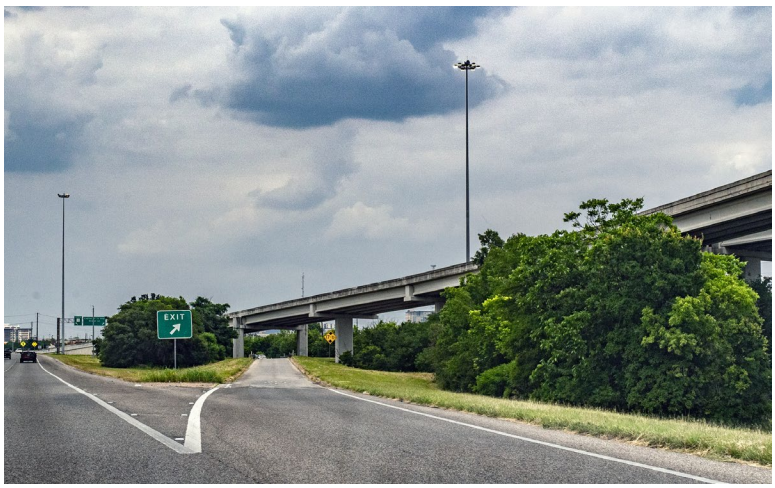


Figure 3-11: Vegetation allowed to attain natural growth may be visually acceptable where it can be set back from travel lanes.

3.4.7.5 Prairie Replication

Involves replicating critical habitat for pollinators, including monarch butterflies, and enhances the roadway conditions by allowing wildflowers to thrive.

Few prairie areas still exist within the roadway sections due to disturbance, but replication is possible on smaller scales with the right type of installation practices and management.

Once prairie areas are established, these are often less expensive to manage and require fewer resources to maintain as compared to traditional landscapes.

3.4.7.6 Monarch Butterfly & Pollinator Habitat

TxDOT is actively working to keep Texas Monarch Butterfly & pollinator habitats abundant, including the development and implementation of new ideas to expand habitats across Texas. Decreasing mowing and adopting mowing practices that utilize proper guidelines and timing in designated areas contribute to the success of this goal.

TxDOT has funded research to create new native plant species for specific seed mixes, while at the same time it has incorporated pollinator plant species into replanting seed mixes on its construction and maintenance projects.

Native, pollinator hosts and nectar plants are typically specified in planting projects.

3.4.8 Wildlife Crossings

Wildlife communities are typically identified within corridors of roadway development as part of TxDOT's environmental clearance process for highway projects. Coordination with Division and District environmental specialists, along with familiarization with the related TxDOT Environmental Compliance Toolkit requirements, will guide the landscape architect in designing and planting areas identified for wildlife crossings. The proposed design should reduce wildlife-vehicle conflict, while encouraging wildlife to use designated corridors. Refer to the **RDM**, Chapter 24, Section 6 for additional information on Wildlife Crossings.

3.4.8.1 Plant Materials Selection

- Use native plants to induce animals to utilize crossing structures; and
- Avoid use of plant species identified as 'highly palatable' plants that may attract animals to cross the road for food and thus affect traffic safety.

3.4.8.2 Fencing

- Fencing is a critical component of wildlife crossings. Refer to the FHWA **Wildlife Crossing Structure Handbook Design and Evaluation in North America** for additional information on designing fencing for wildlife crossings.

3.5 Landscape Irrigation

The goal of roadside landscape irrigation is to allow the plants to become established such that supplemental irrigation is no longer required. TxDOT is mandated to adopt water-wise techniques associated with landscape developments per federal and state codes. In particular, rules regarding landscape irrigation in the State of Texas are found under **Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality (TCEQ) - 30 TAC Chapter 344** (July 23, 2020). Subchapters under **TCEQ Landscape Irrigation Rules and Publications Chapter 344** include standards for design, installation, and maintenance of landscape irrigation systems, as well as licensing requirements, backflow prevention and cross-connections, contracts, and warranties. In addition to these state codes, most local government entities (LGs) across the State have adopted local rules and ordinances, notably concerning water conservation practices.

Multiple methods for watering the landscape are available to achieve this goal:

- Controller-based irrigation systems;
- Bubbler and drip irrigation;
- Rainwater harvesting;
- Temporary irrigation; and
- Xeriscape irrigation design principles (see **Section 3.4.5** for complete list of xeriscape design principles)

To determine the best method for any given project, on-site percolation tests should be conducted to determine infiltration rates, to set minimum application rates, and to achieve a balanced irrigation design for the proposed site planting. Perform percolation tests by excavating a tree planting pit, filling the pit entirely with water and inspecting the pit within 24 hours to verify water has percolated into the surrounding soil.

3.5.1 Irrigation Systems

Controller-based irrigation systems are recommended to protect both the monetary investment in the project and to insure healthy landscape development. The design and extent of the system should be appropriate to the plant material and the location. Design and installation must meet all state and local rules and requirements related to the public water supply.

- **System Design**
  - Irrigation components within the system should be selected for longevity and durability and should be secure from vandalism. Controllers and backflow preventers should be enclosed within lockable enclosures. All valve covers should be lockable as well. All valves and nozzles should be plastic. Typical system components are:
    - Controllers may be electric, solar, two wire, and/or battery-operated;
    - Rain sensors & water budgets required by state code;
    - Soil moisture sensors; and
    - Bubblers & drip irrigation, including laser tubing & emitters.
  - If adding new irrigation to an existing system, always ensure that the components of the new system are compatible with existing equipment; controller stations, valve decoders, etc., should all work together.
  - Within median and groundcover areas, drip irrigation is the best option to comply with TCEQ requirements and to avoid overspray onto pavement areas. When combined with bubblers for trees, these two components form an effective and efficient system and aid in water conservation.
  - Under limited circumstances, TxDOT may consider turf irrigation within the ROW, notably in those situations where responsibility for the maintenance and operation is assumed by local governments or other TxDOT approved entities. In this case, drip irrigation is the preferred method of application.

- **Inspection and Maintenance**
  - Main system components should be easily accessible and away from traffic lanes.
  - All irrigation systems will require routine inspection and maintenance.
  - In most situations, roadside landscape irrigation systems that are three to five years old will not be repaired if damaged.
  - The system design should also allow for scaling back to manual operation during maintenance (when required) or during times of severe drought.

3.5.2 Temporary Irrigation

Temporary and alternative methods of irrigation vary, depending on duration of need and site accessibility. Here is some general information concerning temporary irrigation in the TxDOT ROW:

- TxDOT refers to water made available for temporary irrigation as “vegetative watering”.
- Irrigation trucks are an option for sites with access and dependable scheduling.
- Includes above ground irrigation systems that will be removed after a given time for establishment of plant material.
- Includes below ground irrigation systems that will be abandoned after a given time of establishment save for manual operation capabilities during drought years.

3.5.3 Rainwater Harvesting

Rainwater harvesting provides an alternative source to supplement or replace purchased water for irrigation. Catchment may be employed through several strategies:

- TxDOT facilities with architectural components may capture runoff from rooftops and store in above- or below-ground cisterns or collection tanks. This may be pumped as needed to irrigate the site. The TxDOT Hill County Safety Rest Area, south of Hillsboro, is an excellent example of this combination of architectural design and water conservation. An example of a rainwater harvesting system is shown in **Figure 3-12**.

Figure 3-12: Rainwater Harvesting Cistern, Eastland County Safety Rest Area

3.5.4 Xeriscape Irrigation Design Principles

- Plan the irrigation system design at the same time as the planting and landscape design.

- To minimize water waste, group together plants with similar light and water requirements, and place them in an area that matches these requirements. Separate irrigation zones according to the specific watering needs of the various species of plant materials in the design.
- Use drip and/or bubbler systems for trees, shrubs, perennials, and groundcovers.
- Water deeply and infrequently to develop deep roots. Avoid watering between 10 am and 6 pm to reduce water loss through evaporation.
- Adjust irrigation controllers to accommodate changing weather/seasonal conditions. Install a rain sensor to shut off controllers when it rains.

3.6 Topography, Grading, and Slope Stabilization

Within the Rural and Rural Town roadway contexts, topographical landform changes due to roadway alignments are usually perceived gradually, given the typically larger setbacks of the ROW. Once the setbacks become constrained (especially within the Suburban, Urban, and Urban Core contexts) grade changes take the form of elevated roadways and interchanges.

3.6.1 Landform Manipulation

Manipulation of landforms is an effective tool for modifying the visual scale of roadside elements. Landform manipulation also adds variety to the setting and reduces the sense of visual clutter common to urban centers and complex interchanges.

Design solutions that employ landform modification are most cost effective when undertaken in concert with the horizontal and vertical alignment of the roadway. Highway planners and engineers are encouraged to collaborate with landscape architects on projects where landform modifications can be used as part of the overall landscape and aesthetics design concept.

Consider landform modification as part of the overall solution in these areas:

- Interchanges;
- ROW that require noise walls;
- Embankments; and
- Medians

3.6.1.1 Interchanges

Large urban highway interchanges, with numerous concrete columns and supports, can create a sense of visual disorder for the driver. Since these large interchanges frequently contain sufficient space to generate significant grade changes:

- Utilize the ground plane around these elements to create grade changes that reduce the visual scale of the vertical structures.
- Keep slopes within maintainable grade range.

Figure 3-13: Landform modifications at interchanges can reduce the apparent scale of the structure.

3.6.1.2 Embankments

Roadway embankments often form large physical landmarks so their aesthetic character can have a significant impact on the surrounding community.

- Excessively steep and abrupt embankment slopes do not blend well visually with adjoining landscapes, are difficult to maintain, may erode easily, and may limit or prevent the use of other landscape enhancements.
- Many visual problems associated with embankments are related to the degree of difficulty in maintaining vegetation on steep slopes, near or between barrier devices, or in inaccessible areas close to structures, signs, or luminaires.
- To reduce these problems, consider the following practices:
    - Employ measures to prevent vegetation growth within or between barrier devices;
    - Include paved mow-strips along the edges of walls or other structures;
    - Reduce slopes where possible to increase maintainability (max 4:1) and reduce the chance of erosion and slope failures by maintaining slopes; and
    - Combine signage and structures where possible to reduce obstacles to maintenance.

3.6.1.3 Medians

- Where space and drainage patterns allow, berms may reduce or prevent median crossings and reduce headlight glare.

- Careful consideration should be given to the cross section to ensure driver recovery, mowing access, and drainage.
- No berms should be placed within the sight triangles at intersections or at crossovers on multi-lane divided highways.

3.7 Stormwater Management

Per TxDOT's **Hydraulic Design Manual** (HDM), Chapter 13, Storm Water Management, "Storm water is defined in the Construction General Permit (CGP) as "Rainfall runoff, snow melt runoff, and surface runoff and drainage." For TxDOT purposes, storm water includes overland flow, and flow in ditches and storm drain systems." Many of the large land areas encompassed by highway interchanges have been used for aesthetic as well as practical purposes. One primary purpose of these sites is stormwater management, employing green infrastructure techniques.

Within the aesthetic parameters of landscape architecture, designers can employ the following techniques to manage stormwater runoff through the landscape and reduce the damaging effects of erosion:

- Provide suitable vegetation buffers on slopes;
- Create flatter slopes in drainage ways, 3:1 max, with 6:1 preferred; and
- Reinforce turf lined drainage channels with geosynthetic fabrics to prevent scouring, especially at concentrated flow areas.

3.7.1 Green Infrastructure

The three types of facilities below provide differing levels of biofiltration, conveyance, and flood control. These should be designed in accordance with the **HDM**.

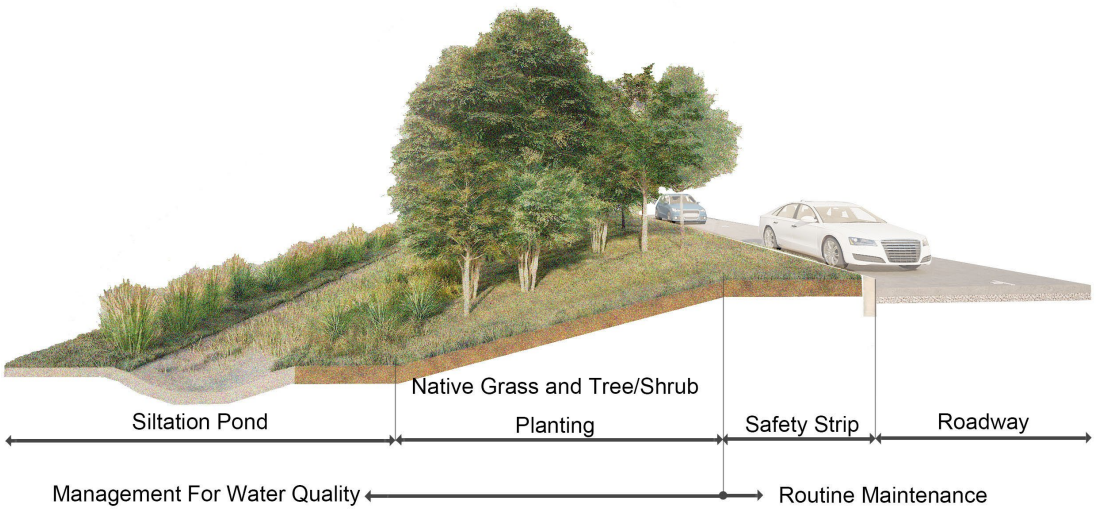


Figure 3-14: Basin Section

3.7.1.1 Ponds and Water Quality Structures

The following design parameters related to the development of PS&E for wetlands, detention ponds, and water quality structures are as follows:

- Water may be released through designed outfall or overflow structures.
- Structure is protected with curbs or other barrier devices where appropriate.
- Natural, freeform design is preferable.
- Detailed grading plan to establish shape and grades of the structures.
- Cross sections of weirs, dams, outlet structures, subdrainage, and spillways.
- Specifications for filter sands, soil additives, clay or fabric liners, and temporary erosion control.
- Setbacks and side slopes that allow for driver recovery of errant vehicles.
- Side slopes are designed for maintenance activities (mowing), see **Section 3.4.3**;
- Appropriate vegetation for the pond use.
- Designed to provide flood control, remove silt and pollutants, and protect downstream water bodies.
- Rain gardens and biofiltration ponds should be designed so that water is held for no longer than 48-72 hours. Otherwise, the pond could develop nuisance conditions where mosquitos can breed.

3.7.1.2 Rain Gardens

- Typically used for smaller drainage areas (less than 1 acre). See **Figure 3-15**.
- Biofiltration Ponds typically have drainage areas larger than one acre.
- Used for retention and/or infiltration, and typically less than 12” depth.
- With infiltration-type rain gardens, water flows in slowly and is not released, but instead percolates into the groundwater through porous soils.
- In locations with native clay soil, the water quality facility must incorporate an underdrain.
- Vegetation may be comprised of turf and/or other plant material but is always specifically selected for periodic inundation.
- Appropriate substrate for the region is utilized for the rain garden base.

RAIN GARDEN NOTES:

1. REFER TO CIVIL PLANS FOR DRAINAGE AND GRADING.
2. CONTRACTOR TO CONFIRM SUBGRADE DRAINS PER CIVIL PLANS.
3. THE GARDEN SOIL MIX SHALL BE FLOODED AFTER PLACEMENT TO ALLOW SETTLEMENT TO OCCUR. ANY SETTLEMENT THAT OCCURS SHALL BE FILLED BACK TO THE DESIGN ELEVATION.
4. RAIN GARDEN SOIL MIX SHALL CONSIST OF: 25% MORTAR SAND, 10% CONCRETE SAND, 25% ENRICHED LOAM TOPSOIL, 10% BROWN PEA GRAVEL 3/8", 15% FUNGAL COMPOST AND 15% DOUBLE GROUND NATIVE MULCH MINUS FINES. RAIN GARDEN SOIL SOURCE: NATURE'S WAY RESOURCES
5. SUBMIT SOIL SAMPLE FOR REVIEW AND APPROVAL BY LANDSCAPE ARCHITECT.
6. RAIN GARDEN SHALL NOT BE CONSTRUCTED UNTIL ALL CONTRIBUTING DRAINAGE AREAS HAVE BEEN STABILIZED AND ADJACENT PAVING INSTALLED.
7. COORDINATE PERFORATED PIPE UNDERDRAIN SYSTEM WITH CIVIL DRAWINGS.
8. AFTER COMPLETION OF THE RAIN GARDEN, CONTRACTOR TO PERFORM A PERCOLATION TEST AND REPORT TO THE OWNER AND LANDSCAPE ARCHITECT. REFER TO CIVIL GRADING PLAN FOR TEST STANDARD.

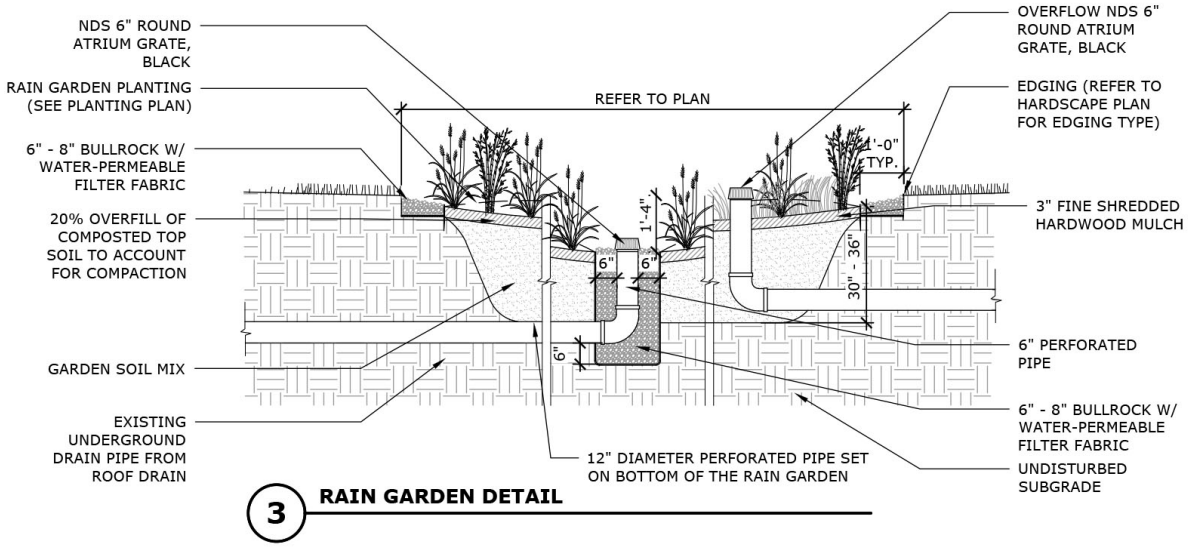


Figure 3-15: Rain Garden

3.7.1.3 Vegetated Drainage Swales/Channels

- Used as conveyance, with vegetation filtering and slowing runoff.
- Aligned to drain to a specific location.
- Vegetation suitable for variable flow rates, as well as periodic inundation.
- Side slopes designed for periodic maintenance.
- Utilize an approved channel lining material.

3.7.2 Wetlands

"Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the year." *(US EPA Website definition for sources list)* For information on wetlands located in TxDOT ROW refer to the *Water Resources* section of TxDOT's Environmental Affairs Division's (ENV) **Natural Resources Toolkit**. Occasionally, TxDOT may be required to design and construct wetlands as part of environmental mitigation.

Areas immediately along the roadway have frequently been altered from their original grade and yet may still qualify as wetlands. Per the U.S. Corps of Engineers, wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." (Refer to TxDOT's **Maintenance Management Manual**, Section 5: Wetlands/Streambed Permits, and the location's District or Division environmental staff before proposing any design in these areas).

Refer to the ENV Division's **Environmental Compliance Toolkits** for mitigation requirements.

3.8 Erosion Prevention Methods

Erosion of ground surfaces in the roadway and ROW threatens the stability of the pavement and structures, increases costs for cleaning of drainage structures, and contributes to siltation and turbidity of nearby streams and lakes. The costs associated with the control and repair of eroded surfaces can be significant and sometimes directly impact driver safety.

The areas most susceptible to erosion are slopes associated with embankments and drainage channels. Embankments often receive concentrated runoff from pavement surfaces that, depending on soil and slope conditions, may lead to significant erosion problems.

Erosion prevention begins with the roadway's design and adherence to best practices per TxDOT's **Erosion Control Standards** and the **HDM**. Aesthetic treatments to prevent erosion include intercepting sheet flows, whether from paved surfaces or adjacent slopes, and utilizing various techniques to minimize, divert, and disperse the intercepted flow.

Additional training for TxDOT employees to become more familiar with erosion prevention methods is available through TxDOT's PeopleSoft/Training & Development. The list of courses can be found in the **Environmental Management System (EMS) Training Matrix** that is managed by ENV. TxDOT's EMS courses are available externally for contractor and subcontractor employees through the **University of Texas @ Arlington's Division for Enterprise Development** and through the **American Association of Highway and Transportation Officials (AASHTO) training**.

3.8.1 Slope Configuration

The percentage of slope and shape of slope can be manipulated to minimize sheet flow over the slope face.

- Design slopes as flat as economically practical (max. 3:1, 6:1 preferred);
- Create rounded tops and bottoms of slopes;
- Step cut-slopes where suitable rock is encountered; and
- Use streamlined cross-section design techniques to help reduce wind erosion.

3.8.2 Surface Protection

Every effort should be made to cover bare ground after disturbance by construction or maintenance activities. A stand of good quality vegetation is the best long-term solution to potential erosion. The use of mulches or compost can be used on gentle slopes (1:4 V:H) or

flatter. Temporary erosion control material may be necessary depending on soil type as slopes increase. These two primary considerations, soil type and slope, determine the selection of the appropriate temporary erosion control measure. Highly erodible channel areas may require more permanent channel liners or possibly riprap.

- Soils with higher percentages of fine sand or silt particles are increasingly more erosive, while soils with minimal percentages of sand or clay particles are considered cohesive soils or clays.
- As the degree of slope increases, the potential for sheet erosion increases.
- The **TxDOT.gov Erosion Control – Products and Vendors webpage** includes approved products for hydro mulch, roll products and hydraulically applied (spray-on) products for temporary erosion control, and temporary and permanent channel protection.
- Products are approved based on soil types and for slopes for temporary erosion control and shear stress for channel protection products.

3.8.2.1 Compost or Mulch

The primary function of mulch is to maintain moisture in the soil and foster seed germination and plant development. Coordinate preferences for use of compost and mulch with each specific District. There are three types of mulch used for erosion control:

- **Straw and hay mulch:** Straw and hay mulch are used as surface covers in conjunction with some type of tacking agent (tackifier). The tackifier helps form a uniform mat and prevents migration of the material down the hill. Straw can also be crimped to help prevent material loss or migration. Refer to the **Standard Specification 162 – Sodding for Erosion Control** and **Standard Specification 164 – Seeding for Erosion Control** on the **TxDOT.gov TxDOT Specifications webpage** for additional information.
- **Hydromulch:** Hydromulches are hydraulically applied. Cellulose mulches may be applied with the seed mix and a tacking agent to form a more consolidated mat on the surface. TxDOT maintains a list of approved cellulose mulch materials. Depending on the soil type and side slope, hydraulically applied mulches have varying rates of application. Refer to the **Standard Specification 164 – Seeding for Erosion Control** on the **TxDOT.gov TxDOT Specifications webpage** for additional information. TxDOT maintains an approved list for cellulose fiber mulches at **TxDOT.gov Erosion Control – Products and Vendors webpage**.

- **Compost:** Compost may be blended to make compost manufactured topsoil in flat areas. Slopes up to 1V:3H should utilize Erosion Control Compost. Erosion Control Compost may be pneumatically applied on slopes 1V:3H or flatter. This material not only provides short term erosion control with mulch chips but also works to improve the existing soil. Refer to the **Standard Specification 161 – Compost** on the **TxDOT.gov TxDOT Specifications webpage** for additional information.

3.8.3 Channel Liners & Soil Retention Blankets

TxDOT maintains an Approved Materials List for channel liners/soil retention blankets at **TxDOT.gov Erosion Control – Products and Vendors webpage**. This list describes the conditions for application and provides a list of materials approved based on its resistance to tensile stress. Refer to the **Standard Specification 169 – Soil Retention Blankets** on the **TxDOT.gov TxDOT Specifications webpage** for additional information.

- There are two broad types of channel lining material: organic/organic composites and synthetics.
- In general, organic and composite lining materials are used for vegetation establishment and offer no long-term channel protection.
- The synthetic materials are longer lived and work with the root matrix of the vegetation to provide long term protection of the channel. Synthetic materials are preferred in ditches and channels that will have frequent flows at depths greater than 8 in (200 mm).

3.8.4 TxDOT Standards

- Standard Details & Specifications (Temporary Erosion Control Measures, Details, & Standard Spec Book); and
- Environmental Forms & Processes (Stormwater Program, EMS, Stage Gate, and Construction BMPs).

3.8.5 Vegetation

Consider the planting material installed for erosion control on slopes and embankments (seeding, sod, shrubs, trees, etc.). Specify material with deep and strong root systems, known to tolerate the extreme roadway conditions. Refer to **TxDOT's Roadside Vegetation Maintenance Manual** for specific material preferred in each District. Refer to **Standard Specification Item 164 – Seeding for Erosion Control** for the appropriate seed mix for each District, based upon Urban or Rural conditions.

3.8.6 Bioengineering Streambank Stabilization

Consists of lining channels and streambanks with live plant materials. In addition to the use of appropriate plants, mechanically stabilized earth, riprap, and natural boulders are frequently used to stabilize eroding streambanks.

- **Plant materials:** As much as possible, use native grasses and forbs with deep roots systems, and woody plants that root easily from cut root stock.
- **Bioengineering techniques:** Multiple techniques are available, with two being the most successful in Texas: Live Stakes and the Vegetated Geogrid.

Chapter 4
Hardscape

4.1 Overview

When used as part of the design palette, the sitework hardscape is both a design feature and a functional element of the landscape aesthetic. It reduces maintenance, improves roadway appearance, and increases driver awareness. This is especially important at intersecting portions of the roadway, where the visual contrast of material textures and colors improves the driver's perception of road components.

4.1.1 Hardscape Types and Finishes

Hardscape type and finish will vary by District as will certain product colors and finishes. Always verify product availability with company representatives.

- **Scoring:** Linear scoring patterns (shown in **Figure 4-1**) are more compatible with roadway geometry and more easily laid out in the construction process than arcs. This is the least expensive option.
- **Broom finish:** Installed perpendicular to the direction of travel, in light, medium, or heavy applications. Provides some visual contrast.
- **Sand blasting:** Multiple depths are available (light, medium, and heavy). The amount of exposed aggregate provides different levels of texture and contrast.
- **Colored concrete:** Integral color provides through-and-through pigmentation in the paving section (shown in **Figure 4-2**). Color provides a clear indication of pedestrian zones, improving safety in these areas.
- **Textured concrete:** Concrete 'stamps' and chemical surface retarding agents provide varying degrees of differentiation on the paving surface. This difference can provide an indication of pedestrian zones, highlight focal points, and provide visual interest in heavy traffic areas (shown in **Figure 4-3** and **Figure 4-4**).
- **Modular paving units:** Concrete, stone veneer, and clay pavers provide visual and texture contrasts. Paver areas may be simple single-color fields or may introduce patterns for visual interest (shown in **Figure 4-5**). Paver depth and overall pattern must be suited to the use, whether vehicular or pedestrian. Keep traffic use in mind when selecting colors for use in vehicular areas, since the continued wear of turning patterns will have an impact.

Figure 4-1: Linear Scoring Patterns

Figure 4-2: Integrally Colored Concrete

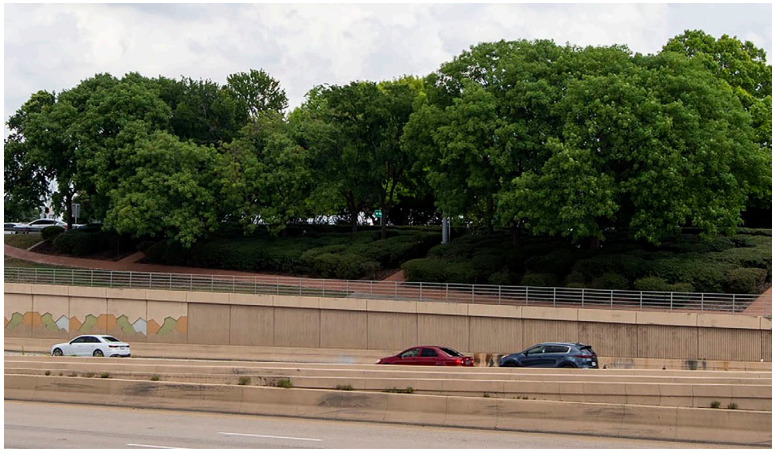


Figure 4-3: Concrete can be used to form patterns to accent and complement existing structures.

Figure 4-4: Textured Concrete

Figure 4-5: Modular Concrete Pavers

4.1.2 Locations

Paving changes and additions, as part of the landscape design, occur in those areas where safety is paramount and/or where maintenance becomes difficult and costly.

- **Concrete mow strip:** at signalization and light standards, below guardrails and fences, and adjacent to walls, to eliminate weeding and maintenance in these areas (shown in **Figure 4-6**).
- **Crosswalks:** as pavers or specialty concrete, to increase the visibility of the intersection and to increase pedestrian security (shown in **Figure 4-5**).
- **Medians and traffic islands:** as pavers or specialty concrete within medians and as part of the maintenance edge at back of curb, minimum 36” width (shown in **Figure 4-7**).
- **Intersections:** as pavers or specialty concrete to increase the visibility of traffic patterns and enhance aesthetics and sight lines through the intersection (shown in **Figure 4-8** and **Figure 4-9**).

Figure 4-6: Concrete Mow Strip at Base of Wall

Figure 4-7: Pavers in Traffic Islands

Figure 4-8: Pavers were added to riprap to brighten intersection & add character.

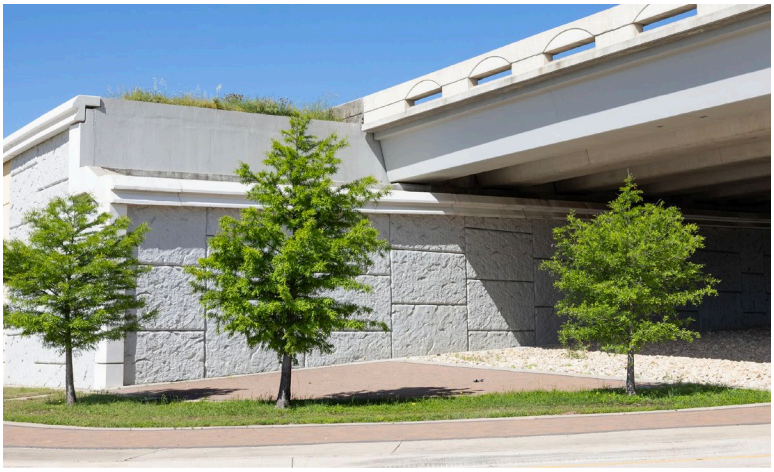


Figure 4-9: A paved surface is a better solution when shade from structures prevents vegetation establishment.

4.2 Walls

TxDOT's **Geotechnical Manual – LRFD** and the respective **Bridge Standards** provide information on the physical placement and structural detailing of walls. This section deals with the aesthetics of walls, including the visual relationship to the surrounding landscape and the selection of finishes and surfaces. The **RDM** provides information on the physical placement and structural detailing of walls.

4.2.1 Wall Types

4.2.1.1 Sound Walls

Sound walls are typically vertical masonry or precast stacked concrete panels between steel columns, with aesthetic treatments for color and texture (depending on location). Suburban, Urban, and Urban Core roadway contexts are best suited for this solution.

Sound walls are the most used form of noise abatement and are the only form of noise abatement required for consideration on Federal or Federal-aid projects in accordance with **23 CFR §772.13**. Sound walls are solid obstructions built between the highway and the receivers along the highway. Effective sound walls can reduce noise levels by 10 decibels, cutting the loudness of traffic noise in half.

The advantages of sound walls are:

- Noise reduction between 5 -10dB(A), reducing traffic noise by as much as one-half; and
- Aesthetic treatment of walls provides area context and continuity.

The possible disadvantages are:

- Noise 'bleed through' where multiple driveways/medians may occur; and
- Increased construction costs.

4.2.1.2 Mechanically Stabilized Earth Walls

MSE walls make up the majority of TXDOT walls and provide an incredible palette for different textures, patterns, and colors within the roadway landscape.

4.2.1.3 Concrete Block Walls

These comprise a smaller portion of TxDOT walls. Concrete block walls are especially suited to areas where tighter curves may be needed, or where tiers of walls might be appropriate (shown in **Figure 4-10**).

Figure 4-10: Concrete Block Walls

4.2.1.4 Decorative Walls

These may be smaller accent walls used as visual transitions and landscape strategies, as described in **Section 1.2**.

4.2.2 Wall Alignment

A significant aspect of wall design from an aesthetic standpoint is the contrast of the horizontal line with the ground plan and alignment of the wall with other elements near or behind it. The extended form of walls is viewed linearly, with the wall top creating a distinct contrast to background elements. Since walls are viewed with the rest of the world as their background, the appearance of wall elements should be considered carefully:

- The upper edge of a wall usually contrasts with elements in front of and behind it. This relationship should be considered to avoid visual conflicts with the immediate surroundings comparison.
- Wall caps that mimic or follow the shape of the background will tend to be less obtrusive (given similar influences of color, etc.) by blending form with the surrounding landscape. The wall top should generally use the entire length to make grade changes if possible.
- Wall elevation changes (step-downs) should be spaced uniformly, provide a sensible, uniform rhythm, and work well with the material dimensions. Avoid oddly spaced or uneven elevation changes and inconsistent angles or radiuses.

- Wall caps that incorporate step-downs to make grade changes may contrast well with the smooth flowing lines of adjacent landscapes and backgrounds (See **Figure 4-11**). This highlights the wall by setting it apart from the background, making it an even more dominant visual element; the greater the elevation change in the step-down, the more visually dominant it becomes. However, this same technique may add an element of visual confusion to an urban scene filled with multistory buildings and elevation changes.

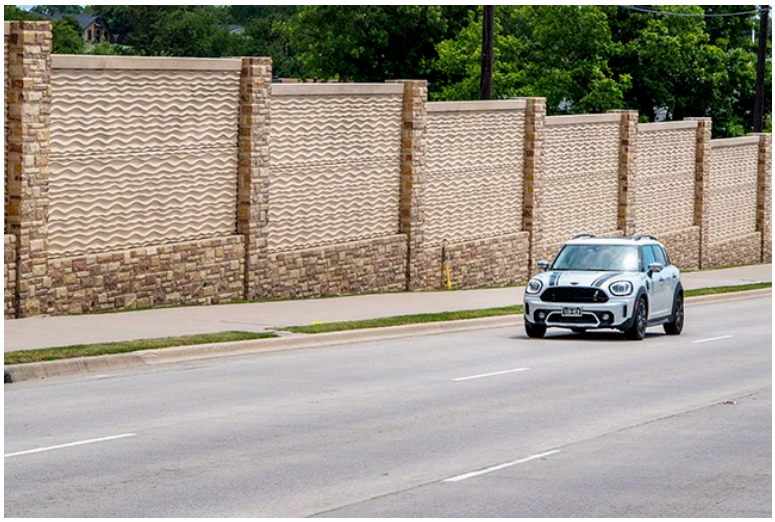


Figure 4-11: Wall Cap Elevation Changes

4.2.3 Wall Finishes

Since walls are strong vertical elements, they can dominate the field of view. The color, texture, and pattern have a commanding influence on driver perception of the highway landscape. The opposite side of the wall must be considered as well and designed with the impact to adjacent properties in mind (see **Section 2.4**).

The size of the roadway creates a relationship between color, texture, pattern, and scale that should be noted. To be appreciated, a color, pattern, or texture must be visible. The size of treated areas should not be so small as to have little visual effect. Inversely, too much of a single treatment can become boring or overpowering. There are no hard-and-fast rules to determine when these lines have been crossed but in general, special treatments should accent rather than dominate a landscape scene.

Depending upon the color, texture, and pattern selected, the wall will either blend or contrast with the background landscape. Always reference back to the LAMP (see **Section**

2.3) to ensure that selections are in keeping with the overall vision for the corridor (see Figure 4-12).

Figure 4-12: Wall Finishes, Bastrop SH 71 at Chestnut

4.2.3.1 Color

Along the highway side, wall colors should be selected to blend and complement the natural surroundings. When adjacent to residential neighborhoods, colors should be muted so that they do not conflict with the appearance of the residences (see Figure 4-13 and Figure 4-14).

Figure 4-13: Wall Color and Graphics

Figure 4-14: Color can visually unite different structures in a scene.

4.2.3.2 Finishes, Textures, and Patterns

Textures are most visually effective where traffic speeds are slower (controlled intersections) or where structures are close to the travel lane. Textures should be rougher if they are to be seen from longer distances. Rougher textures create more shadows on their surfaces and so create a high contrast with the sunlit areas of the surface, thereby providing a more visually prominent surface.

Textures on concrete may be achieved using form-liners, sandblasting, or washing to expose the integral aggregate. The malleability of concrete allows unique patterns to be included in the design at a reasonable cost (see **Figure 4-15** and **Figure 4-16**).

Special finish options for vertical surfaces include:

- Form liners;
- Sandblasting;
- Pigmented coatings;
- Integral color;
- Architectural veneers; and
- Modular structural units.

Figure 4-15: Textures on Concrete

Figure 4-16: Wall Finishes, Textures, and Patterns

Form Liners

Common form liner patterns include raised or indented vertical patterns as well as brick and stone. Strong vertically oriented textures will emphasize the height of structures while horizontal textures will de-emphasize height and highlight the structure's linear character.

Pattern choices should complement the wall surroundings. A heavily developed urban area may suggest a formal architectural pattern, while rural areas or locations with prominent

natural features may warrant the use of form liner patterns suggestive of local native materials (see **Figure 4-17**).

Figure 4-17: Form liners incorporated with architectural details create interesting patterns.

Sandblasting

Sandblasting may be used as a relatively inexpensive method of adding a softer textural interest. These textures will not be visible at long distances since sandblasting only affects a shallow depth of the surface. Consequently, this technique is best used where traffic speeds are lower, and the walls are near the travel lane.

Sandblasting entire surfaces may make the walls less distinct and blend into the background. A band of untreated surface at the edges of the wall will prevent this and make the texture contrast more visually effective.

Pigmented Coatings (Paints and Stains)

Pigmented coatings are a relatively inexpensive method of adding visual interest to structures. Paints have proven to be less durable than stains, requiring reapplication due to flaking, and are not recommended for concrete structures. Paints also fade significantly over time, so the use of darker color paints should be considered if painting is desired. Acrylic stains have proven to be much more long-lived in concrete applications and are available in a wide range of colors.

Stains are affected by the quality of the surface before application. Surface imperfections due to damage or to inadequate vibration during pouring will be clearly visible once the stain is applied.

Anti-graffiti Finish

To deter/minimize the impact of vandalism on hard surface improvements in the ROW and its other facilities, TxDOT encourages the use of anti-graffiti coating products in its projects. These coatings may be either Type II (Solvent-Cleanable) or Type III (Water-Cleanable). Care should be taken to follow **Standard Specification 740 – Graffiti Removal and Anti-Graffiti Coating** along with manufacturer's recommendations in applying the coating. TxDOT has found that some anti-graffiti coatings have tended to stain and/or fade some original paint colors if not applied appropriately.

Integral Color

Integral color infuses the entire quantity of concrete used in the wall. Variation in the quality of concrete can result in different shades of color, so matching earlier pours becomes very difficult when adding new sections or repairing existing damaged areas.

Architectural Veneers

Non-structural veneers of various materials may be installed over other wall structural materials. The veneers may be stone, modular concrete block, or brick, and in some cases, tile. Veneers may be useful in creating visual links between unconnected elements by retrofitting some portions of wall surfaces with the same material.

Modular Structural Units

Modular units are most prominent in the use of pre-cast panel, Retained Earth Walls. A smaller unit scale is found in Modular Block retaining wall systems. These systems impart patterns to wall surfaces that provide visual interest and help prevent large surfaces from becoming oppressively monotonous.

The patterns provided by these systems can result from two components: the shape of the modular unit and the pattern created by the arrangement of different colored or textured units. The scale of the structure and the type of unit affect the decision to add pattern in this way (see **Figure 4-18**).

Figure 4-18: Deep shadow lines increase the distance at which texture can be perceived.

4.3 Lighting

In addition to lighting the roadway for required visibility, designers should consider the illumination of significant structures, such as bridges and walls, to provide clarity and interest at night as shown in **Figure 4-19**. Lighting for visual emphasis typically occurs within Urban and Suburban contexts, though major Rural and Rural Town interchanges or intersections may also benefit from increased contrast and visibility. Illuminated, backlit, or directly lit elements along the highway improve the overall perception of the highway corridor.

Aesthetic lighting may provide visual effect and enhance the following features:

- Roadway Structures;
  - Bridges
  - Walls and Wall Textures
- Landscape Elements; and
  - Sitework and Hardscape
  - Trees
- Artistic Elements
  - Bas-Relief
  - Decorative Metalwork
  - Sculptures

Figure 4-19: Aesthetic Bridge Lighting, IH 35 Bridge at Brazos River, Waco

4.3.1 General Requirements

Aesthetic lighting must be designed and installed in a way that will not distract drivers or create a safety hazard according to the following guidelines:

- The feature may not contain or be illuminated by flashing, intermittent, or moving lights, including any type of screen using animated or scrolling displays.
- Luminaires must be shielded, directed, and positioned to prevent beams or rays of light from being directed at any portion of the traveled ways of a regulated highway.
- The lighting may not be of such intensity or brilliance as to cause vision impairment of a driver of any motor vehicle on a regulated highway, or otherwise interfere with the driver's operation of a motor vehicle.
- Illuminance levels shall conform to the recommendations in Chapter 26, Lighting for Exteriors, from the **Illuminating Engineering Society (IES) Lighting Handbook, 10th Edition.**
- Lighting features that are not crash worthy must be located outside the roadway clear zone or protected by a TxDOT approved crash barrier.
- The lighting may not simulate, resemble, obscure, or interfere with the effectiveness of an official traffic sign, device, or signal.
- When possible, cutoff luminaires should be used to minimize light pollution as called for in **Texas Health and Safety Code Chapter 425, Regulation of Certain Outdoor Lighting**.
- For direct view sources like LED or neon, the aesthetic lighting should not exceed 0.3 footcandles over ambient lighting levels when measured according to the International Sign Association's **Recommended Night-time Brightness Levels for On-Premises Electronic Message Centers (EMCs)**.
- For lighting designed to change appearance over time, the minimum length of time between changes of scene shall be either:
  - At least eight seconds; or
  - Calculated by the formula: Sight distance to lit area (ft) / Speed limit (ft/sec) = Minimum display duration (sec).
- Lighting systems and Illumination levels should meet and conform with the applicable requirements of AASHTO, IES, the **National Electrical Code**, BUG (Backlight, Uplight, Glare) ratings, the TxDOT **Highway Illumination Manual**, and other standards as deemed appropriate by the TxDOT District Engineer.

4.3.2 Light Sources

LED fixtures are the standard for highway lighting and should be used for aesthetic lighting as well. The color standard for highway fixtures is 4000K, though slightly warmer colors may be suitable for the landscape, ranging between 2700K - 3500K. Other considerations for LED aesthetic lighting in the landscape are as follows:

- LED fixtures require drivers to operate. Some are contained within the luminaire, but others are not. Ensure the design includes all components, connections, and necessary space to perform effectively.
- If specifying LED displays with color-changing arrays, include strong security features to prevent unauthorized operation of the lights (manually and/or digitally).

4.3.3 Posts and Luminaires

Choose the style of posts and luminaires based on practical requirements. First, consider height clearances, single or double arm, post arm reach, the inclusion of banner fixtures (if warranted), etc. After these have been considered, then consider the character of the space. See **Figure 4-20**.

- The post and the luminaire should complement the style and character of the surroundings. For example, a Contemporary or Post-modern space would be enhanced with fixtures that fit within the design. The **Texas Historical Commission** should be consulted for guidance on choosing light fixtures for historic districts located within the TxDOT ROW.
- Widely spaced posts read as individual objects within the landscape; closely spaced posts tend to read as defining, individual elements.

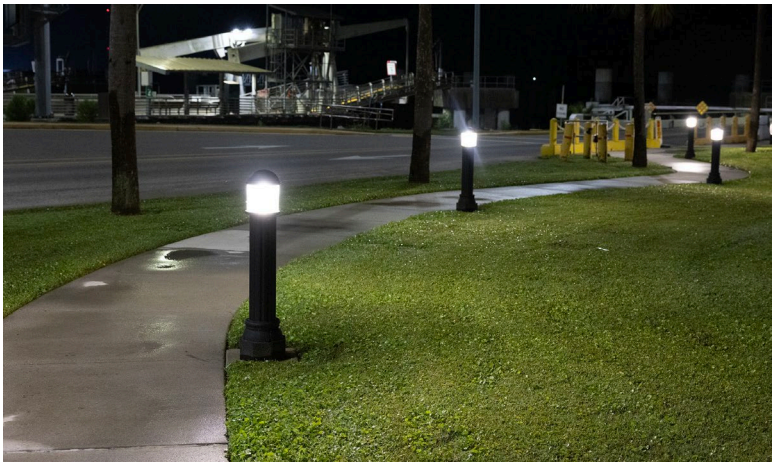


Figure 4-20: Bollard Lighting, Ferry Landing, Galveston

4.3.4 Lighting & Plant Materials

The placement of plant materials must be done with knowledge of the photometrics and pole placement for the highway. In general, high mast lighting will not be affected by plant material placement due to the height of the light source. Plant material, however, should not be placed immediately next to the mast, since lowering the lighting for maintenance requires a clear zone.

Where standard pole mounted fixtures are used, placement of plant materials becomes more critical. Trees must be placed so future growth will not interfere with the light source. As a rule, trees should not be placed forward of any light standard.

Lighting may also be used to highlight trees in a landscape design within the ROW.

4.3.5 Dark Skies Fixture Types

Selected luminaires should have the **International Dark Sky Association** (IDA) Seal. This third- party seal certifies that outdoor fixtures minimize glare, while reducing light trespass and sky glow. To minimize light pollution, dark skies fixtures should:

- Only light the area needed;
- Be no brighter than needed;
- Minimize blue light emissions; and
- Be fully shielded, so that the light bulb is not visible.

4.4 Public Art

The department supports efforts to enhance the appearance of public highways by integrating public art into the transportation landscape. Public art includes graphic or sculptural elements which are usually free standing but can be incorporated into existing transportation features such as retaining walls, bridges, bridge rails, bridge abutments, etc. when approved by the department.

Placement of public art in the state ROW by others will be evaluated on a case-by-case basis and must adhere to the following guidelines unless otherwise approved. Further restrictions may apply. See **Figure 4-21**, **Figure 4-22**, and **Figure 4-23**.

Proposals for art installation must be submitted by a local government entity (LG) with responsibility over the proposed location of the piece.

- The State will review and evaluate the Public Art proposal with due consideration to safety (location, potential for motorist distraction, accessibility for maintenance, etc.), aesthetics, community support and maintainability.
- The submittal must include a letter of support from the local governmental entity (city, county, or state) approving the placement of the public art.
- A formal resolution from the local governing body in support of the Public Art piece must also be submitted prior to installation.
- A formal agreement such as the Multiple Use Agreement must be fully executed prior to installation.
- Art to be installed along the Interstate Highway system is subject to review and approval by the FHWA.

The LG must agree to:

- Fund, furnish, construct, and maintain the Public Art according to plans approved by the State.
- Furnish, erect, and maintain any barricades, signs, and traffic handling devices in accordance with the latest **Texas Manual of Uniform Traffic Control Devices** (TMUTCD) and to the satisfaction of the State related to this project. Proper traffic control is essential to protect the safety of the public.
- Conduct periodic inspections of the Public Art as deemed necessary.
- Remove Public Art as may be required for any construction or maintenance of the roadway and restore the area to the satisfaction of the State.

Public Art must be designed and placed to:

- Be freestanding unless otherwise approved (except murals).
- Be appropriate to its proposed setting and community context.
- Be in proper size and scale with its surroundings.
- Be composed of materials that are durable for the projected life span of the Public Art.
- Be located beyond the clear zone, for both main lane traffic and frontage road traffic.
- Be located where maintenance can be safely performed.

Public Art must not:

- Contain any text of any sort, including, but not limited to, religious, political, special interest, private or commercial messages, symbols, logos, business names, trade names, jingles, or slogans.
- Contain actual or abstract images of real people.
- Contain any displays of any sort, including, but not limited to, advertising, decorative banners, flags, or flag poles.
- Display telephone numbers, street addresses, or Internet addresses.
- Interfere with airspace above the roadway.
- Create a distraction to the motoring public; for example, the Public Art should be large enough to interpret at highway speed, but not be so large that it demands attention from the motorist.
- Include reflective or glaring surface finishes.
- Include illumination that impairs or distracts the vision of transportation system users. Other lighting may be permitted in **accordance with the aesthetic lighting provisions in this manual.**
- Display blinking or intermittent or moving lights, including changeable message signs, digital displays, or lighted static displays such as LED.
- Include moving elements (kinetic art) or simulate movement.
- Include water features of any sort.
- Interfere with official traffic control devices, nor interfere with the operational ROW above the roadway.
- Be placed within state ROW upon trees or painted or drawn upon rocks or other existing natural features.
- Make use of or simulate colors or combinations of colors usually reserved for official traffic control devices described in the **Texas MUTCD**.

- Require the removal of trees or other vegetation for visibility, or harm trees during installation. Pruning of tree branches or roots, and removal of shrubs must be avoided.
- Negatively impact existing highway features, including existing signs, irrigation systems, necessary drainage patterns, and facilities.

The Public Art must be removed, if in the opinion of TxDOT, creates a safety issue, operational concerns, or due to deterioration or inadequate maintenance. TxDOT reserves the right to remove or alter any Public Art that presents an immediate safety hazard to the public without delay or advanced notification.

Figure 4-21: Public art projects can be a viable and creative way to allow residents to express their sense of community.

Figure 4-22: Sam Houston Statue

Figure 4-23: El Paso Wind Art

Chapter 5
References

Environmental Forms & Processes (Stormwater Program, Environmental Management System (EMS), Stage Gate, and Construction BMPs).

Executive Memorandum: Memorandum on Environmentally Beneficial Landscaping, April 26, 1994.

Executive Memorandum: Memorandum on Invasive Species, February 3, 1999.

Highway Traffic Noise Analysis and Abatement Guidance, 2011 Updates, U. S. Department of Transportation, Federal Highway Administration, FHWA-HEP-10-025.

Implementation and Effectiveness of Sound Mitigation Measures on Texas Highways, (HB 790) Final Report, PRC 16-64F, Texas A&M Transportation Institute, Transportation Policy Research Center, October 2016.

Investigating the Applicability of Biotechnical Streambank Stabilization in Texas, Harlow C. Landphair and Ming-Han Li, Texas Transportation Institute, Report 1836-1, September, 2002.

National Environmental Policy Act, (NEPA), 1969.

Section 6(f) of the Land and Water Conservation Fund Act (LWCF), 1964., TX GOV.CODE. TITLE 4, CHAPTER 447.004.

Standard Details & Specifications (Temporary Erosion Control Measures Details, & Standard Spec Book).

TCEQ Title 30, Part 1, Chapter 344, Subchapter F, Rule 344.62, Section 3(g).

Appendix A
List of Links

23 CFR §772.13

43 TAC §11.101

Association of Highway and Transportation Officials (AASHTO) training

Bridge Standards

Environmental Compliance Toolkits

Environmental Management System (EMS) Training Matrix

Erosion Control Standards

Final Supplemental EIS, Roadside Pest Management Program

Geotechnical Manual – LRFD

Highway Illumination Manual

Hydraulic Design Manual

Illuminating Engineering Society (IES) Lighting Handbook, 10th Edition

International Dark Sky Association

Maintenance Management Manual

National Electrical Code

Natural Resources Toolkit

Recommended Night-time Brightness Levels for On-Premises Electronic Message Centers (EMC's)

Regulation of Certain Outdoor Lighting

Roadside Vegetation Maintenance Manual

Roadway Design Manual

Standard Specification 161 - Compost

Standard Specification 162 - Sodding for Erosion Control

Standard Specification 164 - Seeding for Erosion Control

Standard Specification 169 - Soil Retention Blankets

Standard Specification 740 - Graffiti Removal and Anti-graffiti Coating

TCEQ Landscape Irrigation Rules and Publications Chapter 344

Texas Historical Commission

Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality (TCEQ) - 30 TAC Chapter 344

TxDOT.gov Environmental Management System (EMS) webpage

TxDOT.gov Erosion Control – Products and Vendors webpage

TxDOT.gov Texas Manual of Uniform Traffic Control Devices (TMUTCD) webpage

TxDOT.gov TxDOT Specifications webpage

University of Texas @ Arlington's Division for Enterprise Development

Wildlife Crossing Structure Handbook Design and Evaluation in North America