FDM 27-20-1 Planting Plan Development Process

April 23, 1999

1.1 Overview

This section presents the steps involved in developing planting plans. It outlines which documents are required in each stage of plan development and addresses proper formatting.

Historically, WisDOT landscape architects developed planting plans for state highway projects. However, consultants are now the primary plan producers, and the number of consulting firms doing this work has greatly increased. This has resulted in a variety of plan styles and formats that cause inefficiency, time delays and confusion for those involved in examining, bidding on and constructing the plans. A standard WisDOT Planting Plan Development process is established here for use on projects authorized by the planting project ranking process. The planting plan development process is summarized in Attachment 1.1.

1.2 Scoping

Planting projects should follow the same basic scoping process as highway improvement projects. This includes a scoping meeting with region staff (see FDM 3-5-3) and an operational planning meeting with external interests (see FDM 3-10-1).

In addition to these activities, the region project manager, the landscape architect consultant, and the Landscape Architect Contact (LAC) should tour the site of the project to become familiar with the project location and to discuss various options. After the site tour these same people should meet to establish a project work program. This document identifies the tasks to be done, who will do them, and when they will be done. Finally, the group will be able to complete the Project Information Form.

1.3 Site Inventory Analysis

The site inventory is based on a second, more thorough site visit that familiarizes the designer with the site. The inventory documents existing site conditions and features that affect the planting design. It also verifies previously documented information (e.g. aerial photos, roadside vegetation inventories, or base maps). The region's Development staff and Operations staff may be able to provide further information related to site conditions or features. Conduct the site inventory in accordance with the Site Inventory/Conceptual Plan Checklist (see Attachment 1.2). Record any additional pertinent information gathered in the field but not listed on this checklist.

The site analysis determines how the inventoried conditions will affect the design and, conversely, how the design will affect the conditions. In addition to these items, the site analysis notes the site context. For example, a rural highway may require a much different style than an urban freeway.

Note information derived from the site inventory/analysis on aerial photos. For urban projects, a scale of 1" = 200' (1:2000 metric) is used. For rural projects, a scale of 1" = 400' (1:4000 metric) is used. Note significant features or conditions and ways in which they impact the project (see Attachment 1.3). A landscape photo log may be prepared to better document site features.

The site inventory/analysis is NOT used for presentation purposes, so it should consist only of field notes. At this point, documentation should be general. Later in the process more specific information is recorded on the plan sheets. Some conditions or features to note in the inventory/analysis stage include:

- Existing Vegetation: Note species and locations of existing vegetation on both sides of the right-of-way line, to develop a feel for local plant communities and associations. Identify plant communities considered "native" to the area and note individual plants or plant groupings that should be preserved or transplanted. For some highways, information on existing vegetation may be found in WisDOT's Roadside Inventory. Contact the BHO LACs for access to this data. There are some non-profit groups with an interest in native plant rescue. For more information on native plant rescue, contact the BHO LACs.
- Existing/Potential Viewsheds: Note aesthetically pleasing views so they may be preserved or enhanced. This may require action (selectively clearing trees and shrubs to create/enhance a view), or inaction (avoiding installation of plantings that would screen the view).
- General Lay of the Land: Items to note include, but are not limited to drainage, slopes, soil types and water bodies.

- Micro-climate: Note any significant micro-climate issues, such as heat from sunlight being reflected off the light-colored facade of a building or paved surface.
- Existing Improvements: Items to note include, but are not limited to adjacent land uses, access, right-of-way lines, fence lines (if different from right-of-way lines), building locations, outdoor advertising sign locations, underground and overhead utility locations, names of side streets and roads, transportation structures (noise walls, guard rails) and clear zones.
- Areas Appropriate for Planting: Identify areas where plantings may be installed to provide headlight screening, visual buffering, erosion control, snowdrift control, impact attenuation, noise barriers and delineation of road alignment.
- Areas Appropriate for Native Seeding: Highly visible areas have the most potential for native seeding. However, a steep slope stabilized by existing vegetation, even if highly visible, should remain undisturbed so as to avoid erosion. Native species normally require more time to become established, thus increasing the possibility of initial erosion problems.

1.4 Conceptual Plan

Using information gathered during the scoping and site analysis, the designer will prepare a conceptual plan consisting of a written narrative of three pages or less, prepared in accordance with the Narrative Checklist (see Attachment 1.4), and an actual plan, created on aerial photos if possible, in accordance with the Site Inventory/ Conceptual Plan Checklist (Attachment 1.2). The conceptual plan should contain site information such as the existence of an unsightly salvage yard or areas of extreme snow drifting (see Attachment 3).

The narrative provides information regarding the limits and context of the site, the general intent of the planting project, insight into the construction schedule, and maintenance requirements or concerns. For a sample narrative, see Attachment 1.5.

The steps involved in the conceptual plan stage are as follows:

1. The designer prepares the conceptual plan (preferably on aerial photos) and a written narrative which will address the design philosophy and include maintenance considerations (Attachment 1.5).
2. At least one week prior to the review meeting, the designer sends a copy of the conceptual plan to the region representative and the LAC for internal review.
3. The designer, region representative and LAC meet to review the conceptual plan

A preliminary plant list should be included as part of the narrative checklist (see Attachment 1.6). Also include a rough estimate of the quantities and sizes of plants to be included in the contract, (see Attachment 1.7) using the following categories:

- Large (>35'or >11 m), medium (15-35' or 5-11 m) and small (<15'or <5 m) deciduous trees
- Large (>30' or >9.15 m) and small (10-30' or 3.05-9.15 m) evergreen trees
- Large (>10' or >3.05 m), medium (4-10' or 1-3.05 m) and small (<4' or <1.2 m) deciduous shrubs
- Evergreen shrubs (<10' or <3.05 m)
- Vines
- Special Seeding

Provide a rough estimate of the required quantity of seed in pounds or acres (kilograms or hectares metric). Finally, include a very rough cost estimate so all parties understand the budgetary constraints. This may help to avoid design decisions resulting in cost overruns later.

The conceptual plan should also provide the general location of plant masses, along with an explanation stating the purpose of each planting (snow drift control, framing a view, etc.). The exact species to be used at each proposed planting location need not be determined at this time. However, do include a list of suggested species and/or seed mixes in the narrative.

The conceptual plan does not need to be a refined product. It is a working plan, not a presentation plan. The content should be well-considered, but no more effort should be put into presentation than needed to convey general ideas. Often, the conceptual plan simply consists of a slightly refined or cleaned-up version of the site analysis with some design solutions.

After the conceptual plan is complete, the designer, region representative, and LAC meet to review it. Send a copy of the plan to the region and LAC at least one week prior to the meeting to allow for internal review.

1.5 Preliminary Plan

The preliminary plan is developed after the conceptual plan has been agreed upon by all parties.

The steps involved in the preliminary plan stage are as follows:

1. The designer develops the preliminary plan (see Preliminary Plan Checklist Attachment 1.8) consisting of plan sheets, a Plant Data Chart (see Attachment 1.9), a Miscellaneous Quantities Chart (see Attachment 1.10), the cost estimate (see Attachment 1.7), any special details and a draft of Special Provisions
2. At least two weeks prior to the site tour, the designer sends a copy of the preliminary plan to the region representative and LAC for internal review
3. The designer, region representative and LAC meet to review the preliminary plan and discuss any concerns
4. The designer, region representative, and LAC visit the site to review the preliminary plan

For plan base sheets on urban projects, use a scale of 1" = 50' (1:500 metric). For rural projects, use a scale of 1" = 100' (1:1000 metric), unless otherwise agreed upon by all parties. The plans should be more detailed as to exact plant locations and species. The designer will begin filling out a Plant Data Chart, which includes information about the types and sizes of plants and the root handling method (bare-root, balled-and-burlapped, etc. (see FDM 27-25-1). However, complete information may not be available at this time.

Complete the Miscellaneous Quantities Chart and a cost estimate to the extent possible. The designer should provide preliminary drafts of any special details or Special Provisions relating to the project.

Designers and region representatives involved in developing the planting plan should be aware that the LAC requires three weeks to review such plans. The plan should be sent to the LAC two weeks prior to the site tour, and internal review may continue for one week after the site tour. Designers and region staff should be aware of this so they can schedule their project timetable to allow the LAC adequate time to review the plans.

At this time the designer, region representative and LAC should discuss long-term maintenance of the plantings and any maintenance partnerships with local communities or interest groups. The designer should prepare a draft maintenance plan to lay out the agreed-upon maintenance activities.

1.6 Final Plan

After the Preliminary Plan Review Meeting, the designer will incorporate comments and prepare the final plans. At this point the plan sheets, Plant Data Chart, Miscellaneous Quantities, proposal estimate (Attachment 1.11) and Special Provisions should be in final form.

The estimate prepared at this stage should be in accordance with the example found in Section 5 of Chapter 19. For specific information relating to planting estimates see Attachment 1.11. Designers must use Trns-port software to create their estimates.

The steps involved in the final plan stage (See Final Plan Checklist, Attachment 1.12) are as follows:

1. The designer prepares final plans, incorporating the preliminary plan review comments.
2. The designer sends a copy of the final plans to the region representative and LAC, allowing for two weeks of internal review.
3. The region representative and LAC review the final plans and submit comments or concerns to the designer so they can be incorporated prior to submitting the PS&E package.

1.7 Submitting the P. S. & E.

To avoid possible complications in the PS&E process, all interested parties (LAC, region representative and designer) should review the final plans prior to submitting the PS&E package.

Also prior to submitting the PS&E, the Region Development Section and/or the consultant must obtain a signed commitment (in the form of a signed document or email) from the Region System Planning and Operations Section supervisor responsible for that section of the highway to provide funding for the maintenance needs given in this outline and in the maintenance plan.

For specific information regarding the submittal of plans for P. S. & E. see Chapter 19.

A maintenance plan, is not technically a part of the P. S. & E. package but it needs to be submitted to the region project manager along with the P. S. & E. The following outline lists maintenance concerns to be addressed in the maintenance plans.

OUTLINE OF MAINTENANCE PLAN

TO BE FURNISHED WITH

P. S. & E.s FOR LANDSCAPE PLANTING PLANS

1, List of anticipated needs and activities beyond the 2-year Plant Establishment Period including:

- Pruning
- Watering
- Fertilizing
- Weeding
- Mulching
- Replacing dead plant material
- Applying pesticides
- Removing planting accessories (tags, guy wires, etc.)

2, Timeline with frequency and types of maintenance activities needed after the Plant Establishment Period ends.

3. Estimates of time in man-hours and projected cost.

4, Exceptions (if any) to Maintenance Manual policies in the following areas:

- Mowing
- Woody plant control
- Controlled burns
- Pesticide applications

If special maintenance tasks are required in addition to those provided for by general policy, the designer must also submit maintenance plans to the BHO LACs at the same time the final P. S. & E. is submitted to central office. They should contain the same information appearing in this list.

5. Exception locations graphically represented on plan sheets showing boundaries of areas requiring special maintenance.

1.8 Maintenance Plans

Maintenance is a facet of design that is often overlooked. Maintenance or vegetation management activities compete for funding with other highway maintenance needs. Therefore, every effort should be made to design for low maintenance plantings in landscape plans.

After the Plant Establishment Period has expired (see FDM 27-25-10), little if any additional maintenance will typically be performed, except in rare cases such as in urban areas which may have more sophisticated plantings. Even in those instances, care will likely be minimal at best.

Plan designers should be familiar with Sections 70 and 74 of the Highway Maintenance Manual which deal with roadside maintenance and vegetation management, respectively. They cover the policies and procedures governing these activities and directly affect the successful installation and establishment of landscape plantings.

Landscape elements requiring an on-going high level of maintenance should only be included in the plan after carefully considering the ramifications. As an example, mulched plant beds may be quite attractive while the contractor keeps the mulched area weed-free. The beds may not be visually acceptable after the plant establishment period if weeds are no longer controlled. If weeds are not acceptable, mulch the plants individually rather than mulching the entire bed. Similarly, flower beds that might be acceptable in highly maintained areas such as safety rest area plazas, should not be designed for no/low maintenance areas along roadsides.

It is recognized that some maintenance will eventually be required to maintain plant health and preserve the integrity of the design. To this end, the following guidelines have been established:

1.8.1 Guidelines for Rural Areas

- Remove remaining planting aids such as tree wrap, braces and guys, rodent protection, etc., during

the summer following the expiration of the contract plant establishment period (PEP).

- Remove dead plants, especially evergreens, as soon as death is apparent.
- Three to five years after the PEP expires, replace significant plants that have died.
- Water plants during extreme drought periods if they occur during the first five years after the PEP expires.

1.8.2 Guidelines for Urban Areas

Apply these guidelines in addition to the Guidelines for Rural Areas.

- Weed and re-mulch shrub beds as needed to keep them weed-free until the shrubs are large enough to suppress weed growth on their own approximately three to five years after the PEP expires.
- Prune specimen plants within three to five years after the PEP to promote good branch structure.
- Rejuvenate appropriate shrubs by renewal pruning (removing 1/3 of the older canes completely) approximately every three to five years.

1.8.3 Mowing

The department's mowing policy is defined in Policy 74.10 of the Highway Maintenance Manual. Do not place plantings in areas likely to be mowed. However, plants with a mature size of no more than four inches in diameter may be planted in the clear zone if there is a safety-related reason to do so, such as impact attenuation. Appropriate plantings may be located in un-mowed areas without concern about mower damage.

If exceptions to the mowing policy are necessary during the construction phase of a planting contract, the contractor should be required to do the mowing. For example, an exception could occur where periodic mowing is required to facilitate growth of native grasses and forbs seeded under contract.

The region Systems Planning and Operations Section must be notified of the exception. If proposed exceptions are of longer duration than the normal plant establishment period required by the contract, contact the Region Systems Planning and Operations Manager and the BHO LAC for concurrence and incorporate the exceptions into the maintenance plan.

LIST OF ATTACHMENTS

Attachment 1.1	Planting Plan Development Process
Attachment 1.2	Site Inventory/Conceptual Plan Checklist
Attachment 1.3	Sample Aerial Photo With Labeled Areas (Conceptual Plan)
Attachment 1.4	Narrative Checklist
Attachment 1.5	Sample Narrative
Attachment 1.6	Preliminary Plant List
Attachment 1.7	Preliminary Cost Estimate
Attachment 1.8	Preliminary Plan Checklist
Attachment 1.9	Sample Plant Data Chart
Attachment 1.10	Sample Miscellaneous Quantities Sheet
Attachment 1.11	Sample Proposal Estimate of Planting Costs
Attachment 1.12	Final Plan Checklist

FDM 27-20-5 Planting Design Issues

April 23, 1999

5.1 Overview

The traveling public no longer considers highways to be just a means of getting from one place to another. Recreational travelers expect highways to be both safe and visually pleasant. The Federal Highway Administration regards planting as an integral part of federally funded project development, and federal agencies or other state agencies may require that plantings be included in proposed projects before granting project approval. This is based on the need to mitigate anticipated adverse environmental effects a project may cause. The public involvement process often highlights the need for special plantings or seeding along sections of proposed projects.

The Bureau of Highway Operations landscape architects are available to assist in the planting plan development process (see FDM 27-20-1). See FDM 27-1-1 for their names and telephone numbers/email addresses.

5.2 Planting Context

Generally, plantings should be arranged informally and reflect local native plant communities in their species composition, restoring the appearance of the area as it looked prior to settlement. Ideally, the area should seem to be the result of nature. For example, in the southern part of the state where prairies and savannas were common, limit the number of large trees to a range from one tree per acre up to the equivalent of less than 50% canopy cover. In northern areas, plant groups of trees that reflect the forested character of the area. Avoid over-planting; plant only at the locations needed, in the quantities and sizes necessary to achieve the desired result. Arrange shrubs in large masses for a natural appearance. Exceptions to these guidelines may occur in urban areas where a more formal look is desired or less space is available.

An informal planting scheme features undulating edges and curvilinear lines. Use irregular, random spacing in individual groups and the overall planting scheme. Exceptions occur when plants function as snowdrift control or screening. In those cases, regular spacing may be necessary for optimum performance; however, beds may be planted in a curvilinear fashion and the width of the planting may vary where right-of-way width and topographic conditions have no negative impact on snow storage capacity.

5.3 Highway Context

Planting context partly depends on whether a highway is considered to be rural, urban or transitional as follows:

5.3.1 Rural Highways

Are located in rural areas. In general a constant speed is posted, and adjacent lands are mostly agricultural or wooded with little residential, commercial or industrial development except for occasional farmsteads. Plantings are usually minimal and arranged in informal groups.

5.3.2 Urban highways

Are found in highly developed areas, usually within the corporate limits of one or more municipalities. The high traffic volume increases the need for safety features. Good highway design includes features that help increase driver alertness and reduce driver reaction time. This can be accomplished in part by designing well-aligned horizontal and vertical curves, and installing functional plantings. While informal planting arrangements are the norm in an urban setting, more formal plantings, such as regularly spaced street trees, may be more appropriate in some situations.

Planting space may be limited by narrow rights-of-way, underground and overhead utilities and the need to provide visual access to intersections, frontage roads, and adjacent businesses. Since planting sites may be limited, it may be desirable to plant heavily in available sites. Interstate highways and freeways present more opportunities for planting because of their wider rights-of-way.

5.3.3 Transitional Highways

Pass through areas between undeveloped rural areas and highly developed urban areas. Development varies in intensity and the cultural environment has more influence on the design process. Signs, utilities, and development are often close to the road, thereby limiting planting space in the right-of-way. Space and physical constraints may dictate that designers use a more formal, geometric planting design.

5.4 Planting For Functional Purposes

Planting for a functional purpose means that the plantings serve a particular practical function at that location other than aesthetics. Depending on the purpose the planting is to serve, plant sizes may need to be large enough to provide immediate benefit, or smaller so as to stay within budget or increase chances of plant survival. Plantings may serve any of the following functions.

5.4.1 Visual Screens

Screening reduces or completely hides a scene or object from view. Screening may be accomplished with plants alone or in combination with fences and earth berms. Often, the designer has the responsibility of determining whether it is necessary to screen a particular object or view completely. It may be adequate to provide just enough of a barrier to draw attention away from the distracting object or scene.

Evergreens are the most effective plant material for screening. They do not lose their foliage in winter, so they are effective year-round. Regardless of plant type, the more closely the plants are spaced, the more effective the screen will be. Contact the LAC for guidance on plant spacing.

When spacing plants closely to form masses, use plants which are aesthetically pleasing when massed and

tend to grow in masses naturally, such as grey dogwood or American plum. Consider the general form of the plants when determining suitability for massing. For instance, masses of arborvitae or junipers are more pleasing than masses of pines or spruce. Arborvitae and junipers have a 'softer' form that blends well into a mass, while pines and spruce have a stiff branching structure and a distinct spire at the top of each tree which remains as an individual shape and does not blend well into a mass.

Screening is often used in the following situations.

Headlight Glare - Screening against headlight glare may be total or partial. A total screen is desirable if headlights from on-coming traffic shine directly into the driver's eyes (see Attachment 1).

Note- Any plantings around intersections must consider a driver's need to see oncoming vehicles on other intersection approaches. Therefore, nothing shall be planted in intersection vision triangles that will hinder a driver's ability to see or be seen. Refer to FDM 11-5-10 for more guidance on vision triangles.

If headlights are distracting but unlikely to blind the driver, a partial plant screen that limits on-coming headlight glare to intermittent flickers of light may be adequate. This lets drivers know that a separating device divides their respective roadways, as on frontage roads where cars travel in the opposite direction to the right of the driver (see Attachment 5.2).

Junkyards - A junkyard is defined as an area where 10 or more hulks are permanently stored. The Federal Highway Beautification Act of 1965 requires that all junkyards within 1000 feet (305 m) of and visible from a Federal Aid Primary System highway (now National Highway System Primary Highways) be completely screened from view unless they are in a zoned or un-zoned industrial area.

Also, State Statute 84.31 enacted June 11, 1976 states that if a legal junkyard pre-existed the 1976 law, federal and state funds will be used to either screen or relocate it. Recently, federal funds have not been allocated to do the work, so the junkyard screening program has been inactive.

If the junkyard came into existence after the law was passed, the junkyard owner is responsible for screening.

An exception occurs when a legal junkyard exists and becomes visible from a highway as a result of highway relocation. In that case, the Department is responsible for screening and will make a good-faith effort to provide living screens, berms, fencing or a combination thereof when it can be done as part of a larger landscape planting contract in the vicinity, or a landscape planting project planned for the right-of-way in the area.

Other unsightly areas - Areas that might be considered unsightly include unkempt or abandoned buildings or farmsteads, industrial areas, gravel pits or other areas which don't qualify as junkyards, but would still be perceived by the public as visually displeasing. The designer must decide whether the site requires a total screen or limited or intermittent screening.

5.4.2 Visual Buffers

Visual buffers are similar to visual screens, but their purpose is to provide a psychological separation between the highway and an adjacent land use. A buffer planting draws attention away from the surrounding environment enough to psychologically soften or even separate it from the highway environment. Buffer plants should draw attention because of their aesthetic qualities--such as form, texture, flowers or fall color. There is usually no immediate critical need for these plants to perform this function so smaller sizes may be planted.

5.4.3 Noise Barriers

As a rule, vegetation is inefficient as a noise barrier. To be effective, a plant grouping must be very dense, wide and high. However, simply blocking the source of the noise from view may reduce awareness of the problem, and thereby effectively "reduce" noise levels. As with any type of noise barrier, the height of the plantings must exceed the height of the imaginary line between the source of the noise and the people affected.

Plants may be used in conjunction with other noise barrier structures if there is enough room between either the structure and the highway, or the structure and the right-of-way line. Plants will help to absorb sound waves and soften the visual impact of the structure.

5.4.4 Impact Attenuators

Multi-stemmed shrubby plants may be used as supplemental impact attenuators in conjunction with other systems. Individual stems of mature plants used for this purpose must not be capable of exceeding four inches in diameter. Shrubs should be planted closely enough together to form a mass so that individual plants are not recognizable. The mass should be as large as space allows.

5.4.5 Delineators

Plants can often be used to delineate changes in the horizontal alignment of highways. They are typically used

on the outside of curves where the combination of vertical and horizontal alignments combine and may confuse the driver as to where the road goes (see Attachment 5.3). At "T" intersections or cul de sacs, particularly if a previous through street has been cut off (see Attachment 5.4), plants used as delineators should be large enough to perform their function immediately. They must have enough mass to indicate visually that the roadway direction changes just out of the driver's sight.

5.4.6 Snowdrift Control

Mass plantings of trees and/or shrubs, are very effective for controlling drifting snow. They are relatively long-lived and require little maintenance once the plants have become established.

Each site will have its own unique set of factors which will affect the shape and storage capacity of the snow drift. The following is some general information which will help in understanding the dynamics of snowdrift control.

Plant Variety: Whenever large numbers of plants are planted in close proximity, use a variety of species rather than a single species. This helps prevent heavy plant losses in the event of insect or disease problems which may affect an individual species.

Choose species that have between 45% and 55% twig density especially at ground level. Maximum drift depth decreases slowly with decreasing twig density down to a density of about 20%. See Attachment 5.5 for a list of plants that are particularly well-suited for use as living snow fences.

Evergreen trees are not recommended for snowdrift control; they should be used only in exceptional cases when shrubs are not appropriate. During the period of their greatest effectiveness, evergreens form a very dense mass which causes more drifting on the windward side. However, their pyramidal shape limits their effectiveness when small, and as they approach maturity they become less effective as they lose their lower branches. If evergreen trees must be used, plant at least one row of shrubs on the highway side of the planting to extend the useful life of the snow fence. Evergreens should be planted 8 feet (2.4 m) apart in rows that are 6 feet (1.8 m) apart for maximum effectiveness.

Right-of-Way Snow Storage Capacity: This is the critical factor in selecting living snow fence locations. Drifting occurs on the leeward side of the plantings for a distance of at least 15 times their height and may extend up to 35 times the height.

For example, if the plants are expected to grow to 5 feet (1.5 m) tall, a minimum of 75 feet (22.5 m) of open space is required under ideal conditions to store the drifted snow between the near edge of the roadway and the closest plants. However, situations are often encountered where a living snow fence is desirable but the ideal width necessary for snow storage is not available. In such cases the snow fence planting may be installed with the understanding that if the drift reaches its maximum potential, the downwind edge may need to be plowed. When three rows of shrubs are proposed, the minimum width between the security fence and the near edge of the pavement should be 70-75 feet (21-22.5 m). Drifting distance on the windward side of the snow fence may also reach up to 15 times the snow fence height but it will be only about half as deep as the snow fence height (see Attachment 5.6). Storage capacity is proportional to the square of the snow fence height. Thus, an eight-foot-tall snow fence will store four times as much snow as a four-foot-tall snow fence.

Plant Spacing: Use multiple rows of plants for snowdrift control plantings. Three or more rows are desirable, but one or two rows may be used where space is limited. Space the shrubs four feet apart, in rows which are also four feet apart, and stagger the spacing from row to row.

End Effect: Snowdrifts are rounded near the end of a snow fence (see Attachment 5.7). This "end effect" extends inward toward the center of the fence for a distance of about 12 times the fence height. Rounding significantly reduces snow storage capacity over the affected portion of the fence. Therefore, it must be factored in when determining where the fence end points are located. The snow fence ends should be located at least 12 times the height of the snow fence past the area where drifting snow is a problem.

Snow fence length: Drift length, depth and volume decrease as snow fence length decreases. Therefore, a long snow fence is more effective than a series of short snow fences. Snow fence lengths should be at least 30 times their height, and the longer the better. Avoid openings in the snow fence. Where openings must be provided, separate the snow fence lines by three times the height and overlap two times the height. See Attachment 5.8 for an illustration of this principle.

Topography and Drift Shape: Roadside topography influences the location and design of the snow fence in the following ways.

- The windward drift is very sensitive to topography. Only very small windward drifts form on hill crests and windward-facing slopes steeper than about 10%. See Attachment 5.9.
- Windward drifts are deeper on slopes that are downward in the direction of the wind, causing a

tendency for snow fences to become buried on slopes steeper than about 10%. See Attachment 5.9.

- Upward slopes in the approach zone (the area leading up to the fence on the windward side) increase snow storage capacity by increasing drift depth. Upslopes and hills in the exhaust zone (the area on the leeward side of the fence) generally decrease fence capacity. Maximum snow storage capacity is achieved by placing fences on hill crests and ridge tops. See Attachment 5.9.
- The surface of the drift is not affected by topographic unevenness underneath. As a result, depressions such as stream channels can greatly augment snow storage capacity, while mounds or hills reduce storage capacity. See Attachment 5.10.
- Downward slopes on the lee side of a snow fence increase storage capacity (a 15% to 20% estimated increase in capacity for each degree of slope).

Snow Fence Placement and Orientation: After the distance of maximum effectiveness has been passed, snow fence effectiveness decreases in proportion to its distance from the area to be protected. In general, snow fences should not be placed more than 70 times the height of the fence from the area to be protected. Align snow fence parallel to the road for winds that are within 25 degrees of perpendicular to the road. Otherwise, orient snow fences perpendicular to the prevailing wind direction. Snow fences should extend far enough on either side of the area to be protected to intercept winds from 30 degrees on either side of the prevailing wind.

5.4.7 Erosion Control

Vegetation is the most cost effective and aesthetic means of erosion control. Existing vegetation on the construction site should be preserved where practical. If this is not possible, vegetation should be re-established using grasses, forbs (such as wildflowers) and woody plants. The Department's Natural Roadside Policy requires the use of native species as much as possible. See FDM 10-10-3, FDM 10-10-5, FDM 10-10-7, and FDM 10-10-9 for further guidance regarding vegetation as erosion control.

5.5 Planting for Aesthetic Purposes

Although most planting has a functional purpose, there are situations where planting may be done for aesthetic reasons if a partnership is formed with another agency or local community in which that agency or community agrees to fund all construction and future maintenance costs. Opportunities for aesthetic planting are identified during the site analysis, in the initial phases of plan development (see FDM 27-20-1). See FDM 27-1-5 for more guidance regarding aesthetic design.

The following list identifies situations where planting for aesthetic reasons may be justified.

5.5.1 Adding Interest to Landscape

Evergreen trees add color, as do large trees and groups of tall shrubs with brightly colored twigs or fruit. Plants with attractive flowers during the spring and summer months or bright fall coloration also add visual interest. For example, plants could be used to create visual interest in a large interchange area, which might seem bleak without plantings, especially during winter.

Plants provide color in a number of ways.

Leaves: Leaves contribute to the perception of color in the landscape. Most landscape plants WisDOT uses have green leaves, in conformance with the Department's Natural Roadsides Policy.

Still, it is possible to contrast differing shades of green. Interspersing evergreen trees among deciduous species creates a visually pleasing contrast in color, form and texture. Of course, evergreens also retain their color in winter. Use native evergreen species or, in more urban locations, use species that blend with plantings on adjacent properties.

In addition, many deciduous trees and shrubs have spectacular fall color, such as sugar maple, ash species, viburnums, sumacs, paper birch and serviceberry species.

Bark: The bark of many native plants is quite colorful and can \add interest to the landscape, particularly during dormancy. Examples include the white bark of the paper birch and the red bark of redosier dogwood.

Flowers: Although flowering is usually of short duration, many plants, such as flowering crabapples and various viburnum and dogwood species, have flowers that are very attractive and are easily seen from the highway.

Fruit: Many plants have small but nevertheless quite colorful fruit that persist well into the winter months. These include some viburnum, dogwood, crabapple, and hawthorn species, among others.

5.5.2 Framing

Plants may be used to create a frame which enhances a distant view or a structure such as a bridge.

5.5.3 Softening

Structures with harsh edges or large surface areas, such as concrete or block retaining walls, look softer and more pleasing if vines are growing on them or plants are placed in front of them. Plants break up the larger surface into smaller surfaces and provide three-dimensional variety.

5.5.4 Blending

Plantings that reflect or expand upon vegetation occurring either naturally or as landscape plantings on the right-of-way or on adjacent land can create a more harmonious landscape. The same principle can be used to blend wide median areas in with vegetation on either side of the right-of-way.

5.5.5 Highlighting

Plantings can draw attention to or enhance the view of geologic or cultural features within the view shed.

5.5.6 Historic Building Restoration

Occasionally there is an opportunity to provide plantings around historic buildings that are being restored as part of a WisDOT project. It is best to choose plants which were commonly used during the historic period to which the building is being restored. It may be possible to identify actual species used at the site during the period in question through old photos or by observing plants still existing on the site.

5.5.7 Vegetation Removal

There are also occasions when views can be created or enhanced by selectively removing vegetation. For example, a roadway may be located next to a river but vegetation obstructs the driver's view of the river. If possible, remove enough of the vegetation to provide adequate, safe viewing time. Consider purchasing easements if the vegetation exists off the right-of-way. There may be similar situations where a distant view of the surrounding countryside could be opened up by selectively removing vegetation.

5.6 Physical Constraints

Designers should be aware of physical constraints which may limit the amount or type of plantings which can be installed. Awareness of the following constraints may help avoid problems in the future.

5.6.1 Utilities

Utility lines, whether underground or overhead, may severely limit the space available for planting, especially in urban situations. Buried telephone or electrical cables or conduit, gas lines, and sewer or water pipes will all restrict planting, as will overhead telephone or power lines.

Attachment 5.11 contains guidelines for planting near overhead electrical distribution or transmission lines. As the chart indicates, the minimum distance from the centerline of the power line at which planting may occur may be correlated to the number of bells on the insulators holding the lines to the poles or towers.

Although similar guidelines have not been developed for underground utilities, space must be provided for future line maintenance so undue damage to plantings does not occur.

5.6.2 Outdoor Advertising Signs

Placement of outdoor advertising signs is regulated under Section 84.30 Wisconsin Statutes, and TRANS 201 and 280, Wisconsin Administrative Code. Section 78 of the Highway Maintenance Manual describes how plantings are treated in relation to outdoor advertising signs. This section also defines conditions under which signs are considered to be screened. Generally, if vegetation screening an outdoor advertising sign was in place before the sign was erected, the vegetation will be allowed to remain. If the sign was legally erected before the vegetation was planted, the vegetation may be removed unless there is an overriding reason (i.e. highway safety) for leaving it in place.

The department receives many requests from sign owners to remove vegetation screening their signs, so care must be taken not to plant anything that might screen existing signs and lead to a request for plant removal.

5.6.3 Ditches and Drainage Ways

Vegetation that could impede water flow must not be planted in ditches or other drainage ways. This includes trees, shrubs, and thick or tall grasses and ground covers. Show ditch and drainage way locations on the plan. A detail or note to the project manager and the contractor should specify that plants must not be located where they might cause drainage problems.

5.6.4 Bridges

Vegetation growing too close to bridge abutments reduces the space available for maneuvering equipment used in performing bridge safety inspections. Therefore, a minimum clear distance of 5 feet (1.5 m) must be

maintained between the bridge and the anticipated drip line of the vegetation. Generally, this can be accomplished by planting no closer than 10 feet (3 m) from the bridge structure, but if wide-spreading plants are specified, a greater distance may be necessary.

5.6.5 Right-of-way

Woody plants should be kept back from the right-of-way line so they do not encroach upon neighboring property. If the right-of-way is fenced, keep woody plants pruned back so they do not harm the fence or interfere with fence maintenance.

5.6.6 Deicing Salt

Designers need to be aware of salt used as a de-icing agent on roadways. Both airborne and soilborne salt can be a hazard to some plants. The effects of salt spray carried by prevailing winds are of greater concern on the south and east sides of the roadway. Designers should use salt-tolerant species when planting in these areas, especially within 100 feet of the edge of pavement. For a list of the salt tolerance levels of commonly used woody plants see Attachment 5.12.

5.7 Safety Considerations

5.7.1 Clear zone

The clear zone is defined as the roadside border, starting at the edge of the traveled way, that is available for safe use by errant vehicles. The width of the clear zone is determined based on design speed, traffic volume and certain site-specific conditions such as the history of accident occurrences. Guidance on clear zones and methods for calculating clear zone widths based on design standards appears in FDM 11-15-1. Guidance on clear zones from a maintenance perspective appears in Policy 74.40 of the DOT Highway Maintenance Manual. Plants capable of attaining a trunk diameter greater than four inches should not be planted within the clear zone. Plants that are not capable of growing over four inches in diameter may be planted in the clear zone if there is a safety-related reason to do so, such as impact attenuation. A guideline for planting woody plants near clear zones is to plant a minimum of 50 feet (15 m) from the edge of the pavement--preferably farther if space is available. It increases the chances of survival for the plants as well as preventing the psychological feeling of encroachment for travelers.

5.7.2 Vision Corners

A vision corner may be defined as a triangular area located at the intersection of two roads that is free of obstructions that would hinder a driver's view of one road from the other. These areas should be kept free of plant material that could block vision of on-coming traffic.

FDM 11-10 Attachment 5.11 gives guidance for determining dimensions for vision triangles. Also, the “Function, Operation and Safety” section of the Transportation Landscape Design Handbook contains more information and illustrations on this subject.

5.7.3 Inside of Horizontal Curves

The roadside on the inside of horizontal curves must also be kept free of visual obstructions where passing is allowed on the curve. FDM 11-10 Attachment 5.6 provides a formula for determining the sight distance to be maintained on horizontal curves.

5.7.4 Encroachment

Vegetation planted too close to the road causes the psychological feeling that the road is narrowing. This may cause drivers to crowd the centerline, creating a hazardous situation.

5.8 Effects of Plantings on the Environment

5.8.1 Winter Shading

Tall-growing trees, particularly on the south or west sides of the highway, may cast shadows on the roadway, even during the warmest part of the day in the winter months. This constant or nearly constant shade prevents the sun from melting ice on the paved surface. Groups of tall-growing trees must be sited carefully, so they do not create icing problems upon attaining their mature height. Individual trees or widely spaced trees are not as likely to cause problems because sunlight can filter through the branches and warm the highway surface. Attachment 5.13 is a shadow length and direction chart which determines approximately where shadows will be cast by plants at different times of the year.

5.8.2 Snowdrift Control

Plants should not be placed in areas where they may cause snow to drift and accumulate on the highway. Consult the region Systems Planning and Operations Section to determine which locations may be problematic.

5.9 Construction Considerations

Delaying the design of the planting project, at least until after the highway has been graded, allows the designer to better understand conditions as they will exist after highway construction is complete. Therefore, it is recommended that plantings be stand-alone projects rather than incorporated into a highway grading or paving project. The following items should be considered:

5.9.1 Planting Locations

During the initial site investigation, enough information should be gathered for the designer to develop a planting plan that will not create problems in the field during construction. For example, plants should not be planned for an area where they would interfere with utilities, or in locations where the contractor might have difficulty gaining access.

5.9.2 Plant Sources and Substitutions

The contract Special Provisions should require that plants furnished under contract come from sources within Wisconsin or portions of contiguous states. Check several nursery catalogs from this region to verify that species and sizes selected are reasonably available in the nursery trade. This will help ensure that the project manager will receive minimal substitution requests.

5.9.3 Details

Include cross sections showing plant locations in relation to topography and the roadway so the project manager and the contractor clearly understand the designer's intent. For the same reason, SDD 14A2, the Tree Planting Detail, is required for every plan which contains woody plant materials. The Project Development section of the Transportation Landscape Design Handbook contains a Shrub Bed Detail Sheet to be used when appropriate. Additional detail drawings may be appropriate when specialty items or unusual design features are included.

5.9.4 Plant Establishment Period

Unless otherwise specified, a two-year period.

LIST OF ATTACHMENTS

Attachment 5.1	Plantings as Glare Screens
Attachment 5.2	Partial Plant Screening
Attachment 5.3	Plantings as Delineators
Attachment 5.4	Delineating Cut-off Roads
Attachment 5.5	Plants Suitable for Snow Drift Control
Attachment 5.6	Snow Fence Size & Drift Distance
Attachment 5.7	Snow Drift End Effect
Attachment 5.8	Snow Fence Overlap
Attachment 5.9	Topography and Drift Shape
Attachment 5.10	Topography and Snow Storage
Attachment 5.11	Guidelines for Planting Trees Near Overhead Power Lines
Attachment 5.12	Salt Tolerance Chart
Attachment 5.13	Shadow Length and Direction Chart