Roadside Landscaping and Safety

Dick Albin, FHWA Resource Center
John Mauthner, Florida Department of Transportation

May 15, 2014
Today’s Presentation

- Introduction and housekeeping
- Audio issues?
  Dial into the phone line instead of using “mic & speakers”
- PBIC Trainings and Webinars
  www.pedbikeinfo.org/training
- Registration and Archives at
  pedbikeinfo.org/webinars
- PBIC News and updates on Facebook
  www.facebook.com/pedbike
- Questions at the end
Trees and Safety in the Urban Environment

Dick Albin
FHWA Resource Center
I THINK that I shall never see
A poem lovely as a tree.
Joyce Kilmer. 1886–1918
To street tree, or not to street tree--that is the question

Paraphrased from William Shakesphere
Benefits of Street Trees

Benefits attributed to street trees include:

• Increase by 9-12% the amount people will pay for products and services
• Lessen stress of commuters
• Reduce aggressive driving
• Increase job satisfaction
• Reduce storm water runoff by 4-8%
• Calm traffic - 10% reduction in 85th % speed

http://depts.washington.edu/hhwb/Thm_SafeStreets.html
Are fixed Object Crashes a concern in the Urban area?

There are some opinions that fixed objects aren’t an issues in the urbanized area because speeds are lower.
Often, the impacts to motorist safety are minimized

- “Far less than 1% of crashes involve a tree on an urban street”
- Fatal Pedestrian crashes are approximately 0.08% of all crashes

<table>
<thead>
<tr>
<th></th>
<th>U.S. Total</th>
<th>Tree Accidents</th>
<th>Urban Accidents</th>
<th>Urban Tree Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All Accidents</strong></td>
<td><em>6,316,000</em></td>
<td>1.9%</td>
<td>37%</td>
<td>0.7%</td>
</tr>
<tr>
<td></td>
<td>(100%)</td>
<td><em>141,000</em> (2.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Incapacitating</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury and Fatality</td>
<td></td>
<td>0.9%</td>
<td>4.1%</td>
<td>0.04%</td>
</tr>
<tr>
<td><strong>Fatality</strong></td>
<td></td>
<td>0.1%</td>
<td>0.4%</td>
<td>&lt; 0.001%</td>
</tr>
<tr>
<td></td>
<td><em>43,005</em> (0.6%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*3,258 (&lt; 0.001%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* NHTSA (2004) - %s may differ due to sampling and analysis procedures
Roadway Departure Crashes

Roadway Departure Crash - A non-intersection crash in which a vehicle crosses an edge line, a centerline, or otherwise leaves the traveled way.

National Fatal Crashes
(Average 2009-2011)

30,305 Fatal Crashes/Year
15,783 Fatal RwD Crashes/Year

Source: NHSTA FARS
Nearly \( \frac{3}{4} \) of Roadway Departure Fatalities are from 3 crash types.

- Overturn: 18,530
- Opposite Direction: 14,374
- Trees, Shrubs: 11,452

http://safety.fhwa.dot.gov/roadway_dept/
Fatal Tree Crashes (2007-2009)

Trees are 50% of Fixed Object Fatalities

11,452
A large number are in “Low Speed” Environments

Deaths in fixed object crashes by speed limit, 2010

<table>
<thead>
<tr>
<th>Speed limit</th>
<th>Deaths</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No limit</td>
<td>22</td>
<td>&lt;1</td>
</tr>
<tr>
<td>&lt;35 mph</td>
<td>1,003</td>
<td>14</td>
</tr>
<tr>
<td>35-40 mph</td>
<td>1,389</td>
<td>19</td>
</tr>
<tr>
<td>45-50 mph</td>
<td>1,446</td>
<td>20</td>
</tr>
<tr>
<td>55+ mph</td>
<td>3,277</td>
<td>45</td>
</tr>
<tr>
<td>Total*</td>
<td>7,272</td>
<td>100</td>
</tr>
</tbody>
</table>

*Total includes other and/or unknowns
Side Impact crashes can be more severe
Do trees at the curb line affect pedestrians?
Pedestrians Vs Motorists

For urban other principal arterials, minor arterials, and collectors shows that:

• 48 pedestrians were killed on the roadside.
• 395 people were killed from impacts with trees on the same streets.

Source: 2008 Fatality Analysis Reporting System (FARS)
Trees at the curb can reduce the ability for drivers to see the pedestrian or signs.
Trees reduce the effectiveness of lighting
Roots can cause buckling of sidewalks
Trees don’t like being there
Bicycle Lane Impacts
Are all “Urban Streets” the same?
• In an urban environment, right of way is often extremely limited and in many cases it is not practical to establish a full-width clear zone using the guidance in the AASHTO Roadside Design Guide
In these environments, a lateral offset to vertical obstructions (signs, utility poles, luminaire supports, fire hydrants, etc., including breakaway devices) is needed to accommodate motorists operating on the roadway and parked vehicles.
This lateral offset to obstructions helps to:

- Avoid adverse impacts on vehicle lane position and encroachments into opposing or adjacent lanes
- Improve driveway and horizontal sight distances
- Reduce the travel lane encroachments from occasional parked and disabled vehicles
- Improve travel lane capacity
- Minimize contact from vehicle mounted intrusions (e.g., large mirrors, car doors, and the overhang of turning trucks)
• On curbed facilities located in transition areas between rural and urban settings there may be an opportunity to provide greater lateral offset in the location of fixed objects.

• These facilities are generally characterized by
  – higher operating speeds
  – sidewalks separated from the curb by a buffer strip
Where establishing a full-width clear zone in an urban area is not practical due to right-of-way constraints, consideration should be given to establishing a reduced clear zone, or incorporating as many clear zone concepts as practical such as removing roadside objects or making them crashworthy.
### Fixed Object Crashes

<table>
<thead>
<tr>
<th>Lat. Dist.</th>
<th>Crashes</th>
<th>%</th>
<th>Cumul.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1’</td>
<td>129</td>
<td>28.3%</td>
<td>28.3%</td>
</tr>
<tr>
<td>1-2’</td>
<td>157</td>
<td>34.4%</td>
<td>62.7%</td>
</tr>
<tr>
<td>2-4’</td>
<td>90</td>
<td>19.7%</td>
<td>82.5%</td>
</tr>
<tr>
<td>4-6’</td>
<td>50</td>
<td>11.0%</td>
<td>93.4%</td>
</tr>
<tr>
<td>6-8’</td>
<td>23</td>
<td>5.0%</td>
<td>98.5%</td>
</tr>
<tr>
<td>8-10’</td>
<td>6</td>
<td>1.3%</td>
<td>99.8%</td>
</tr>
<tr>
<td>10-15’</td>
<td>1</td>
<td>0.2%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>456</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: NCHRP Report 612
Figure 10-1. Lateral Offset for Objects at Horizontal Curves on Curbed Facilities
Lane Merge / Acceleration
Lane Tapers

Figure 10-2. Enhanced Lateral Offsets at Merge Points
Driveways

Figure 10-3. Enhanced Lateral Offsets at Driveways
Landscape Buffer (Planting Strip) Configuration
Landscape Buffer (Planting Strip) > 4’ wide

Figure 10-4. Landscape and Rigid Object Placement for Buffer Strip Widths ≤1.2 m [4 ft]

Source: NCHRP Report 612
Landscape Buffer (Planting Strip) < 4’ wide

NARROW BUFFER STRIP

Figure 10-5. Landscape and Rigid Object Placement for Buffer Strip Widths >1.2 m [4 ft]

Source: NCHRP Report 612
TL-2 Median Barrier
CMF for Roadside Fixed Objects

\[
\text{CMF}_{2r} = f_{\text{offset}} \times D_{\text{fo}} \times p_{\text{fo}} + (1 - p_{\text{fo}})
\]

Where:

- \( f_{\text{offset}} \) = fixed object offset factor from Table 12-20
- \( D_{\text{fo}} \) = fixed object density (fixed objects/mi)
- \( p_{\text{fo}} \) = fixed-object collisions as a proportion of total crashes, Table 12-21

- Only point objects that are 4 inches or more in diameter and do not have breakaway design are considered.
- Point objects that are within 70 feet of each other longitudinally are considered as a single object.
EX: For 4-Ln Urban undivided street (4U) with trees at 2 ft offset

- $f_{\text{offset}} = 0.232$
- $p_{fo} = 0.037$

**Table 12-20. Fixed-Object Offset Factor**

<table>
<thead>
<tr>
<th>Offset to Fixed Objects ($O_{fo}$) (ft)</th>
<th>Fixed-Object Offset Factor ($f_{\text{offset}}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.232</td>
</tr>
<tr>
<td>5</td>
<td>0.133</td>
</tr>
<tr>
<td>10</td>
<td>0.087</td>
</tr>
<tr>
<td>15</td>
<td>0.068</td>
</tr>
<tr>
<td>20</td>
<td>0.057</td>
</tr>
<tr>
<td>25</td>
<td>0.049</td>
</tr>
<tr>
<td>30</td>
<td>0.044</td>
</tr>
</tbody>
</table>

**Table 12-21. Proportion of Fixed-Object Collisions**

<table>
<thead>
<tr>
<th>Road Type (Type)</th>
<th>Proportion of Fixed-Object Collisions ($p_{fo}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2U</td>
<td>0.055</td>
</tr>
<tr>
<td>3T</td>
<td>0.034</td>
</tr>
<tr>
<td>4U</td>
<td>0.037</td>
</tr>
<tr>
<td>4D</td>
<td>0.036</td>
</tr>
<tr>
<td>5T</td>
<td>0.016</td>
</tr>
</tbody>
</table>
CMF for Roadside Fixed Objects: Example

For one mile of 4-Ln Urban undivided commercial curbed street (4U) with trees on both sides on 50 foot spacing 2 feet from edge of travel way:

\[
CMF_{2r} = f_{\text{offset}} \times D_{fo} \times p_{fo} + (1 - p_{fo})
\]

\[
= 0.232 \times \frac{5280}{70} \times 2 \times 0.037 + (1 - 0.037)
\]

\[
= 0.232 \times 150.8 \times 0.037 + (0.963)
\]

\[
= 1.295 + 0.963
\]

\[
= 2.258
\]
CMF for Roadside Fixed Objects: Example

For one mile of 4-Ln Urban undivided commercial curbed street (4U) with trees on both sides on 50 foot spacing 5 feet from edge of travel way:

\[ \text{CMF}_{2r} = f_{offset} \times D_{fo} \times p_{fo} + (1 - p_{fo}) \]

\[ = 0.133 \times \left( \frac{5280}{70} \right) \times (2) \times 0.037 + (1 - 0.037) \]

\[ = 0.133 \times 150.8 \times 0.037 + (0.963) \]

\[ = 0.742 + 0.963 \]

\[ = 1.705 \]
For one mile of 4-Ln Urban undivided commercial curbed street (4U) with trees on both sides on 50 foot spacing 10 feet from edge of travel way:

\[
CMF_{2r} = f_{\text{offset}} \times D_{fo} \times p_{fo} + (1 - p_{fo})
\]

\[
= 0.087 \times \left( \frac{5280}{70} \right)(2)(0.037) + (1 - 0.037)
\]

\[
= 0.087 \times 150.8 \times 0.037 + (0.963)
\]

\[
= 0.486 + 0.963
\]

\[
= 1.449
\]
• Crashes into trees are a significant contributor in fatal crashes – even in “low speed (45 mph or less)” urban environments
• The benefits of trees need to be balanced with other trade-offs
• Recent changes in AASHTO encourage greater lateral offsets to fixed objects (minimum of 4’ to 6’)
• Risk of crashes decreases as the fixed objects are moved further from the travelled way
Introduction

• Landscaping of Highway Medians at Intersections Research by CUTR. We will cover the following:
  – Need for Research and Background
  – Research Objectives and Methodology
  – Conclusion and Recommendations
Need for Research and Background

• Landscaping of Highway Medians at Intersections Research
  – Validation of Index 546 and its criteria
  – Propose changes to Index 546 based on:
    • Median width
    • Tree diameter
    • Tree spacing
    • Vehicle speed
Need for Research and Background

- Context Sensitive Solutions
  - Effective November 20, 2008
  - Collaborative, Interdisciplinary Approach
  - Develop a transportation facility that
    - Fits its physical settings
    - Preserves
      - Scenic
      - Aesthetic
      - Historic
      - Environmental resources
    - Maintaining safety and mobility
Need for Research and Background

- Highway Beautification and the Bold Landscaping Policy
  - Many Trees
  - $30 Million/Year for Highway Beatification
Need for Research and Background

• 2010 - Roadway Design Bulletin 10-04
  – Tree placement within an intersection median
    • Horizontal Clearance
    • No left turn present
    • Left turn present (signalized or not)
      – Low speed facilities (100’ Setback)
      – High speed facilities (200’ Setback)
Need for Research and Background

- Before Roadway Design Bulletin 10-04

**Special Areas Limited to Ground Cover**

** For signalized and unsignalized intersections, the median area along left turn lanes, including the taper, shall be limited to ground cover with height not greater than 18” below the sight line datum, regardless of whether or not the area is within the limit of clear sight.
Need for Research and Background

• Before Roadway Design Bulletin 10-04
Need for Research and Background

• After Roadway Design Bulletin 10-04

PLAN
Special Areas Limited to Ground Cover

* See GENERAL NOTE 5.B

Lane Identification and Direction of Traffic
Pavement Markings

100' for <50 mph*
200' for ≥50 mph*
Need for Research and Background

• After Roadway Design Bulletin 10-04
Research Objectives and Methodology

• Landscaping of Highway Medians at Intersections Research
  – Main Objectives
    • Review current landscaping criteria
    • Provide a computational procedure to analyze landscaping configurations
    • Perform an empirical study of the Safety Performance of Standard Index 546
Landscaping Policy in other States

- AASHTO’s landscaping policy for intersections has two main parts
  1. Drivers require an unobstructed view of the intersection
  2. Does not strictly forbid landscaping near intersection approaches

<table>
<thead>
<tr>
<th>State</th>
<th>Median Tree Placement Criteria</th>
<th>Setback Restriction</th>
</tr>
</thead>
</table>
| California | • Barrier is required for speeds 45 mph or less  
• Mature trees (4” or greater in diameter) require an 11” or more wide median | • Signalized Intersections: 100’ from intersections  
• Unsignalized Intersections:  
  o 25 mph - 150’ from intersections  
  o 30 mph - 200’ from intersections  
  o 35 mph - 250’ from intersections |
| Louisiana | • Only allows shrubbery and ground cover in the clear sight triangle area with heights less than 2.5’ above roadway surface  
• No trees allowed in the clear sight triangles | • 30 mph - 300’ from median nose  
• 40 mph - 400’ from median nose  
• 50 mph - 500’ from median nose  
• 55 mph - 550’ from median nose |
# Landscaping Policy in Florida

## Table 2-2. Detailed Median Landscaping Policy for Florida

<table>
<thead>
<tr>
<th>Median Trees Guidelines at Intersections</th>
<th>Florida</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Cover</td>
<td>Top of ground cover to sight line datum: Ground cover only, &gt; 18”</td>
</tr>
<tr>
<td></td>
<td>For ground cover in combination with trees and palms:</td>
</tr>
<tr>
<td></td>
<td>&gt; 24” for trees and palms ≤ 11” diameter</td>
</tr>
<tr>
<td></td>
<td>&gt; 18” for Sabal Palms &gt;11” but ≤ 18” diameter</td>
</tr>
<tr>
<td>Setback Restrictions (Trees/Trunked Plants)</td>
<td>100’ from pavement edge for design speeds &lt; 50 mph</td>
</tr>
<tr>
<td></td>
<td>200’ from pavement edge for design speeds ≥ 50 mph</td>
</tr>
<tr>
<td>Trunked Plants</td>
<td>Diameter ≤ 4”</td>
</tr>
<tr>
<td></td>
<td>≥5’ above the sight line datum</td>
</tr>
<tr>
<td></td>
<td>Minimal space: 20’</td>
</tr>
<tr>
<td>Trees</td>
<td>Diameter ≤ 18”</td>
</tr>
<tr>
<td></td>
<td>Distance to bottom of canopy 8’6”</td>
</tr>
<tr>
<td></td>
<td>Minimal tree spacing (center to center of trunk)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Diameter &gt; 4”</th>
<th>Diameter &gt; 11”</th>
<th>Diameter &gt; 11” ≤ 18”</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>22</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>27</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>33</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>40</td>
<td>146</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>45</td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>52</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>193</td>
<td></td>
</tr>
</tbody>
</table>
Research Objectives and Methodology

• Sight Distance and Index 546
  – Approach Sight Triangles
  – Departure Sight Triangles
Research Objectives and Methodology

- Sight Distance and Index 546
  - Approach Sight Triangles
Research Objectives and Methodology

- Sight Distance and Index 546
  - Departure Sight Triangles
Research Objectives and Methodology

- Studied intersections divided into 3 groups for controlled intersections (signalized or stop sign on minor road)
  - No median trees near the intersection
  - Median trees near the intersection (compliant with Index 546)
  - Median trees near the intersection (noncompliant with Index 546)
## Research Objectives and Methodology

- **Validation of FDOT Standard Index 546 on Computational Values**
  - Sight Distance Tables

<table>
<thead>
<tr>
<th>Design Speed</th>
<th>(d)</th>
<th>(d_L)</th>
<th>(d_r)</th>
<th>Design Speed</th>
<th>(d)</th>
<th>(d_L)</th>
<th>(d_r)</th>
<th>Design Speed</th>
<th>(d)</th>
<th>(d_L)</th>
<th>(d_r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>375</td>
<td>265</td>
<td>80</td>
<td>30</td>
<td>480</td>
<td>340</td>
<td>105</td>
<td>30</td>
<td>570</td>
<td>405</td>
<td>125</td>
</tr>
<tr>
<td>35</td>
<td>440</td>
<td>315</td>
<td>95</td>
<td>35</td>
<td>560</td>
<td>400</td>
<td>120</td>
<td>35</td>
<td>665</td>
<td>470</td>
<td>145</td>
</tr>
<tr>
<td>40</td>
<td>500</td>
<td>355</td>
<td>110</td>
<td>40</td>
<td>640</td>
<td>455</td>
<td>135</td>
<td>40</td>
<td>760</td>
<td>540</td>
<td>165</td>
</tr>
<tr>
<td>45</td>
<td>565</td>
<td>400</td>
<td>120</td>
<td>45</td>
<td>720</td>
<td>510</td>
<td>155</td>
<td>45</td>
<td>855</td>
<td>605</td>
<td>185</td>
</tr>
<tr>
<td>50</td>
<td>625</td>
<td>445</td>
<td>135</td>
<td>50</td>
<td>800</td>
<td>570</td>
<td>170</td>
<td>50</td>
<td>950</td>
<td>675</td>
<td>205</td>
</tr>
<tr>
<td>55</td>
<td>690</td>
<td>490</td>
<td>150</td>
<td>55</td>
<td>880</td>
<td>625</td>
<td>190</td>
<td>55</td>
<td>1045</td>
<td>740</td>
<td>225</td>
</tr>
<tr>
<td>60</td>
<td>750</td>
<td>530</td>
<td>160</td>
<td>60</td>
<td>960</td>
<td>680</td>
<td>205</td>
<td>60</td>
<td>1140</td>
<td>810</td>
<td>245</td>
</tr>
<tr>
<td>65</td>
<td>815</td>
<td>580</td>
<td>175</td>
<td>65</td>
<td>1040</td>
<td>740</td>
<td>220</td>
<td>65</td>
<td>1235</td>
<td>875</td>
<td>265</td>
</tr>
</tbody>
</table>

**SIGHT DISTANCE (\(d\)) AND RELATED DISTANCES (\(d_L\), \(d_r\)) (FEET)**

4 LANE UNDIVIDED WITH OPTIONAL LANE
Research Objectives and Methodology

• Visibility Criteria
  – Restricted Visibility
    • 50 Percent visible area
    • Stopped vehicle profile
Research Objectives and Methodology

• Visibility Criteria
  – Unrestricted Visibility
    • 2 seconds minimum
    • Minimum tree spacing

The Intent Of This Standard Is To Provide A Window With Vertical Limits Of Not Less Than 5’ Above And 1’-6” Below The Sight Line Datum, And Horizontal Limits Defined By The Limits Of Clear Sight.

PICTORIAL
WINDOW DETAIL

PBIC Webinar www.pedbikeinfo.org
Research Objectives and Methodology

PERCEPTION DIAGRAM
SETTING SABAL PALM (STATE TREE) SPACING
Research Objectives and Methodology

• Validation of FDOT Standard Index 546 on Computational Values
  – Tree Spacing Table

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Inches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;4≤11</td>
<td>&gt;11≤18</td>
<td>&gt;4≤11</td>
<td>&gt;11≤18</td>
<td>&gt;4≤11</td>
<td>&gt;11≤18</td>
<td>&gt;4≤11</td>
<td>&gt;11≤18</td>
</tr>
<tr>
<td>(Feet)</td>
<td>25</td>
<td>90</td>
<td>30</td>
<td>105</td>
<td>35</td>
<td>120</td>
<td>40</td>
</tr>
</tbody>
</table>
Conclusion and Recommendations

• Visibility Simulator Tools
  – Computational Tool
    • Evaluate visibility
    • More flexibility in the design of landscaping configurations
      – Change intersection plan views
      – Change tree spacing and configuration
      – Design Speeds
      – Vehicle path
  • Simulation
    – Measures performance
    – Output file
Conclusion and Recommendations

- Base Scenario in Visibility Simulator

\[ DS = 40 \text{ MPH} \]
Conclusion and Recommendations

- Base Scenario in Visibility Simulator
**Conclusion and Recommendations**

- **Simulation Results for Baseline Scenario**

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Distance</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8.7</td>
<td>510.4</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Average Visibility</th>
<th>Unobstructed Visibility Time</th>
<th>Max Unobstructed Visibility Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>96.51%</td>
<td>7.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Before Threshold Distance</td>
<td>95.81%</td>
<td>3.5</td>
<td>2</td>
</tr>
</tbody>
</table>
• Visibility Profile for the Baseline Scenario
Conclusion and Recommendations

• Research Completed in September 2013
  – Validating Index 546
    • Tree Spacing Table (Sheet 1 of 6)
    • Sight Distance Tables (Sheets 2 through 6)
  – Recommended Setback from median nose
    • 120 feet for DS < 50 mph
    • 200 feet for DS > 50 mph
Summary

• Design Standard Index 546 Sight Distance at Intersections
  – Landscaping of Highway Medians at Intersections

Research

• Need for Research
  – Validation of current criteria
  – Recommended changes

• Research Objectives and Methodology
  – Reviewed current landscaping criteria
  – Provided a computational procedure to analyze landscaping configurations
  – Performed an empirical study on the safety performance of Standard Index 546
Summary

• Conclusion and Recommendations
  – Visibility Simulator Tool
    » Handles flexibility in design of landscaped configurations
    » May be available in the future for design of medians with trees
  – Tables have been revised
    » Tree spacing
    » Sight Distance
  – Setbacks for medians have been updated
    » 120 feet for DS < 50 mph
    » 200 feet for DS ≥ 50 mph
Summary

- Landscaping at Roundabouts
Summary

• Tree Maintenance Concerns
Summary

• Index 546 Compliance
Thank You!

⇒ Archive at www.pedbikeinfo.org/webinars
  - Downloadable/streaming recording and presentation slides

⇒ Questions?
  webinars@hsrc.unc.edu
ADDITIONAL RESOURCES
Guide for Maintaining Pedestrian Facilities for Enhanced Safety

Released by FHWA in 2013

Chapter 6.6 focuses on street trees, specifically:
• Soil selection and volume
• Tree pit recommendations
• Selecting tree types
• Tree placement

Available at:
http://safety fhwa dot gov/ped_bike/tools_solve/fhwasa13037/fhwasa13037.pdf
Model Design Manual for Living Streets

Developed for the LA County Dept of Public Health in 2011

Chapter 11 addresses the Streetscape Ecosystem, including recommendations for:

• Planting sites
• Climate and soil
• Species selection
• Tree spacing and lighting

Available at:
www.modelstreetdesignmanual.com/
Road to a Thoughtful 
Street Tree Master Plan

Developed for the Minnesota Local Roads Research Board

Provides local officials, engineers, planners and landscape architects with a guide for developing a master plan for street trees.

Available at:
Thank You!

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