Minutes

FLORIDA GREENBOOK ADVISORY COMMITTEE MEETING

Thursday, March 29, 2012 8:00 AM – 5:35 PM

Florida Turnpike Headquarters
Turkey Lake Service Plaza
Building 5315, Auditorium B
Mile Marker 263 on Florida Turnpike
Ocoee, Florida 34761

General Information

- Introductions - David O'Hagan introduced Ben Gerrell and Frank Sullivan, and emphasized the meeting will focus on improving safety for all highways in Florida. Members introduced themselves.

- Discussed Florida Greenbook Committee - Ben Gerrell discussed the statute, 336.045 F.S. which established the Greenbook Committee.

- Rulemaking Process - Ben Gerrell gave an update on the status of adoption of the 2011 Florida Greenbook. Upon completion of the rulemaking process, it will be adopted by FDOT and posted to FDOT's web site.

- Sunshine Law - Ben Gerrell advised members the meeting was being held in accordance with Florida's Sunshine Law. Meetings of public boards and commissions must be open to the public. Notice was posted on FDOT's web site of the meeting and meeting materials. He reviewed the requirements of the sunshine law for the committee and chapter subcommittees.

- Committee Member Changes - David O'Hagan reviewed committee member changes. The following member changes have occurred.

  District 4 - Robert Behar replaced Tanzer Kalayci in District 4 as a non-government member.

  District 5 - Gail Woods replaced Craig Batterson in District 5 as a non-government member.

  District 7 - Jim Burnside retired from the City of Tampa, leaving a vacancy. He was a member of the Florida Greenbook Advisory Committee for over 20 years. There is also a vacancy for the rural area representative in District 7.

  Associate Members - David O'Hagan briefed members on changes in FDOT. Rob Quigley has moved to FDOT's Production Support Office, and serves as the State Project Management Engineer. Ben Gerrell has replaced Rob Quigley in the Roadway Design Office, and is responsible for the Plans Preparation Manual and Florida Greenbook. Billy Hattaway has also resigned from the Committee, as he is now the Secretary for FDOT District One.

- Review and Approval of March 2011 Meeting Minutes - David O'Hagan asked for a motion to adopt the minutes from the March 30, 2011 Greenbook meeting. Richard Diez moved to adopt the minutes; Andy Tilton seconded the motion, approved unanimously.

Status of 2011 Greenbook/Updates - Ben Gerrell gave an update on the status of rulemaking process and 2011 Greenbook. The Greenbook could be ready for adoption by mid-April. The chapters updated included two new chapters, Chapter 18 Signing and Markings and Chapter 19 Traditional Neighborhood Development. Chapter 8 Pedestrian Facilities and Chapter 9 Bicycle Facilities both had substantial revisions. Chapter 3 Geometric Design, Chapter 6 Roadway Lighting, Chapter 11 Work Zone Safety, Chapter 17 Bridges and other Structures had minor changes. The 2011 Greenbook that is proceeding with rule making is posted on FDOT's web site under "May 2011 Draft Florida Greenbook".

LAP Community of Practice - Duane Brautigam gave an update on FDOT's LAP Community of Practice Task Team, which several members of the Greenbook Committee serve on. The goal is achieving commitment for delivery of FDOT and Local Agency Program (LAP) projects in a timely way. The Local Agency Program Info Tool (LAPIT) provides information about project documentation and the Plans, Specifications and Estimates Package (PSE), and analyzes proposals, award and selection, invoicing, construction, and contract closeout. Their next meeting is in April 2012.

Ramon Gavarrete and George Webb discussed the LAP process from the local's perspective on the variety of ways that District's implement the LAP process and the time needed to manage LAP projects. The process is complex, partly because of the oversight brought by federal funding. Hopefully the manual will help to clarify the process. The Florida Association of County Engineers and Road Superintendents (FACERS) has been instrumental in representing not just their own counties but all local governments statewide.

It was asked if the LAP manual can be revised. Mr. Brautigam's response was the LAP Manual is mostly administrative guidance, while the LAP Community of Practice's goal is to go beyond the purpose and content of the LAP Manual. His goal is to give simplification, stability and predictability to how projects are implemented. Charles Ramdatt asked if he could meet with the LAP Team since he has extensive experience with LAP projects. Mr. Brautigam welcomed his thoughts and invited him to work with group.

Monica Gourdine explained FHWA is ultimately responsible for the LAP projects, and working with FDOT to develop a consistent message in which requirements apply to projects based upon where the project is located (Status on FHS). Concerns from the Greenbook members were that FHWA policy may change and projects may not be reimbursed or FDOT Districts may be perceived as requiring extra paperwork to ensure funding is secure.

8:50 – 11:00 Quantitative Safety of Local Roads and Proven Safety Counter Measures
(Rickey Fitzgerald and Monica Gourdine)

Rickey Fitzgerald, FDOT Safety Office, gave a presentation on crash data collected by FDOT/DHSMV on local and state highways. There are a few similarities between counties across both SHS and Local Road crashes. The majority of crashes occur during daylight hours (55%), followed by crashes in the dark on lit roadways (27%). On local roads, 29% of the pedestrian crashes occur at intersections. He explained that the Safety Office collects crash forms from DHSMV, uploads them into the CAR system, and can conduct queries and shape files in response to requests from local governments.

Monica Gourdine presented FHWA's 2012 Proven Safety Countermeasures. These include roundabouts, safety edge, medians and pedestrian crossing islands, longitudinal rumble strips, corridor access management, back plates and reflective borders on traffic signals, enhanced delineation and friction on horizontal curves, pedestrian hybrid beacon, and road diets/roadway reconfiguration.

9:45 – 10:00 ***Morning Break***

11:00 – 12:00 Proposed Updates for 2013 Greenbook

Dean Perkins provided a brief update on the US Dept. of Justice's adoption of new ADA Standards and the change in criteria proposed under the Public Right of Way Accessibility Guidelines. Proposed changes include a min. pedestrian access route width of 48", inclusion of Accessible Pedestrian Signals (APS) at signalized intersections, and allowing sidewalk grades to follow the grade of the adjacent roadway.

Jennifer Green gave an overview of the new Drainage Chapter proposed for the Greenbook. The revisions are based upon a survey of many different types of roadways. It is consistent with FDOT's Drainage Manual, which most people are using today for their criteria. Members appreciated the work that was done to draft the chapter, and felt it was an excellent resource.

In response to member concerns about the "shall" conditions, Ms. Green responded that the "shalls" are really limited to the minimum criteria (e.g.18" pipe size, 15" hub caps). Discussion continued as to whether the chapter should contain requirements (shall) or guidance. Mr. O'Hagan spoke to the fact that in the entire Greenbook, there are only ~100 shall conditions and it's much easier to enforce if we limit the Greenbook to the minimum of what must be done.

Mr. O'Hagan asked for a motion as to whether a chapter should be added. Mr. Gavarrate moved to include a drainage chapter in the Greenbook, seconded by Mr. Ramdatt. All were in favor, none opposed. Mr. G. Webb agreed to serve as chair, supported by his staff. Others who volunteered to help on committee are Fred Schneider, Andy Tilton, Andres Garganta, and Gaspar Miranda. They asked that Ms. Green continue to support the work of the committee and retain a format similar to the FDOT Drainage Manual. It was agreed to set the end of the summer as the goal for having the finalized chapter.

Mr. O'Hagan discussed whether a chapter on federal aid projects was needed. Mr. Gavarette asked Mr. O'Hagan to discuss the requirements related to stimulus projects that were being implemented by local governments. The constraints of the Greenbook were that it only applies to new construction, and some of the guidance needed for the stimulus projects is not included. The group suggested that the LAP Manual might be an area to include some criteria for federally funded projects, or possibly in Chapter 10 Maintenance. David Cerlanek suggested a link in Chapter 10 to the LAP Manual. A motion was made to add a federal aid chapter to the Greenbook, by Howard Webb. The motion died for lack of a second. Adjourned for lunch.

Lunch

1:00 – 5:30 PM Chapter Author Reports, Vote and Commitments for 2012 Revision Process

Mr. Brautigam and Mr. O'Hagan discussed the need for progress on the chapter updates and enforceable criteria. FDOT is committed to addressing the needs in the Greenbook for updating of chapters and we need everyone to step up. Since we only meet once a year it's hard to accomplish our work just at this meeting. The Drainage committee's work is an excellent example we can all follow.

Mr. O'Hagan identified chapters that need lead authors. The group felt that Mr. H. Webb would be well qualified to lead the Geometric Design chapter, Mr. Webb accepted the responsibility.

- Chapter and Section Numbering – The entire Greenbook is being reformatted to revise the alphabetical identification of chapters and sections to numerical sequences. The following revisions will be based upon the current (alphabetical) sequence. *(Following a review of past minutes, it's been decided to retain the current (alphabetical) system of partitioning the chapter. This allows a distinction between the PPM and Greenbook language.)*

- Chapter 3 – Geometric Design: Sidewalk, Roundabouts and Bridges on Very-Low Volume Local Roads (ADT≤400), the group accepted the work of the committee with the following minor edits:
    - Page 3-29, lines 17-20; page 3-64, lines 8-11, 24-27, page 3-65, lines 7-10: update reference to 2006 ADA Standards for Transportation Facilities and 2012 Florida Accessibility Code.
    - Page 3-68, lines 10-11: revise criteria to require an accessible space for a wheel chair user adjacent to a bench at a bus top, and provide a minimum dimension of 30" wide by 48" deep.
    - Page 3-43, lines 19-29, page 3-44, lines 1-3, 11-23: updated the Roundabout section to include a reference to NCHRP Report 672: Roundabouts: An Informational Guide, added guidance on the conditions in which roundabouts should be considered. Added all conditions in the proposed language except for bullet 6 referencing traffic calming.
    - Very Low Volume Local Roads (ADT ≤ 400): two options for the proposed language were considered, the shorter, one page option was selected and approved without changes. The use of this chapter was clarified in that it is not meant to be applied to bridges in subdivisions or developments; rather that the local governments' subdivision criteria would determine the bridge criteria.
    - The above changes to Chapter 3 were moved by Jimmy Pittman, seconded by Mr. Ramdatt, approved unanimously.

- Chapter 5 - Pavement Design and Construction: Safety Edge – Ron Chin presented on the committee's work to address safety edge in the Greenbook.
    - Page 5-1, last sentence of the introduction, modified proposed language to read "Resurfacing of the existing pavements is discussed and included under Chapter 10 (Maintenance and Resurfacing) of the manual." Use of the

objectives was revised to read "shall be considered in the design and construction of the pavement". The fourth bullet was revised during the committee meeting to read "Provide a Safety Edge treatment adjacent to the travel lane on roadways without curb or paved shoulders and with posted speed 45 mph or greater."

- Page 5-2, revisions to B.1 and B.2 were adopted during the 2011 Greenbook meeting.
- Page 5-3, language regarding "grooved pavement" was moved from Section B.4 to B.3 and revised to read "The use of transverse grooving in concrete pavement frequently improves the wet weather skid resistance and decreases the likelihood of hydroplaning." The remainder of the paragraph remained as proposed in the meeting package. Section B.5 was revised to delete the reference to "preferred path for bicyclists."
- Page 5-4, the proposed language in the first paragraph was revised to read "Particular attention shall be given to provide a smooth transition from pavement to shoulder." The proposed language discussing Safety Edge technology was accepted, with a recommendation to show Figures 5-1 Two Lane Road with Safety Edge and 5-2 Safety Edge Detail (No Paved Shoulders) for "proposed pavement", not "existing pavement".
- Page 5-5, following Figure 5-2, the first paragraph in the proposed language beginning with "Safety Edge shall..." was deleted. The language in the second paragraph was accepted as proposed, "Shoulder pavement may be provided to improve…"
- Page 5-6, the last paragraph was revised to read "After construction the pavement surface shall be inspected to determine the required surface texture was achieved and the surface has the specified slopes. Spot checking skid resistance by approved methods should be considered. Periodic reinspection should be undertaken in conformance with the guidelines described in Chapter 10 - MAINTENANCE.*" (Resurfacing will be added to the title for Chapter 10 in conjunction with the update of the entire Chapter.)*
- There was discussion of whether the language in this chapter should more closely align with the PPM, since the PPM does not require the safety edge if shoulders are at least 2' wide.
- Page 5-3, Section B. 3 Skid Resistance, the direction of grooved concrete pavement and language was revised to use transverse grooving.
- Mr. O'Hagan asked how do the local agencies mean to use the guidance in Section 5-1 and whether or not the Safety Edge will increase the cost of projects. Fred Schneider felt it may cost a bit more in a RRR project due to redesign of the shoulder; however cost in new construction should be insignificant.
- Miranda Glass noted Chapter 10 will likely be revised to be called Maintenance and Resurfacing and delete the language related to Section F4.
- Mr. O'Hagan asked for a motion to approve the above changes in Chapter 5, moved by Ron Chin, including the reference to Safety Edge for RRR projects. Seconded by Gail Woods, approved unanimously.

- Chapter 8 – Pedestrian Facilities
    - Page 8-9, 8-10, Mr. Schneider discussed the changes made to update the references to 2006 ADA Standards for Transportation Facilities and 2012 Florida Accessibility Code.
    - Andy Tilton moved to adopt the proposed changes, seconded by Annette Brennan, approved unanimously.

- Chapter 10 - Maintenance and Resurfacing
    - Miranda Glass discussed how maintenance is different than resurfacing, and how they can be differentiated. As currently drafted, Resurfacing (RRR) is listed under Maintenance. Ms. Glass asked if Resurfacing should be placed in its own section under Chapter 10 and defined differently so that ADA responsibilities can be clarified. The Chapter needed additional language to define how maintenance projects differed from a RRR/alteration.
    - Discussion followed that Resurfacing should be Section 10.7 (G) if it becomes its own section, 10.6.5 (F.5) if kept under maintenance activities. Ms. Brennan asked whether the guidance that was used in ARRA might be included in the Greenbook. Mr. O'Hagan felt that material added to the Greenbook should be limited to criteria; other information should be placed in the LAP Manual or LAP Community of Practice materials. Mr. Gavarrete preferred to leave under Maintenance.
    - FHWA defines maintenance vs. alterations. Reconstruction, widening, mill and fill, and signal installations is considered to be an alteration by FHWA due to affecting the structural capacity of the pavement. Maintenance is defined by FHWA as inspection, overhaul, repair, preservation, and the replacement of parts, but excludes preventive maintenance.
    - Ms. Glass recommended the chapter be edited further, and that both maintenance and resurfacing be addressed in the same chapter.

- Chapter 13 – Public Transit
    - Ms. Brennan suggested adding a description for boarding and alighting areas to the chapter, and note that when projects include a new bus stop or impact existing bus stops they should comply with FAC 14-20. Mr. Tilton moved to accept the changes made in the submitted draft plus the language proposed to add FAC 14-20. Seconded by Steve Neff, unanimously passed.

- Mr. O'Hagan asked the group as it approached 5:00 whether they would agree to continue in an extended session, which they agreed to.

- Chapter 17 – Bridges and Other Structures
    - Mr. O'Hagan discussed the changes, primarily editorial to Chapter 17 and the notional loads in the LRFD, requirement for a FL 120 permit load rating greater than 1, and new guidance on girder transportation. Revisions were also made to Section 17.3.3.3 (C.3.b) that pedestrian and bicycle railings comply with the LRFD. Pedestrian/bicycle railings and 2-pipe guide railings and details may be mounted on walls or other structures where the drop-off is 5' or less. Concrete, aluminum or steel railings shall be used where drop off hazards are greater than 5'.
    - Mr. Ramdatt asked about where the referenced IBF design standards were located. Mr. O'Hagan agreed to include a web link to the instructions.
    - Mr. O'Hagan discussed the need for a consistent process for inspection of local pedestrian bridges and permitting of larger loads. It was agreed that further discussion with FDOT's maintenance office is needed and no changes to the chapter would be made at this time regarding these issues. There was agreement on revising titles, document references and editorial changes that didn't change document requirements.
    - Revisions to Section 17.3.4 (C.4) Bridge Substructure were discussed with a suggestion to spell out SDG (Structures Design Guide) and provide a web link.
    - Mr. G. Webb asked about Section 17.7 (G) Bridge Load Rating, Permitting, and Posting and remove the language "If Necessary" in regards to posting in the National Bridge Inventory. Joy Puerta also mentioned that the LRFD language needs to be maintained. Following discussion, the decision was made to leave this section as is.
    - Mr. Ramdatt moved to adopt the drafted changes to Chapter 17, except for the changes in Section 17.7 (G). Steve Neff seconded, approved unanimously.

- Introduction –
    - Mr. O'Hagan proposed a revision to be made to address the Greenbook Advisory Committee and work groups. Chapter work groups are considered to be doing pen and ink changes which they will provide to the chair of each chapter. The chair will then take the chapter work group's revisions to the whole Greenbook Advisory Committee. This change in structure will require each work group be chaired by an Advisory Committee member.
    - Following several questions from members on how the Sunshine Law would apply to the work groups, Mr. Ramdatt asked whether FDOT could have a follow up discussion with our general council to confirm what the sunshine requirements would be of both the advisory committee members and the Greenbook workgroups. Mr. O'Hagan agreed to provide the draft language to legal for their review. Mr. Ramdatt's concern was that if more than one Advisory Committee member participated on a work group, that sunshine requirements might still apply. Mr. O'Hagan indicated sunshine rules would still apply to the Advisory Committee and Work Groups until new language is adopted in the Greenbook.

- Mr. OHagan asked for volunteers to chair the work groups. It was agreed the chairs would be:

  Howard Webb, Chapter 3, Geometric Design

  Annette Brennan, Chapter 8, Pedestrian Facilities

  Annette Brennan, Chapter 9, Bicycle Facilities

  Chris Tavella, Chapter 11, Work Zone Safety

  Steve Neff, Chapter 15, Traffic Calming

  Keith Bryant, Chapter 17, Bridges and Other Structures

  Gail Woods, Chapter 18, Signing and Marking

  Rick Hall, Chapter 19, will be approached on TND chapter *(Rick Hall has agreed to serve as the Chair)*

  George Webb, Chapter 20, Drainage

Andy Garganta moved to adjourn the meeting, Jimmy Pittman seconded. Approved unanimously. Meeting adjourned at 5:35 pm.

March 29, 2012

Florida Greenbook Advisory Committee Meeting

Meeting Review Package

Agenda

AGENDA

FLORIDA GREENBOOK ADVISORY COMMITTEE MEETING

Thursday, March 29, 2012 8:00am – 5:00pm

Florida Turnpike Headquarters
Turkey Lake Service Plaza
Building 5315, Auditorium B
Mile Marker 263 on Florida Turnpike
Ocoee, Florida 34761

8:00 – 8:30 **General Information**

- Introductions (David O'Hagan)
- Discuss Florida Greenbook Committee (Ben Gerrell)
- Rulemaking Process (Ben Gerrell)
- Sunshine Law (Ben Gerrell)
- Committee Member Changes (David O'Hagan)
- Associate Members (David O'Hagan)
- Review March 2011 Meeting Minutes & VOTE (David O'Hagan)

8:30 – 8:50 **Status of 2011 Greenbook/ Updates** (Ben Gerrell/ Frank Sullivan)

8:50 – 11:00 **Quantitative Safety of Local Roads and Proven Safety Counter Measures** (Rickey Fitzgerald and Monica Gourdine)

- Lap Community of Practice (Duane Brautigam – 10 min)

9:45 – 10:00 ***Morning Break***

11:00 – 12:00 **Proposed Updates for 2013 Greenbook**

- ADA (Dean Perkins – 30 min)
- Drainage – Vote on new Drainage Chapter and content (Jennifer Green – 30 min)

12:00 – 1:00 ***Lunch***

1:00 – 1:30 **Focus of 2013 Updates**

- Need for progress and enforceable criteria (Duane Brautigam and David O'Hagan)
- Preparation of draft materials
- Chapter Work Groups

1:30 – 1:40 ***Break (10min)***

1:40 – 4:00 **Workshops for Updates** (post-2013 Manual) (Chapter Subcommittees)

- Chapter 3 – Geometric Design: Sidewalk, Roundabouts and Bridges on Very-Low Volume Local Roads (ADT≤400)
- Chapter 5 - Pavement Design and Construction: Safety Edge – Vote on today
- Chapter 8 – Pedestrian Facilities
- Chapter 10 - Maintenance and 3R Criteria
- Chapter 13 – Public Transit
- Chapter 17 – Bridges and Other Structures

4:00 – 5:00 **Report and Vote**

Friday, March 30, 2012 8:00am – 12:00pm

Florida Turnpike Headquarters
Turkey Lake Service Plaza
Building 5315, Auditorium A

8:00 – 9:00 **Continue with Workshops for Updates** (post-2013 Manual) (Chapter Subcommittees)

9:00 – 10:00 **Chapter Author Reports, Vote and Commitments for 2012 Revision Process**

10:00 – 10:15 ***Morning Break***

10:15 – 11:45 **Chapter Author Reports, Vote and Commitments for 2012 Revision Process**

11:45 – 12:00 **Closing Items** (Ben Gerrell)

- FDOT Chapter Work Group Assistants
- Review Contact Information / Update Subcommittee Assignments
- Meeting Critique

Florida Greenbook Committee Statute

Select Year: 2010 Go

The 2010 Florida Statutes(including Special Session A)

Title XXVI
PUBLIC TRANSPORTATION

Chapter 336
COUNTY ROAD SYSTEM

View Entire Chapter

336.045 Uniform minimum standards for design, construction, and maintenance; advisory committees.—

(1) The department shall develop and adopt uniform minimum standards and criteria for the design, construction, and maintenance of all public streets, roads, highways, bridges, sidewalks, curbs and curb ramps, crosswalks, where feasible, bicycle ways, underpasses, and overpasses used by the public for vehicular and pedestrian traffic. In developing such standards and criteria, the department shall consider design approaches which provide for the compatibility of such facilities with the surrounding natural or manmade environment; the safety and security of public spaces; and the appropriate aesthetics based upon scale, color, architectural style, materials used to construct the facilities, and the landscape design and landscape materials around the facilities. The department shall annually provide funds in its tentative work program to implement the provisions of this subsection relating to aesthetic design standards. The minimum standards adopted must include a requirement that permanent curb ramps be provided at crosswalks at all intersections where curbs and sidewalks are constructed in order to give handicapped persons and persons in wheelchairs safe access to crosswalks.

(2) An advisory committee of professional engineers employed by any city or any county in each transportation district to aid in the development of such standards shall be appointed by the head of the department. Such committee shall be composed of: one member representing an urban center within each district; one member representing a rural area within each district; one member within each district who is a professional engineer and who is not employed by any governmental agency; and one member employed by the department for each district.

(3) Notwithstanding the provisions of any general or special law to the contrary, all plans and specifications for the construction of public streets and roads by any municipality or county shall provide for permanent curb ramps at crosswalks at all intersections where curbs and sidewalks are constructed in order to give handicapped persons and persons in wheelchairs safe access to crosswalks.

(4) All design and construction plans for projects that are to become part of the county road system and are required to conform with the design and construction standards established pursuant to subsection (1) must be certified to be in substantial conformance with the standards established pursuant to subsection (1) that are then in effect by a professional engineer who is registered in this state.

(5) Curb ramps which are required by subsections (1) and (3) to be provided at all intersections of curbs and sidewalks on public streets and roads shall be constructed to be in substantial conformance with the Uniform Federal Accessibility Standards published by the General Services Administration, Department of Housing and Urban Development, Department of Defense, and United States Postal Service. The provisions of this subsection apply to curb ramps let to contract on or after July 1, 1986.

(6) If the governing body of a county or municipality has adopted a design element as part of its comprehensive plan pursuant to part II of chapter 163, the department shall consider such element during project development of transportation facilities. The design of transportation facilities constructed by the department within the boundaries of that county or municipality must be consistent with that element to the maximum extent feasible.

History.—s. 1, ch. 72-328; ss. 2, 3, ch. 73-58; ss. 1, 2, ch. 74-242; s. 8, ch. 77-165; s. 1, ch. 78-398; ss. 5, 6, ch. 83-52; ss. 1, 2, 3, ch. 84-151; s. 69, ch. 84-309; s. 16, ch. 85-180; s. 31, ch. 86-243; s. 5, ch. 91-429; s. 5, ch. 92-152.

Note.—Former s. 335.075.

Rulemaking Process and Status

Rulemaking for the 2010 Florida Greenbook

On January 4, 2011, Governor Scott issued Executive Order No. 11-01. This order freezes all new regulations and establishes the Office of Fiscal Accountability and Regulatory Reform, which will review all rules prior to promulgation as well as agency practices and contracts. The Florida Greenbook was in FDOT's Office of General Counsel, being prepared for Rulemaking when the order was issued. At that time, Rulemaking on the Florida Greenbook was put on hold.

The following describes the next steps in proceeding with Rulemaking:

1) The Office of General Counsel is writing a report for the Governor's office on all the existing Department Rules, including the existing Florida Greenbook Rule (14-15.002).
2) Once this is done, the Department must request authorization from the Governor's Office to begin Rule Development.
    a) When we request authorization, it is submitted on a standard form the Governor's Office has prepared. It is just a short summary of why the rule is being update.
    b) Also, it must be determined if a Statement of Estimated Regulatory Costs (SERC) must be prepared. If a SERC is required, a SERC will need to be prepared before the Governor's Office will authorize rulemaking.
3) When they approve the rule to go forward with Rule Development, we will publish the Notice of Development of Proposed Rules., we will begin the Rulemaking process with JAPC by filing "Notice of Rule Development" (published in Florida Administrative Weekly).
    a) This is an opportunity for a Rule Development Workshop to take place. At this point a workshop can be announced or wait to see if one is requested. There is no time frame at this point, but the general practice is to wait around 30 days.
    b) If comments are received, we have 90 days to respond.
4) The next step is to publish a Notice of Proposed Rule.
    a) The notice and copy of the rule is sent to the Joint Administrative Procedures Committee (JAPC) at this time.
    b) At this stage a hearing can be announced or a hearing may be requested within 21 days.
5) If no hearing is requested and JAPC has no comments to be addressed we may file the rule for adoption after 28 days from the publication of the notice. We have up to 90 days to adopt the rule.

The 2011 Florida Greenbook is in the final stage of rulemaking, #5.

Sunshine Law

A Summary of Florida's Government in the Sunshine Law

September 22, 2005

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1. Scope of the Sunshine Law

The Sunshine Law provides public access to governmental proceedings, including meetings of public boards or commissions. § 286.011, Fla. Stat. (2004)

Section 286.011, Florida Statutes, provides that 1) meetings of public boards or commissions must be open to the public, 2) reasonable notice of such meetings must be given; and 3) minutes of the meeting must be taken.

2. Definition of a Meeting

The Sunshine Law does not only apply to formal proceedings by boards and commissions. It applies to any gathering, casual or not, concerning matters upon which *foreseeable action* may be taken by the applicable agency or organization. *See Hough v. Stembridge*, 278 So. 2d 288 (Fla. 3d DCA 1973). Meetings in defiance of the Sunshine Law are those that are "violative of the statute's spirit, intent and purpose." *Id.*

Because the Sunshine Law applies to *any* gathering, formal or casual, concerning matters upon which action may be taken, the statute also applies to discussions over the telephone or communications via computer.

3. Individuals/Organizations Subject to the Sunshine Law

The Sunshine Law applies to any meeting between two or more members of "any board or commission of any state agency or authority or of any agency or authority of any county, municipal corporation, or political subdivision." *See* § 286.011, Fla. Stat. (2004). The courts have stated that it was the Legislature's intent to bind "every board or commission of the state, or of any county or political subdivision over which it has domain and control." *Times Publishing Company v. Williams*, 222 So. 2d 470 (Fla. 2d DCA 1969). All public agencies, including elected and appointed boards or commissions and even collegial bodies, are subject to the statute. The Florida Department of Transportation (the Department) is a public agency and thus falls under the authority of the Sunshine Law.

3(a). Advisory Boards or Committees

Advisory boards or committees appointed by public agencies are subject to the Sunshine Law, even if their recommendations are not acted upon. *See* AGO 82-35, *Town of Palm Beach v. Gradison*, 296 So. 2d 473 (Fla. 1974). A limited exception applies to committees established strictly for fact-finding such as information gathering and reporting.

3(b). Staff Members

The meetings of staff members of a board or commission covered by the Sunshine Law are generally not subject to the Sunshine law. This exception also applies to staff members of advisory boards or committees. *See* § 286.011, Fla. Stat., *Occidental Chemical Co. v. Mayo*, 351 So. 2d 336 (Fla. 1977). However, when a staff member ceases to function in a staff capacity and is appointed to a committee which is delegated authority to make recommendations to a board or official, the staff member loses his or her identity as staff while working on the committee and the Sunshine Law applies to the committee. Thus, it is the nature of the act performed, not the makeup of the committee or the proximity of the act to the final decision which determines whether a committee composed of staff is subject to the Sunshine Law.

3(c). Purchasing or Bid Evaluation Committees

Generally committees appointed by agencies subject to Sunshine Law to consider purchases or bids by contractors are themselves subject to the Sunshine Law. However, meetings involving confidential bid estimates are not subject to the Sunshine Law because the Department's contract award process has been adopted in recognition of Sunshine Law requirements.

4. Notice Requirements

As previously mentioned, meetings covered by the Sunshine Law require that "reasonable notice" be given beforehand. The Attorney General's Office has suggested notice guidelines, which include: 1) the notice should contain the time and place of the meeting and, if available, an agenda, 2) the notice should be prominently displayed in the area in the agency's office set aside for that purpose, 3) emergency sessions should be afforded the most effective notice under the circumstances and 4) effective methods include press releases, phone calls to wire services, and advertising in local newspapers of general circulation.

5. Consequences for Failure to Comply

The consequences for violation of the Sunshine Law vary. There can be criminal penalties if any board or commission member *knowingly* violates the Sunshine Law, including the possibility of a second degree misdemeanor charge (which can include imprisonment and/or a fine). Additional consequences include removal from office, non-criminal penalties such as fines, attorney's fees, and civil actions for injunctive or declaratory relief.

Violation of the Sunshine Law also renders actions taken by boards or commissions invalid. Section 286.011, Florida Statute provides that no resolution, rule, regulation or formal action shall be considered binding except as taken or made at an open meeting.

6. Conclusion

It is advisable to be well acquainted with Florida's Government-in-the-Sunshine Law. The overarching policy behind the law is very simple. Actions should be analyzed in light of the Sunshine Law's spirit and intent to provide the public a right of access to government proceedings.

FLORIDA DEPARTMENT OF TRANSPORTATION
GOVERNMENT IN THE SUNSHINE
September 2005

Caveat: This briefing paper is intended as an overview of the complex legal issues involving Florida's Government in the Sunshine Law, Public Record Law, and Ethics Laws. Readers are cautioned that these laws contain traps for the unwary, which can cause seemingly innocent activities to become a crime. The advice of an attorney should he sought for their application to particular circumstances.

OPEN MEETINGS

All meetings at which public business is discussed or transacted shall be duly noticed and open to the public.[1]

YOU CANNOT:

- Discuss with any other member any item that is under consideration by the authority, except at a duly noticed public meeting

YOU CAN:

- Discuss other matters with other members at any time.
- Discuss authority business with any person who is not a member, except that the person cannot act as a liaison between or among members.

A continuing concern is the sending of e-mail by a member to other members. An e-mail that states factual background material is permissible[2] so long as there is no interaction between or among members. E-mails that solicit comments from other members or that circulate responses from members are prohibited. [3]

Minutes of each meeting must be taken, which must include a record of all voting.[4]

PUBLIC RECORDS

Records of "any board or commission of any state agency or authority of any agency or authority of any county, municipal corporation, or political subdivision," except those that are specifically exempted by statute, are public records and must be available for inspection and copying by any person at a reasonable place and time.[5]

A public record is defined very broadly and includes tape recordings, hand written notes, and information in a computer.[6] All materials made or received in connection with official business regardless of form are to be open for public review unless exempted by the legislature. This includes notes that are intended to be kept as a record or that are circulated or communicated to another.[7] However, notes prepared for personal use are not public records.[8]

Electronic mail comes within the public records law, and any e-mail sent or received relating to official business must be made available to the public if requested. As noted above, the Public Meeting Law prohibits interactive e-mail between or among members relating to official business of the authority.

ETHICS

Certain provisions of the Florida Code of Ethics for Public Officers and Employees, Sections 112.311-112.326, Florida Statutes, apply. It is not the intent of this summary to cover the multifarious aspects of governmental ethics. For more information, visit the Commission of Ethics Website: http://ww.ethics.state.fl.us/ Certain key provisions are summarized below.

- Prohibited actions or conduct:[9] Solicitation or acceptance of gifts or unlawful compensation to influence official action; misuse of public position; or use of information not available to the public generally for personal pecuniary gain for themselves or anyone else. Note: For the gifts that are allowed by the statute,[10] the Governor's Code of Ethics places further restrictions.[11]

- Restricted business and contractual relationships:[12] Certain restrictions and prohibitions apply to members or their relatives.

- Voting Conflicts of Interest:[13] Persons present at a meeting are required to vote, unless the member has a voting conflict of interest, in which case the member may abstain from voting.[14] A voting conflict occurs when the measure being voted on inures to the private gain or loss of the member, a relative, the member's employer, or a client of the member. The member must disclose the conflict prior to participating in discussion or voting on the matter, or if unknown at the time, as soon as possible. The member must file Commission on Ethic's Form 8A[15] with the recording secretary within fifteen days of the vote.

Reference Materials:

Attorney General's Website: http://myfloridalegal.com/sunshine
Government-in-the-Sunshine Manual, First Amendment Foundation, Tallahassee, FL
First Amendment's Website: http://www.floridafaf.org/

ENDNOTES:

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[1] Article 1, Section 24(b), Florida Constitution, and Section 286.011, Florida Statutes (Florida Government in the Sunshine Law), apply to agencies of the state. Sections 343.80-343.89, Florida Statutes, created the Northwest Florida Transportation Corridor Authority as an agency of the state.
[2] Attorney General Opinion 2001-20, March 20, 2001.

[3] Attorney General Informal Opinion, October 31, 2000.
[4] Sections 286.011(2) and 286.012, Florida Statutes.

[5] Article I, Section 24(a), Florida Constitution; Section 119.07, Florida Statutes.
[6] Section 119.011(1), Florida Statutes; Orange County v. Florida Land Co., 450 So. 2d 341 (Fla. 5th DCA 1984).
[7] Shevin v. Byron, Harless, Schaffer, Reid & Assoc., Inc., 379 So. 2d 633 (Fla. 1980).
[8] Times Publishing Co. v. City of St. Petersburg, 558 So. 2d 487 (Fla. 2d DCA 1990).
[9] Section 112.313(7), Florida Statutes.
[10] Sections 112.312(12) and 112.313(2), Florida Statutes.
[11] Governor Bush's Code of Ethics, available at:
http://www.myflorida.com/myflorida/government/policies/ethicscode.html
[12] Sections 112.313(3), (7), and (12), Florida Statutes.
[13] Section 112.3143, Florida Statutes.
[14] Section 286.012, Florida Statutes.
[15] http://www.ethics.state.fl.us/forms/Form8a_2000.PDF.

Committee Member Changes

FLORIDA GREENBOOK ADVISORY COMMITTEE

2012/2013 MEMBERSHIP CHANGES

MEMBERS

DISTRICT 4

Robert Behar replaced Tanzer Kalayci in District 4 as a non government member.

DISTRICT 5

Gail Woods replaced Craig Batterson in District 5 as a non government member.

DISTRICT 7

Jim Burnside retired from the City of Tampa he was a District 7 Member. He was a member of the Florida Greenbook Advisory Committee for over 20 years.

There is also a vacancy for the rural area representative in District 7.

ASSOCIATE MEMBERS

Benjamin Gerrell replaced Robert Quigley. Robert Quigley is now the State Project Management Engineer and has moved to the Production Support Office.

Committee Member Information
And
Chapter Subcommittee Assignments

Updated March 21, 2011

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Updated March 22, 2012

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9. Bicycle Facilities	Joy Puerta
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11. Work Zone Safety	Allen Schrumpf
12. Construction	VACANT
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17. Bridges and Other Structures	Andre Pavlov
18. Signing and Marking	Chester Henson
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Updated March 22, 2012

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March 2011 Meeting Minutes

MEETING MINUTES

1. David O'Hagan (Committee Chairperson / Florida Department of Transportation (FDOT) State Roadway Design Engineer) opened the meeting at 8:05 am and each attendee introduced themselves.

2. The **Sign-In Sheet** was circulated. The people attending by webinar were added to the sign-in-sheet.

3. David O'Hagan discussed the **Committee Member Changes**. Jim Mills retired from the Department of Transportation and Frank Sullivan, from the Roadway Design Office, has taken his place.

4. David O'Hagan noted that everybody should have received a **Meeting Package**. He asked that everybody turn to and review the **2010 Meeting Minutes**. The minutes were reviewed with no comments, and all voted to accept the minutes as written.

5. Rob Quigley (FDOT Roadway Design) reviewed the membership requirements for the committee. A comment was submitted that indicated that the rural areas are not represented appropriately. Annette Brennan said that she had two urban members, one from Orange County and the other from the City of Orlando. She knows of another person who wanted to represent the rural area for D-5.

   Rob also indicated that sometimes assignments are not submitted in a timely manner. In the past, term limits were in place. A discussion followed as to whether term limits need to be reactivated. The committee was not in favor of term limits; however, did conclude that there is too much Tallahassee representation on various committees.

6. Rob Quigley stated that the draft Greenbook released last year is still under the **Rulemaking Process** due to the Governor's decree to put all rules on hold. The steps for rule making are on page 31 of the handout. The current draft is in step 1. This draft version will probably be the 2011 publication when the process is completed. The edits resulting from this meeting will be included in a future publication.

7. Rob Quigley stated that the meeting and agenda package are included under the **Sunshine Law**. Rob reviewed the requirements that were met for this meeting. An agenda is included in the advertisements. Subcommittee officers should take minutes for the subcommittee meetings. The minutes include issues, decisions and attendees.

8. Rob Quigley asked that each member review their **Contact Information** and subcommittee memberships for accuracy. Chapter 4 does not have an author. Charles Ramdatt volunteered to be the Chapter 4 author.

9. Frank Sullivan made a presentation on the new Highway Safety Manual and answered questions related to this topic. One question was related to roadside safety and utility poles. There is no direct application for utility poles; however, there is a general application for roadside safety. Research is planned to address roadside safety in more detail.

10. David O'Hagan led the discussion on Safety Edge. Safety Edge is used to mitigate drop-offs by providing a smoother transition from the edge of the travel lane to an unpaved

shoulder. It helps drivers to recover from a roadway departure without overcorrecting. This is not a problem for roadways on the SHS, but may be an issue on for roadways off the SHS. First priority is roadways without paved shoulders. Should continue to use shoulder sod. Speed has not been a consideration thus far. The LTAP center has shoes that can be borrowed.

11. Rob Quigley led the discussion regarding Bridges on Low Volume and/or Unpaved Local Roads. It was noted that some local bridges serve small resident populations and AASHTO does have some guidance for bridges on these type roadways. Andre Pavlov of the FDOT Structures Office was asked by to look at some of these bridges. He commented that there is a lot of variation in the design of these bridges and noted complaints about the lack of guidance. He said that standards are needed and the Structures Office is working on it. They looked at AADT on structurally deficient and functionally obsolete bridges. Rob stated that information related to bridges on low volume unpaved roads may apply to chapters 2, 3, 4, 5, 16 and 17. The subcommittee will determine if it is appropriate to reference the AASHTO documents or incorporate the AASHTO tables into the Greenbook.

12. David O'Hagan led the discussion on Overweight/Oversize Truck Permitting. He stated that the State of Florida issues about 10,000 permits per year. Two types of permits are available; one based on a single trip that expires after 5 days and another based on multiple trips that is good for a year. The Department does not have the authority to issues permits for local roads. Some local governments are developing a permitting process and ordinances as overweight/oversize trucks are using local roads at times. It was suggested that since local roads do use Federal funding this issue should be addressed in the Greenbook.

    A discussion ensued regarding how the Department and local governments could coordinate this issue. Department issued permits state the origin and destination, so it can be determined if it is likely that the route includes local roadways. The Department could require truckers to submit the route they will travel and sate what part of the route would include local roadways. David O'Hagan asked what the local governments would do with the permits if the Department provided them.

    Fred Schneider stated that bridges are the critical issue. He said that Lake County does not have structural engineers on staff and he would prefer that the FDOT address the local roadways this since the Department conducts bridge inspections on the local bridges. Gaspar stated that Miami-Dade has a permitting process in place. Charles Ramdatt stated that City of Orlando does not have a formal program. Chris Mora stated that Indian River County does not have a process for overweight trucks but has gotten help from the FDOT on one project. Ramon Gavarrete said that Highlands County is in the same situation as Indian River County. It was decided that a communication process needs to be set up between the Department and the Local Governments. David O'Hagan will work on a strategy to accomplish this from the Department's end. Duane Brautigam will update FACERS on this issue at the June 22nd meeting.

13. Mark Wilson gave an update on the 2009 Manual of Uniform Traffic Control Devices. He noted that the rule adoption was delayed by the Governor but the Department is expecting to adopt the MUTCD on 1/15/2012. Mark said that we should be using the manual now with only a few exceptions.

9:45 – 10:00 ***Morning Break***

14. Review Major Chapter Edits & Vote on Chapter 5

A. Ron Chin gave an update of Chapter 5 regarding unpaved roads. Ron asked the committee if they would be in favor of including language in Chapter 5, Section B1.1. It was noted that some counties have a limited miles of roadway that has been overlaid with open graded mix on high maintenance sections. This evidently does not work well at intersections. A milled treatment works better for high maintenance sections. The Committee agreed to include new language in Chapter 5.

B. Ron Chin also gave a presentation on Safety Edge that included costs estimates. Ron proposed to include the chart without the cost in the Greenbook. The question was asked how the Safety Edge would last if there was no base? David will try to find out from Georgia as they use the Safety Edge as a standard practice. One proposal was to use a two-foot stabilized shoulder under the Safety Edge.

C. Chapter 5, Section A - The forth bullet was edited and accepted. The edit removed "and provide a safe roadside."

D. Chapter 5, Section B.1 – pavement type selection language was edited.

E. Section B.5 will be revisited by the subcommittee to determine if the 'shall' condition should be included.

No vote was taken as more work is required.

15. Review Minor Chapter Edits & Vote on Chapter 9

Joy Puerta presented updates to Chapter 9. There was discussion over the use of the term 'shall' and the need for the first proposed paragraph. The decision was made to use the "should" condition instead of "shall".

The committee voted to adopt Chapter 9. The request was made to ask the legal staff to advance this chapter to include it in the adopted manual currently in the rule making process. The committee voted to accept this request.

16. Review Minor Chapter Edits on Chapters 3 and 10

Chapters 3, 10 and 17 are still under review. A motion to approve Chapter 3, Section C.7(d) and Section C.7.j.4(b), and Chapter 10, Section 10.4.2 was made. The committee voted to approve this section, as amended, and include it in the current revisions in the rule making process.

12:00 – 1:00 ***Lunch Break***

17. Review of TND Handbook and Committee Vote

Billy Hattaway presented the new TND Handbook. The only comment was that the captions on the photos on page 179 were hard to read. The committee voted to bless the handbook. The handbook will be posted along with the draft TND Chapter already posted online.

18. LAP Community of Practice

Duane Brautigam gave an update of this effort. He demonstrated the FDOT Estimates Office web site that has useful information for local government projects.

19. Drainage - New Chapter vs. FDOT Drainage Manual Reference

Jennifer Green presented a table that was developed to compare drainage issues addressed in the Greenbook, the Plans Preparation Manual and AASHTO Greenbook. David O'Hagan requested that the Greenbook Committee assign a task team to work with Jennifer. David suggested that we include drainage criteria and standards in the Greenbook.

20. Other Chapter Subcommittee Reports

A. Chapter 1 – no updates reported.

B. Chapter 2 – no updates reported.

C. Chapter 4 – Charles Ramdatt will be the new author for Chapter 4. It was noted that a new Roadside Design Guide within a year. Dave Coleman asked if the control zone language in Chapter 4 could be made consistent with the Utility Accommodation Manual by replacing the last two paragraphs of Section D.8 with the language in the UAM, Section 4.4.2. The committee requested that Dave Coleman submit his request in writing so that it can be reviewed by the city's attorney. The subcommittee will take this up within the next two months. Dave Coleman is on the subcommittee.

D. Chapter 6 – no updates reported. Bernie Masing stated that he will work with Chester Henson on chapter updates.

E. Chapter 7 – there are a few issues to address. The Chapter Author will with the Chapter Subcommittee.

F. Chapter 8 – Ron Chin stated that the subcommittee will investigate including mid-block crossings in Chapter 8.

G. Chapter 9 – no updates needed at this time.

H. Chapter 10 – needs to be rewritten.

I. Chapter 11 – no updates needed at this time.

J. Chapter 12 – issues remain from last year that need to be addressed.

K. Chapter 13 – Annette Brennan reported that Dean Perkins is updating the chapter to address bus pads.

L. Chapter 14 – no updates reported.

M. Chapter 15 – no updates reported.

N. Chapter 16 – no updates reported.

O. Chapter 17 – the subcommittee needs to review the proposed changes in the draft chapter.

P. Chapter 18 – Chester Henson stated that this chapter needs to be updated to comply with the new MUTCD.

Q. Chapter 19 – Chapter 19 is awaiting approval.

The question was asked if the Local Specifications Subcommittee can be disbanded. Dwayne Brautigam worked on the Contractor QC and LAP specifications known as the 'Big 4'. Rob Quigley said that he will send out an e-mail asking if this Subcommittee has any additional work to do or can the committee be disbanded?

3:00 – 3:15 ***Afternoon Break***

21. Rob Quigley addressed closing items including the Drainage Subcommittee work, the status of Rule Making and the Roundabout Task Team efforts.

Meeting Adjourned at 4:18 pm.

Status of 2011Greenbook/ Updates

Summary of Changes
May 2011 Edition

MANUAL OF UNIFORM MINIMUM STANDARDS FOR DESIGN, CONSTRUCTION AND MAINTENANCE FOR STREETS AND HIGHWAYS (Commonly known as the "Florida Greenbook")

User Registration Form

- Removed reference to old user database.

Table of Contents

- Added Chapters 18 and 19.

Greenbook Committee Members

- Updated Committee member information.

Chapter Subcommittees

- Updated Chapter Author information including those for new chapters.

Chapter 3 Geometric Design

C.7.b Revised to clarify minimum sidewalk width is 5 feet.

C.7.j.4.b Revised to include vertical clearances for pedestrian bridges, and bridges over railroads. The minimum vertical clearance over freeways and arterials was revised to 16.5 feet.

C.10.a.3 Corrected maximum cross slope from 0.02% to 2.0% and revised to reference Section C.7.b for minimum sidewalk width.

Table 3-11 Updated note to include raised medians.

Chapter 6 Roadway Lighting

E. Updated section to address consistency in lighting and lighting at intersections.

H. Revised redundant terminology reference to “frangible” since section already addresses “breakaway” light poles.

Chapter 8 Pedestrian Facilities

General: This chapter was updated to provide improved guidance on pedestrian facilities.

A. New Introduction places more emphasis on the consideration of pedestrian facilities.

B. New section identifying different types of pedestrian facilities.

C. Updated to include more provisions that minimize vehicle-pedestrian conflicts.

C.3.a Updated to clarify the pedestrian path location criteria.

C.3.b This new section contains information on buffer width and references Chapter 3, Section C.7.b for minimum sidewalk width.

C.4 Updated to include other considerations that minimize vehicle-pedestrian conflict points.

D.1 Updated to address consideration of sight distance near intersections and driveways.

D.2 Minor updates for clarity.

E.1 Updated to address minimum clear height of a pedestrian over/underpass and the minimum clear width of the path.
E.2 Minor updates for clarity.
F. This section has been renamed *Pedestrian Crossings* and rewritten to identify different types of pedestrian crossings and associated features.
G. New section containing additional references related to pedestrian facilities.

Chapter 9 Bicycle Facilities

General: This entire chapter was updated to provide improved guidance on bicycle facilities.

Chapter 11 Work Zone Safety

General: This chapter was updated to be consistent with the Federal Rule for Work Zone Safety and Mobility (Title 23 Code of Federal Regulations (CFR) 630 Subpart J).
A. Updated to address incident management.
B. This new section provides background information on this chapter
C Updated to address the Americans with Disabilities Act
D. Updated to refer to the Federal Rule for Work Zone Safety and Mobility.
E. Updated to address pedestrians, bicyclists and transit passengers, incident management, work zone access, access to adjacent properties, and coordination with businesses and school boards.
F. Updated to address transit agency notification.
G. Updated to include utility operations.

Chapter 17 Bridges and Other Structures

C.1 Updated to now reference the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 5th Edition (2010).
C.3.b Updated to refer to the AASHTO LRFD Bridge Design Specifications, 5th Edition (2010).
C.4.a Updated to change the approval authority to the District Design Engineer
D. Updated to correct the position title of the District Structures Maintenance Engineer.
E. Updated to correct the position title of the District Structures Maintenance Engineer.
H.2 Updated to refer to the AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 5th Edition (2009), and the Department's Structures Manual Volume 9 - FDOT Modifications to Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals (LTS-5).
J This list of references used in the preparation of the chapter has been updated.

Chapter 18 Signing and Marking

General: New chapter addressing Signing and Marking requirements.

Chapter 19 Traditional Neighborhood Development (TND)

General: New chapter addressing requirements for TND.

Quantitative Safety of Local Roads

Quantitative Safety of Local Roads

Florida Department of Transportation Safety Office

3/29/12

Agenda

- Introduction
- Data Results:
  - Pedestrians
  - Bicycles
  - Motorcycles
  - Intersections
  - Lane Departure
- Summary
- Questions

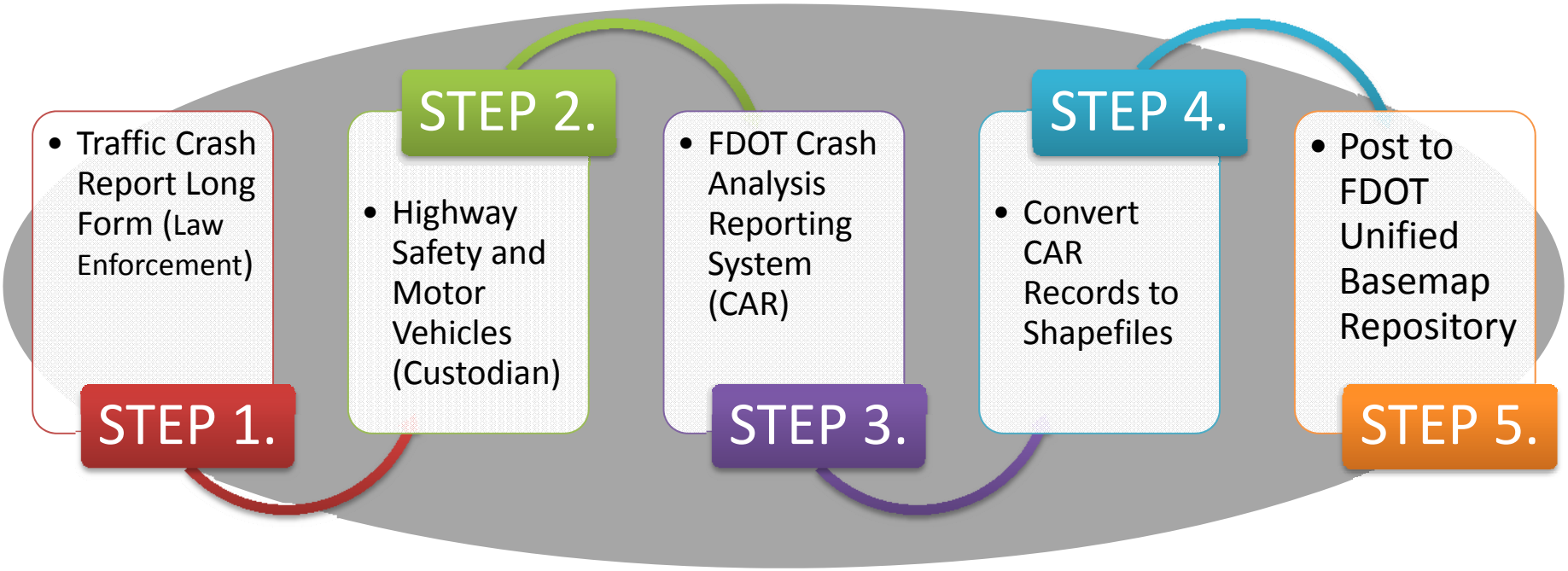
Introduction

Goal

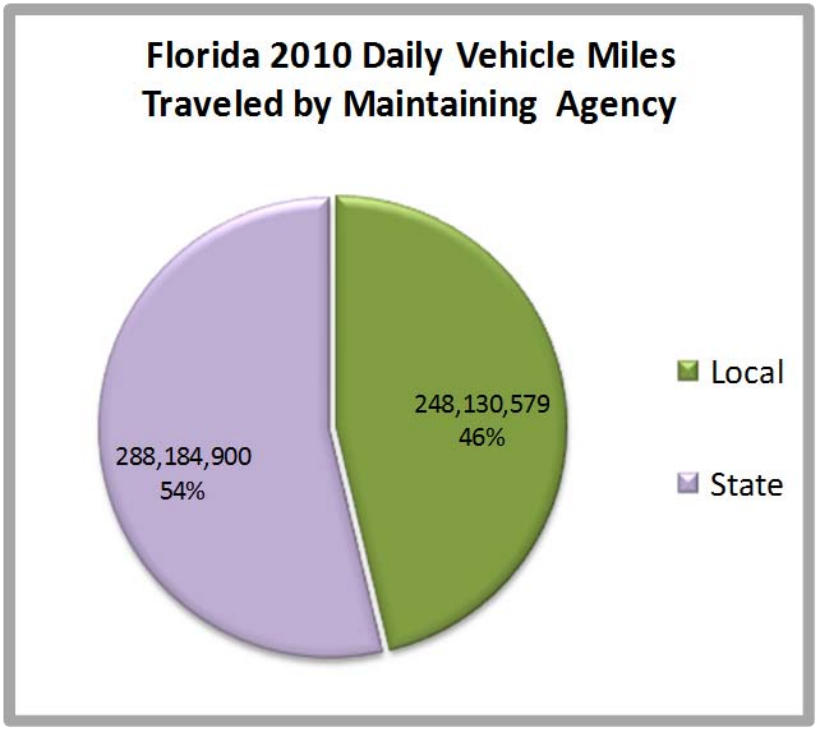
- Strategic Highway Safety Plan:

  Goal: Reduce the rate of fatalities and incapacitating injuries 5% annually.

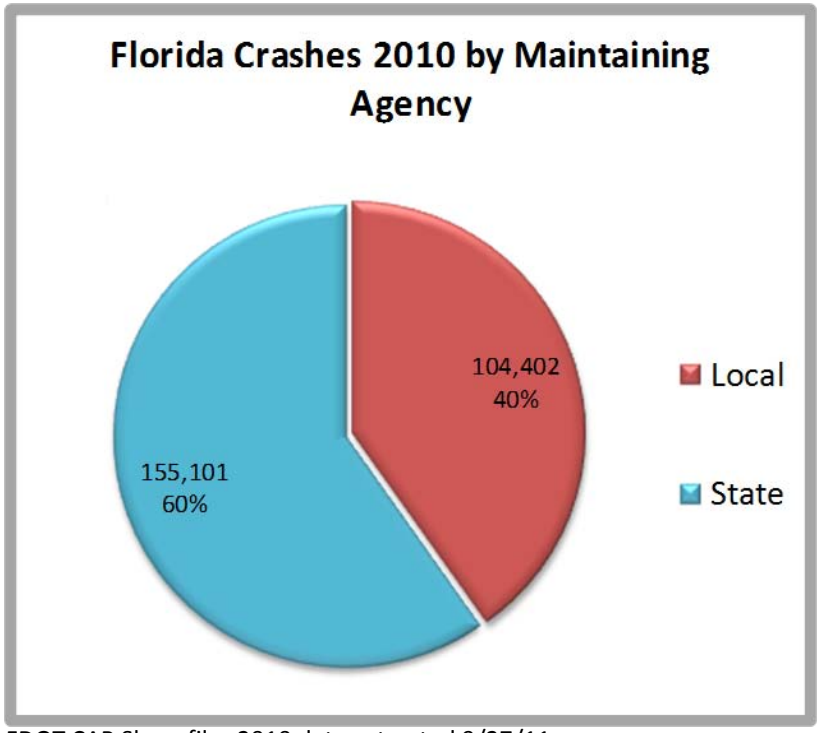
Data Source and Flow:



Introduction Continued



FDOT - Transportation Statistics 2010



FDOT CAR Shapefiles 2010 data extracted 9/27/11

Annual Output: Fatalities

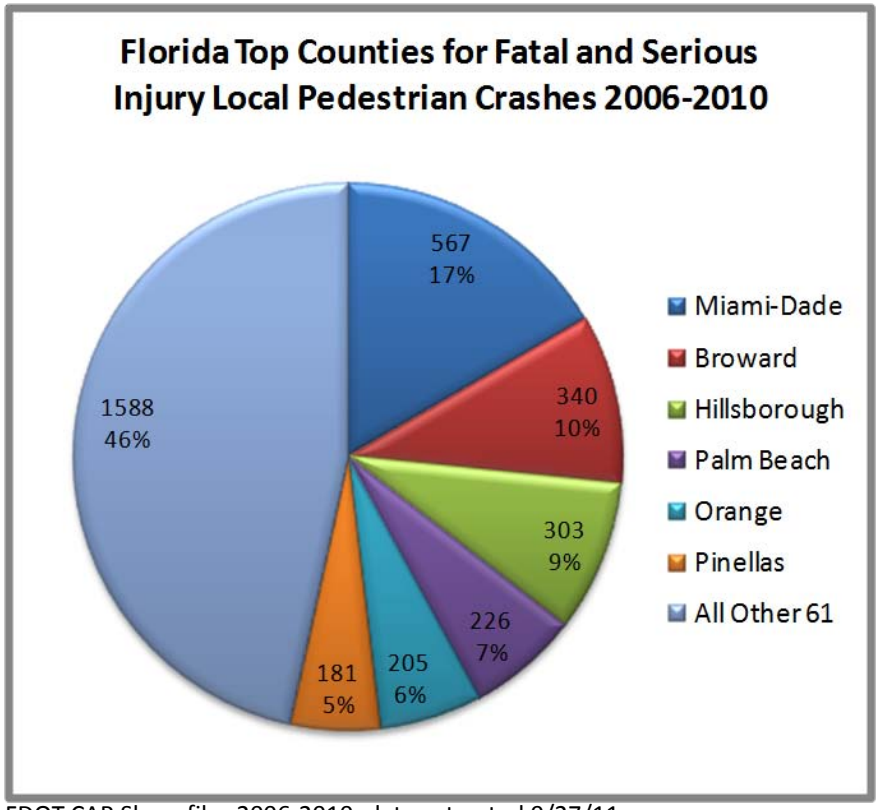
State: 1,566

Local: 877

Vulnerable Road Users: Pedestrians

Pedestrian Crashes – Top Counties

LOCAL



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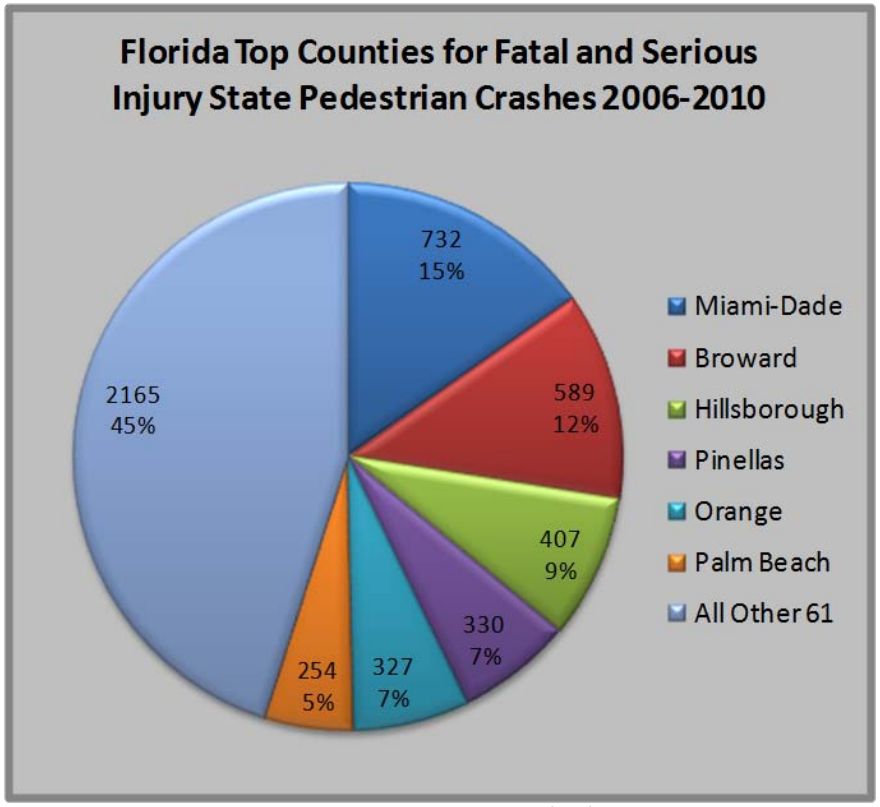
STATE



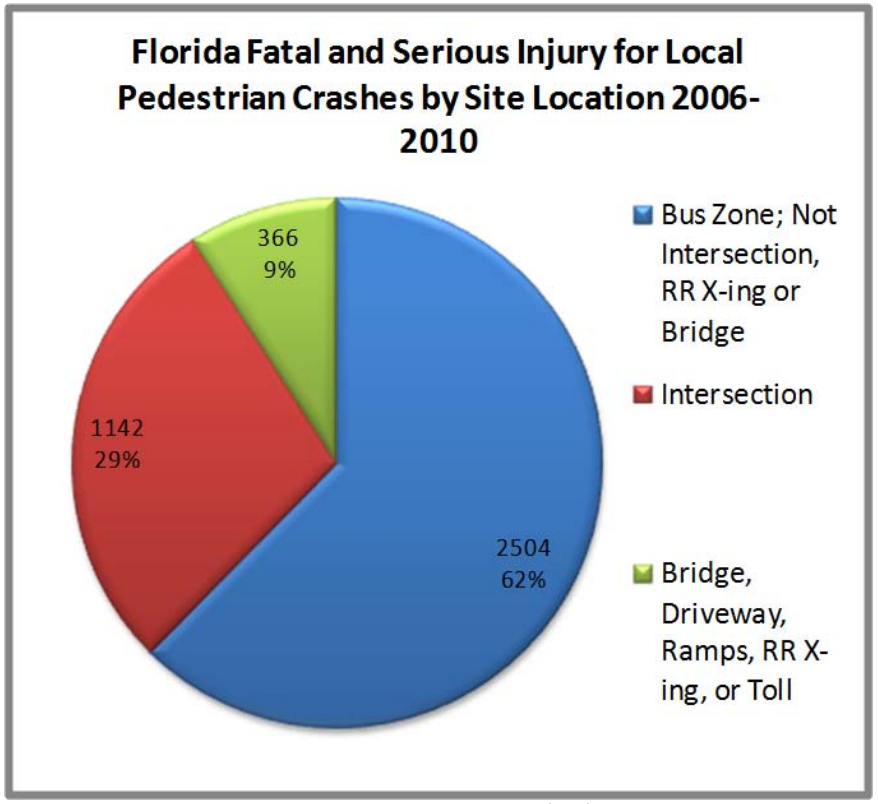
FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

Similarities between Local and State roads:

- Named counties.
- Dispersion amongst counties.

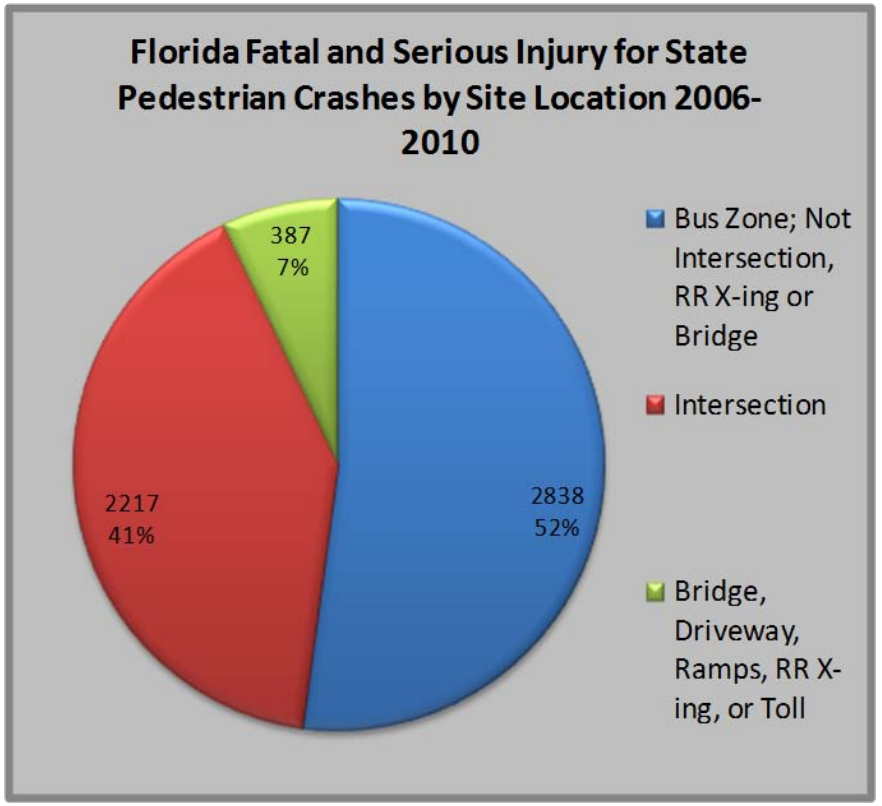
Pedestrian Crashes – Location

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

STATE

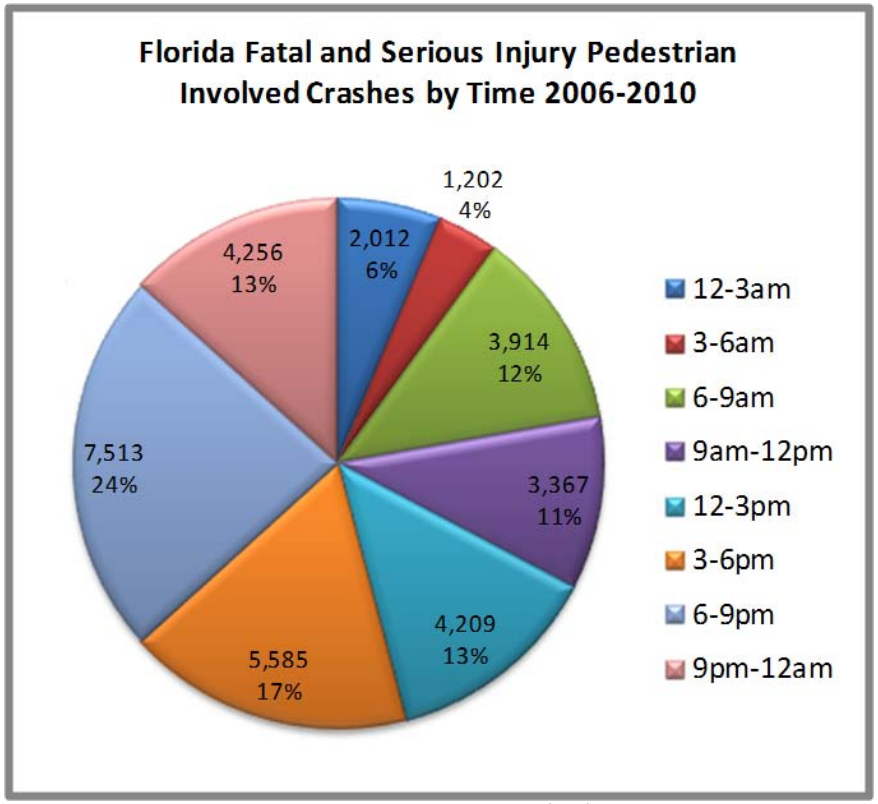


FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- Over 50% occur at bus stop zones, and locations other than intersections, railroad crossing, or bridges .
- Up to 40% occur at intersections.
- Notable differences between Local and State in intersection category.

Pedestrian Crashes – Time and Light Condition

ALL



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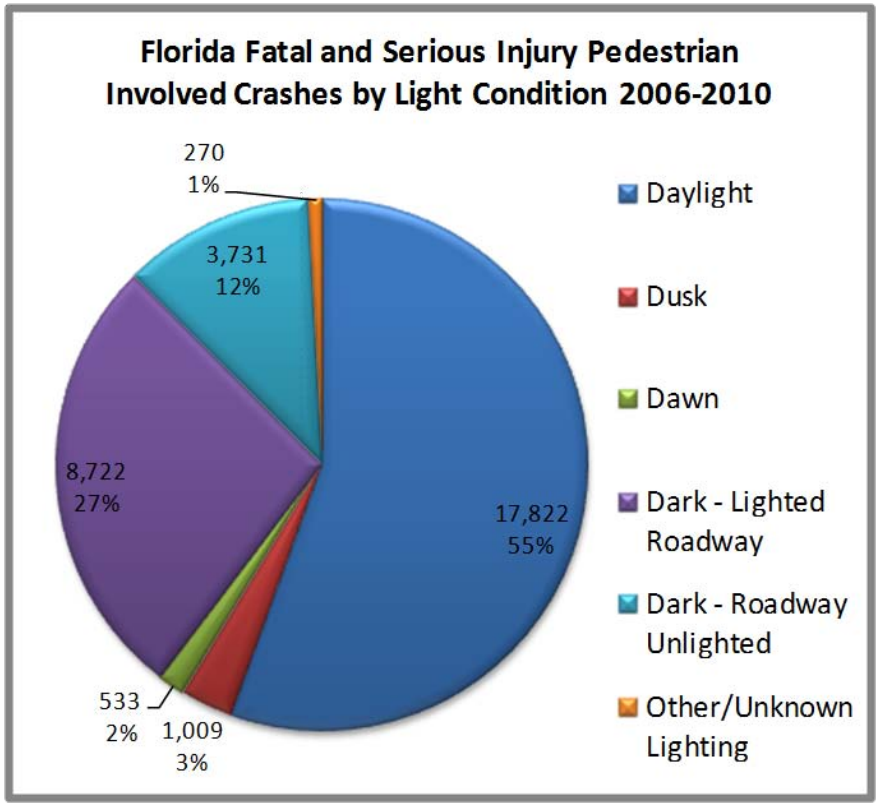
ALL

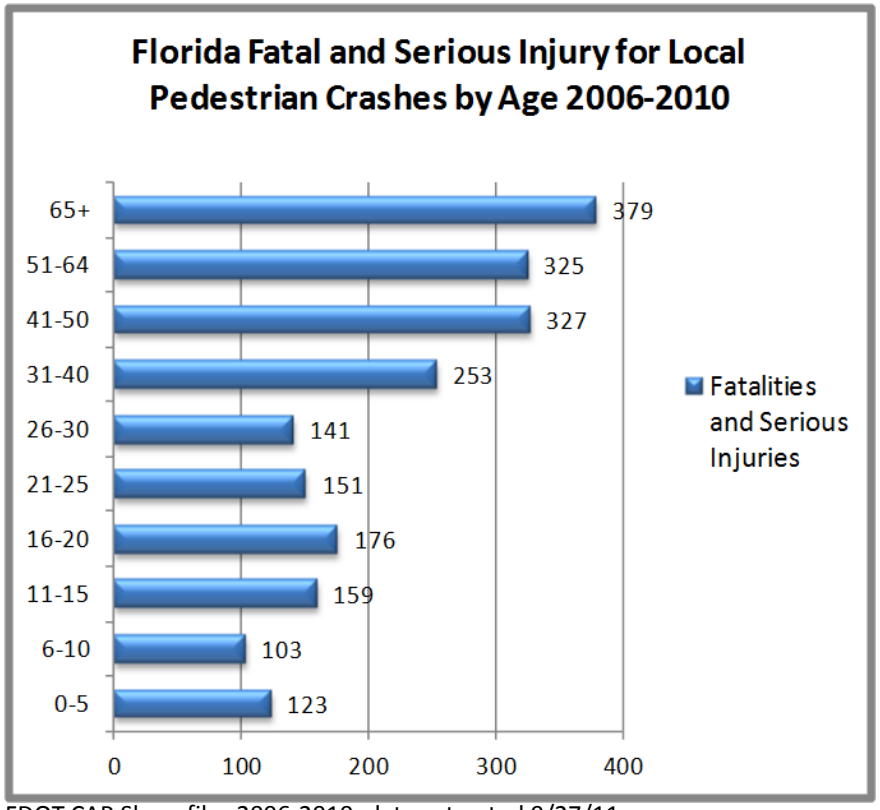


FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- 24% occur between 6-9pm.
- 55% occur in daylight, and
- 27% occur in dark-lighted roadway.

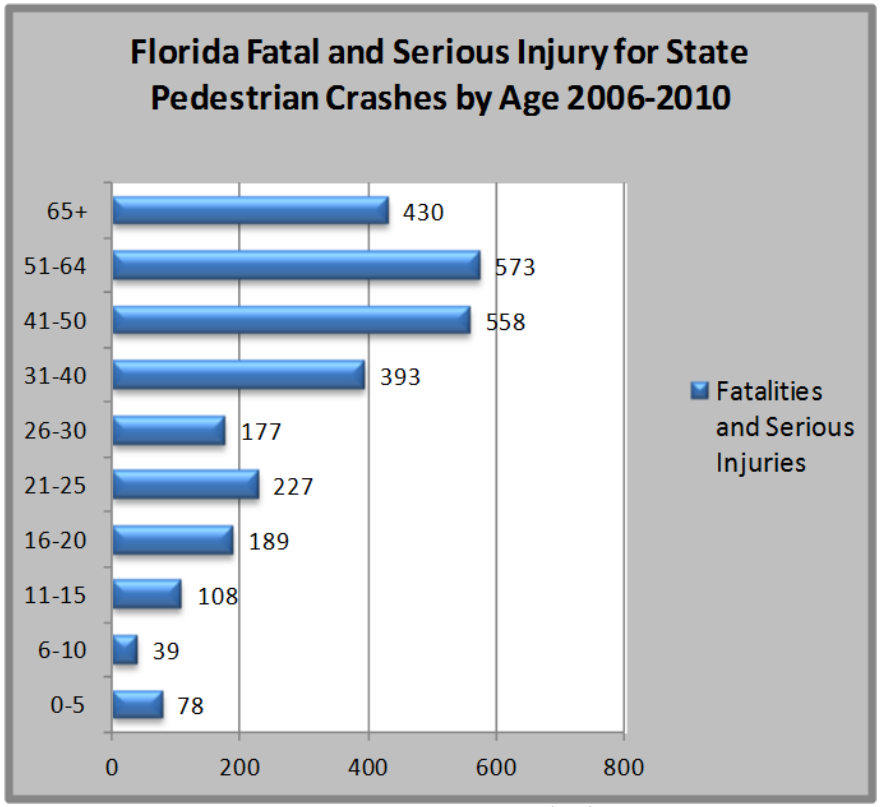
Pedestrian Crashes – Age Group

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

STATE



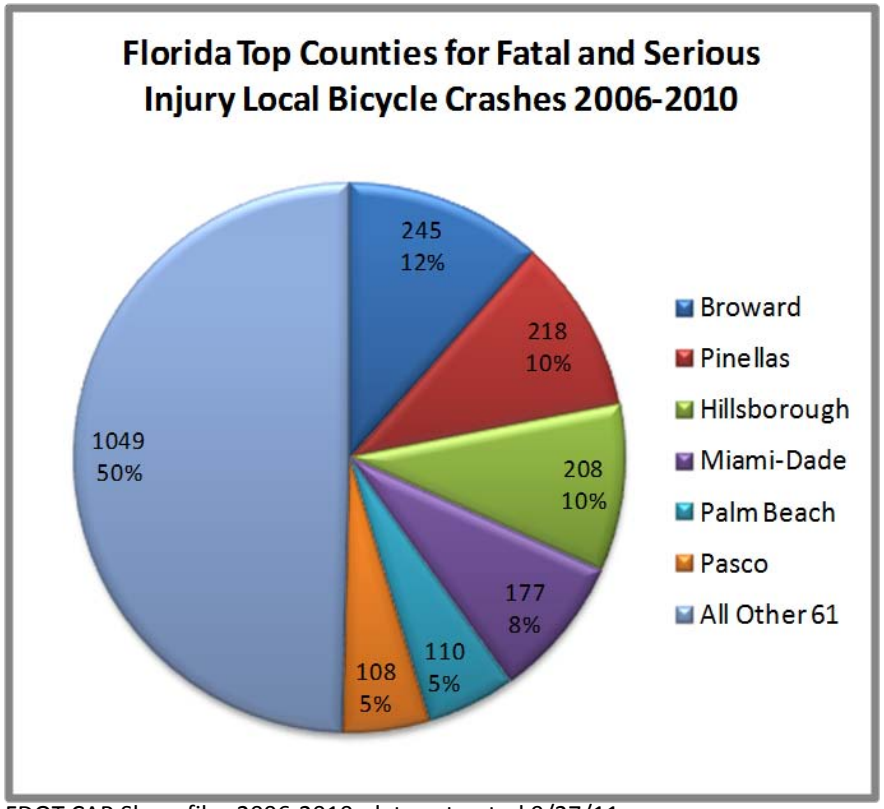
FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- Similar pattern overall between Local and State, but
  - Notable differences between Local and State 31-64 groups.
- Largest proportion occur 31+.

Vulnerable Road Users:
Bicyclist

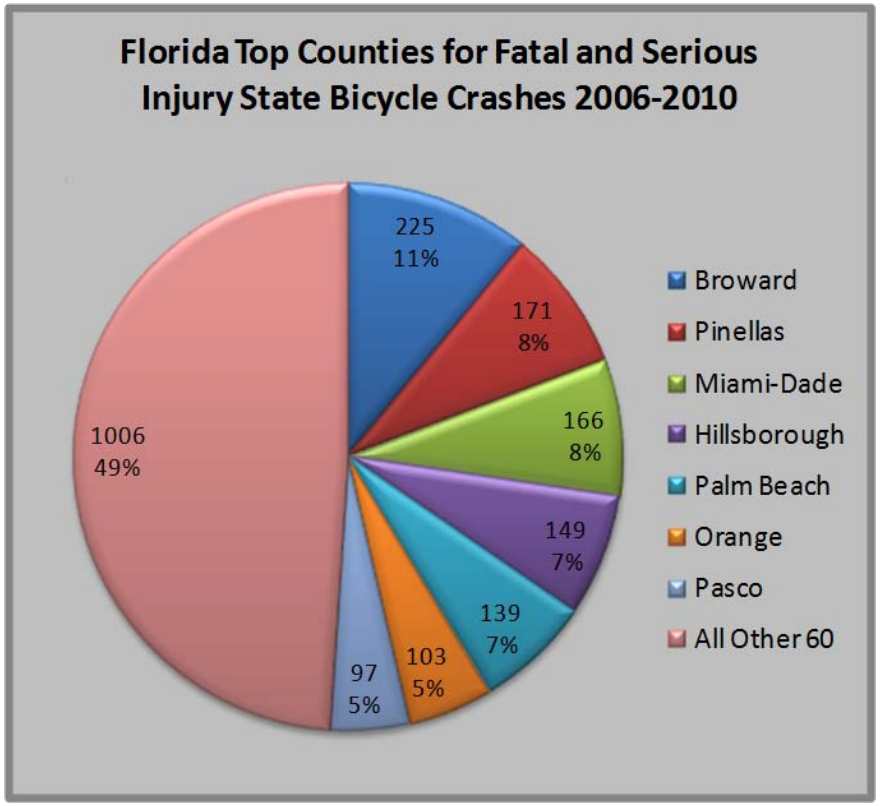
Bicycle Crashes – Top Counties

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

STATE



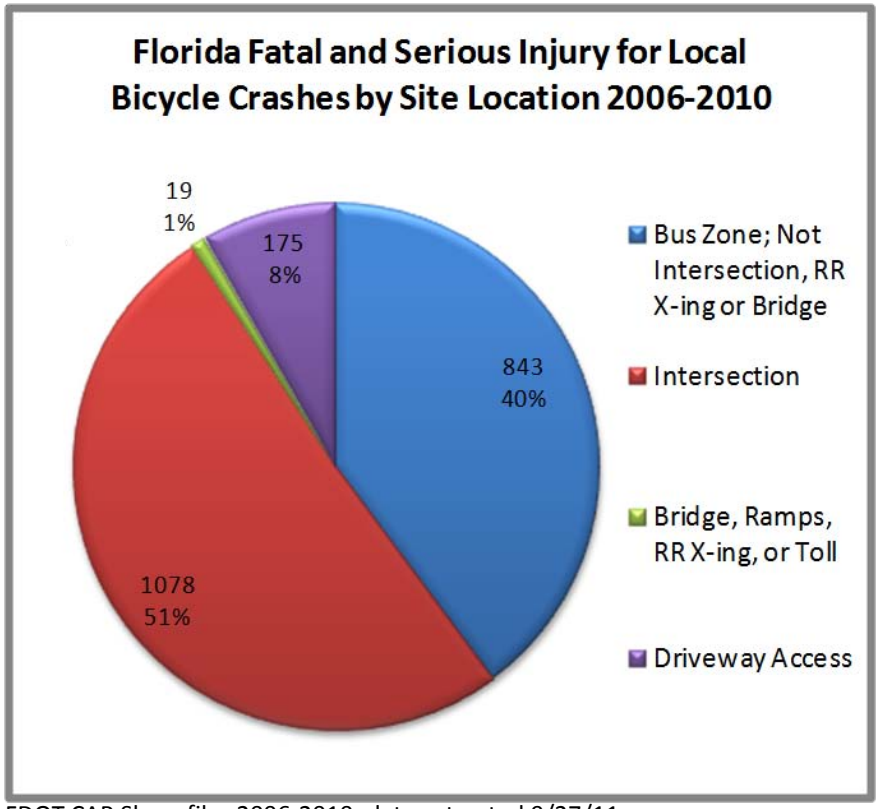
FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

Similarities between Local and State roads:

- Named counties.
- Dispersion amongst counties.

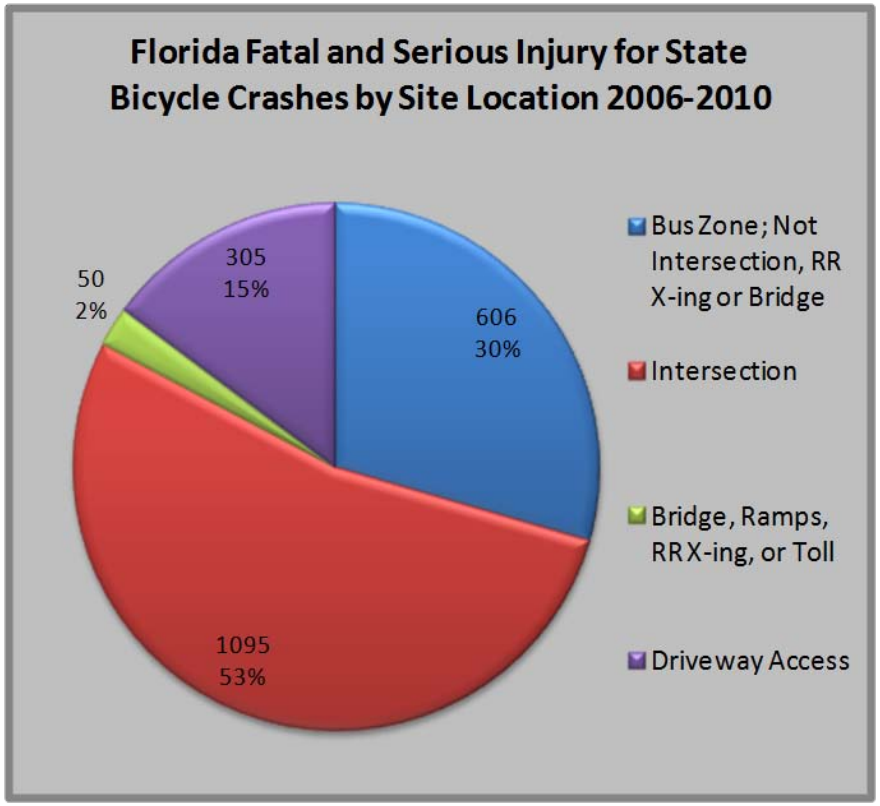
Bicycle Crashes – Location

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

STATE



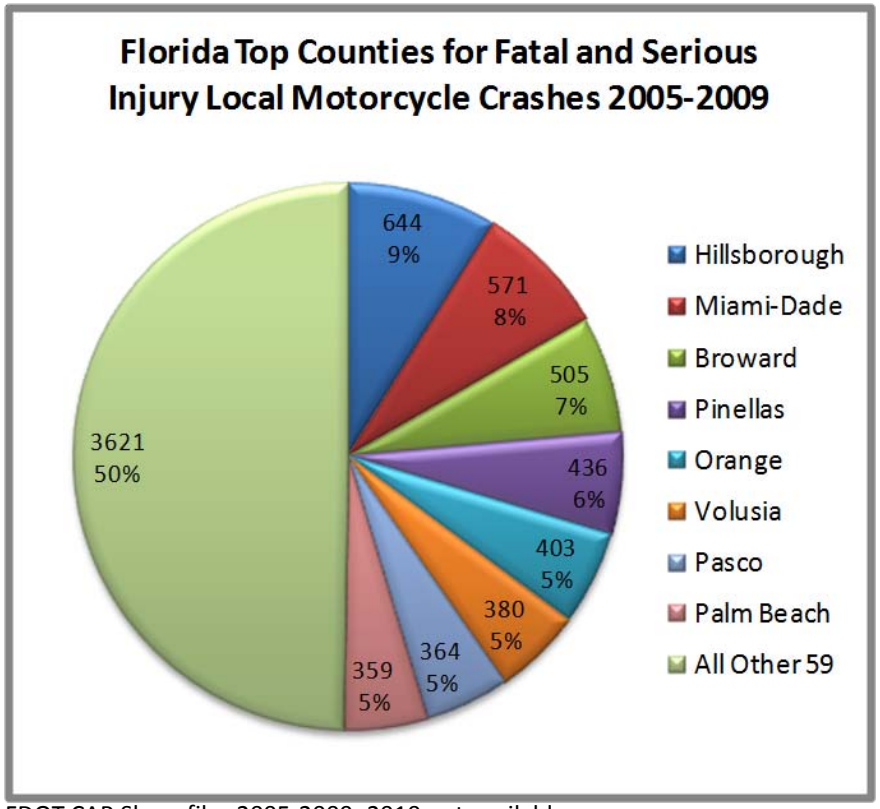
FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- Over 50% occur at intersections.
- Up to 40% occur at bus stop zones, and locations other than intersections, railroad crossing, or bridges.
- Notable differences between Local and State in Driveway Access category.

Vulnerable Road Users: Motorcyclist

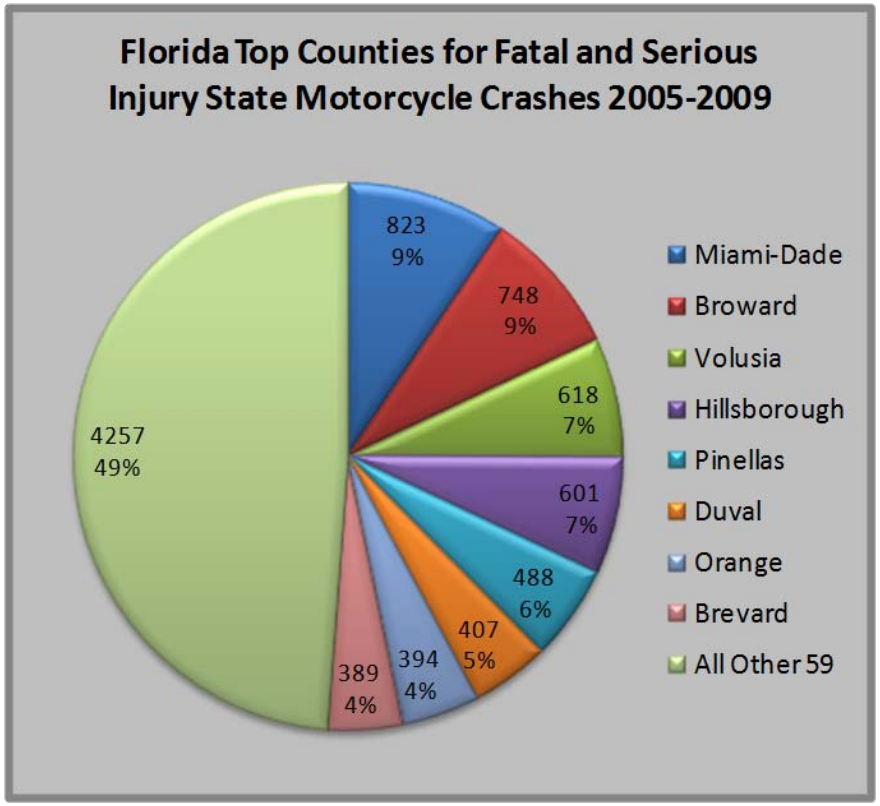
Motorcycle Crashes – Top Counties

LOCAL



FDOT CAR Shapefiles 2005-2009; 2010 not available

STATE



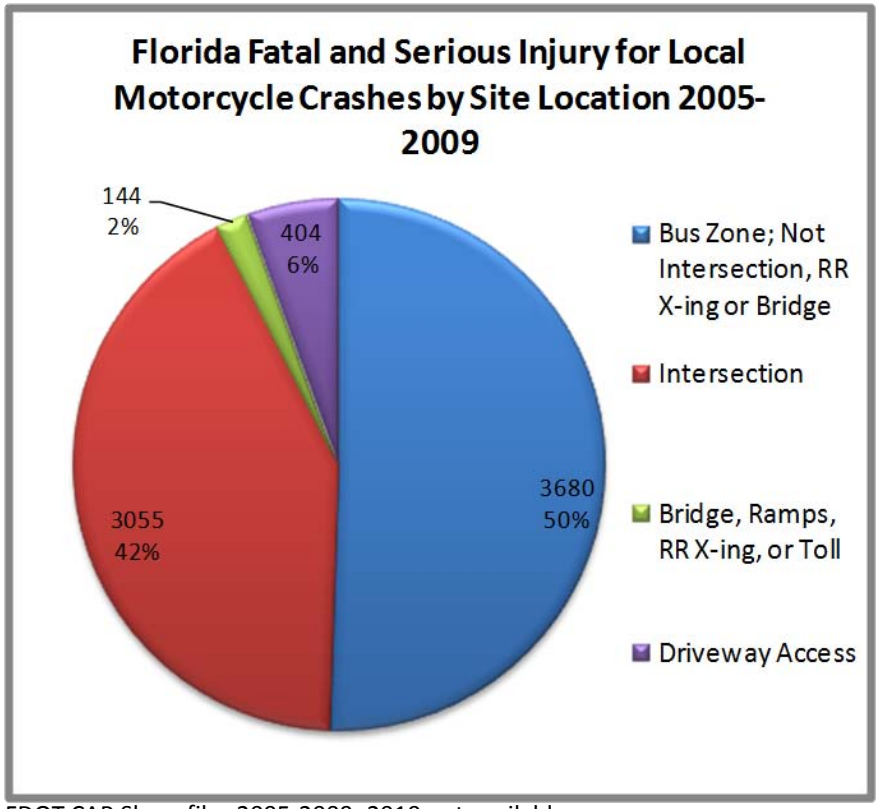
FDOT CAR Shapefiles 2005-2009; 2010 not available

Similarities between Local and State roads:

- Named counties.
- Dispersion amongst counties.

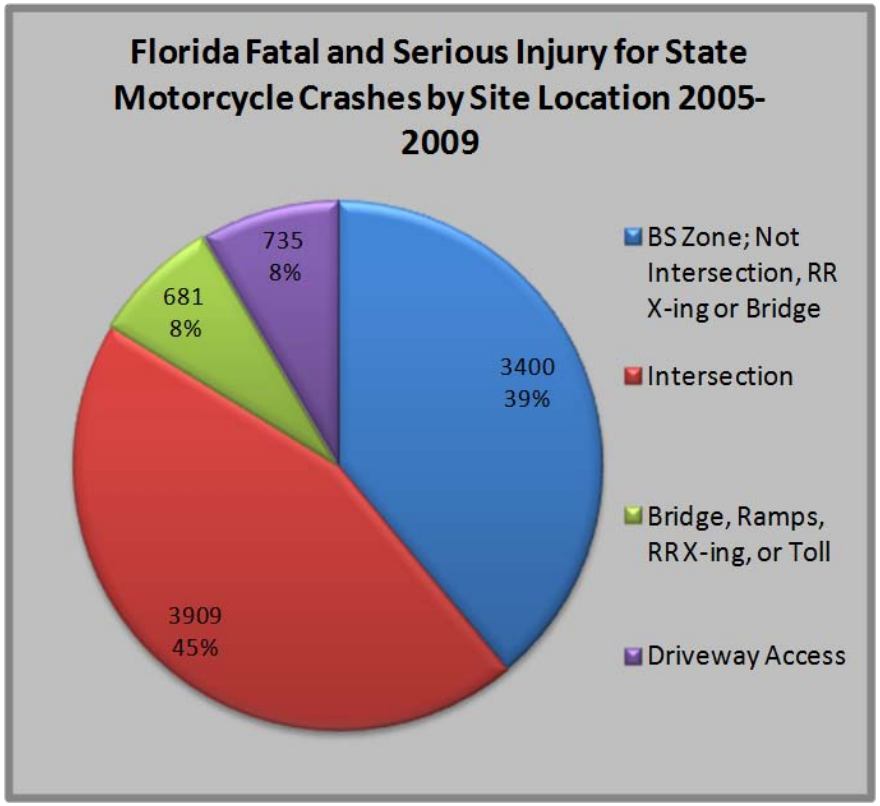
Motorcycle Crashes – Location

LOCAL



FDOT CAR Shapefiles 2005-2009; 2010 not available

STATE



FDOT CAR Shapefiles 2005-2009; 2010 not available

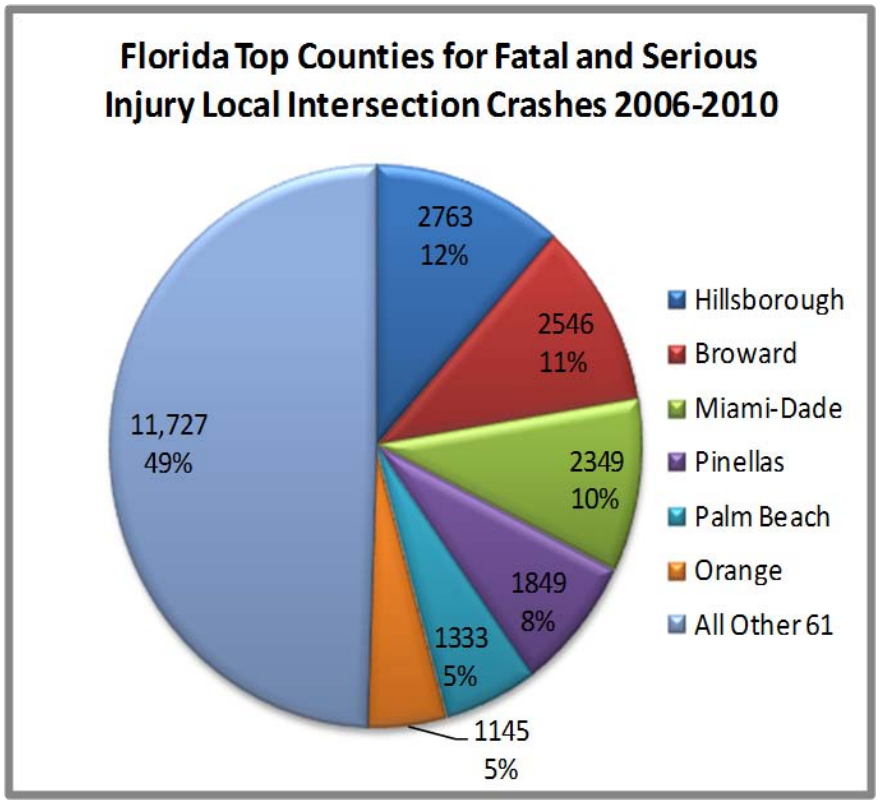
Difference between Local and State:

- Occurring at intersections with 42% Local and 45% State, and
- Occurring at bus stop zones, and locations other than intersections, railroad crossing, or bridges with 50% Local and 39% State.

Intersections

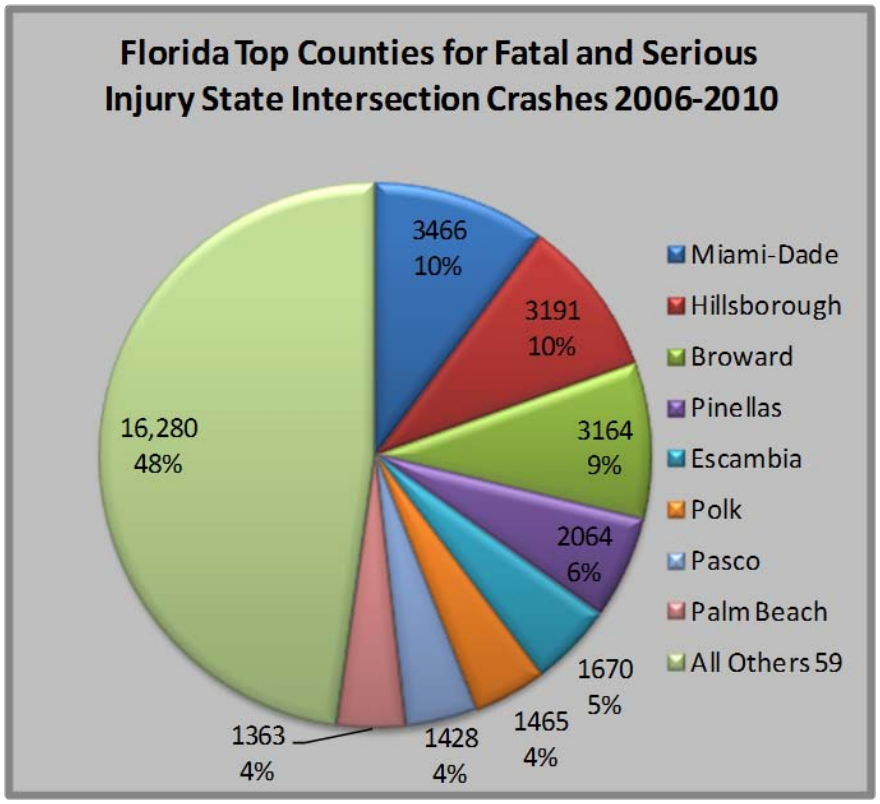
Intersection Crashes – Top Counties

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

STATE

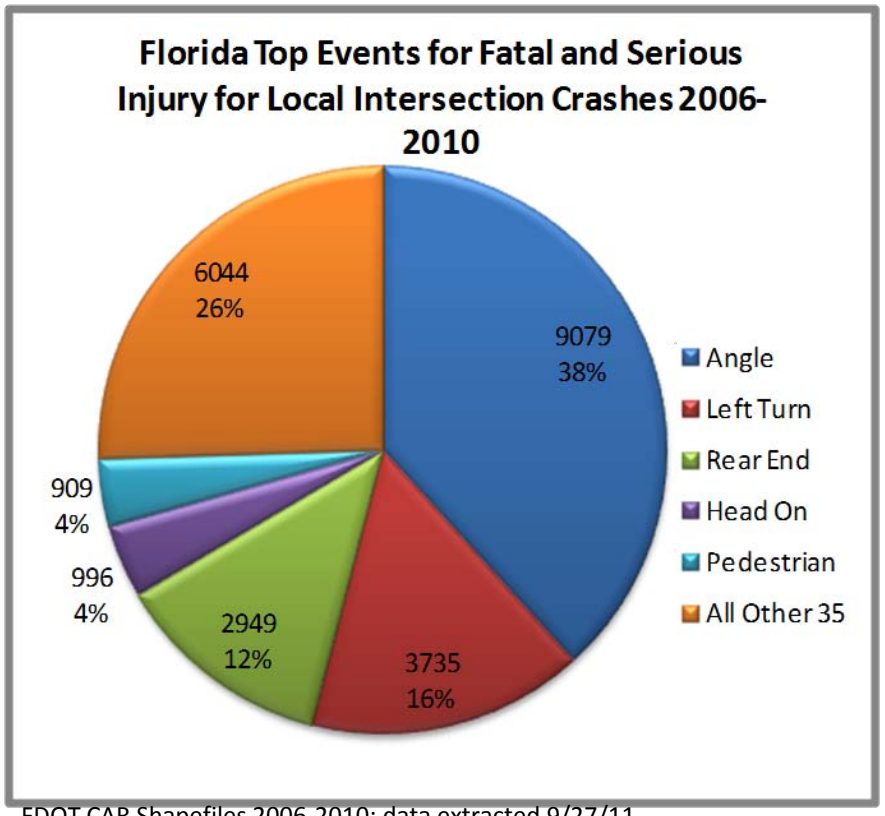


FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- Similarities between named counties.
- Differences in dispersion amongst counties.

Intersection Crashes – Harmful Events

LOCAL



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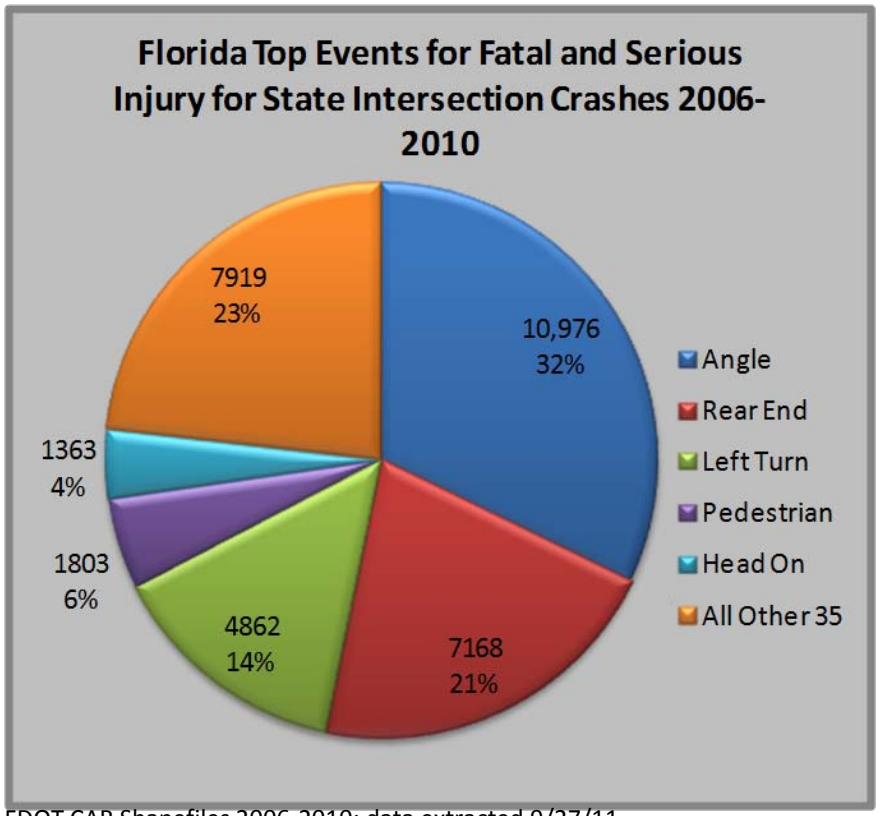
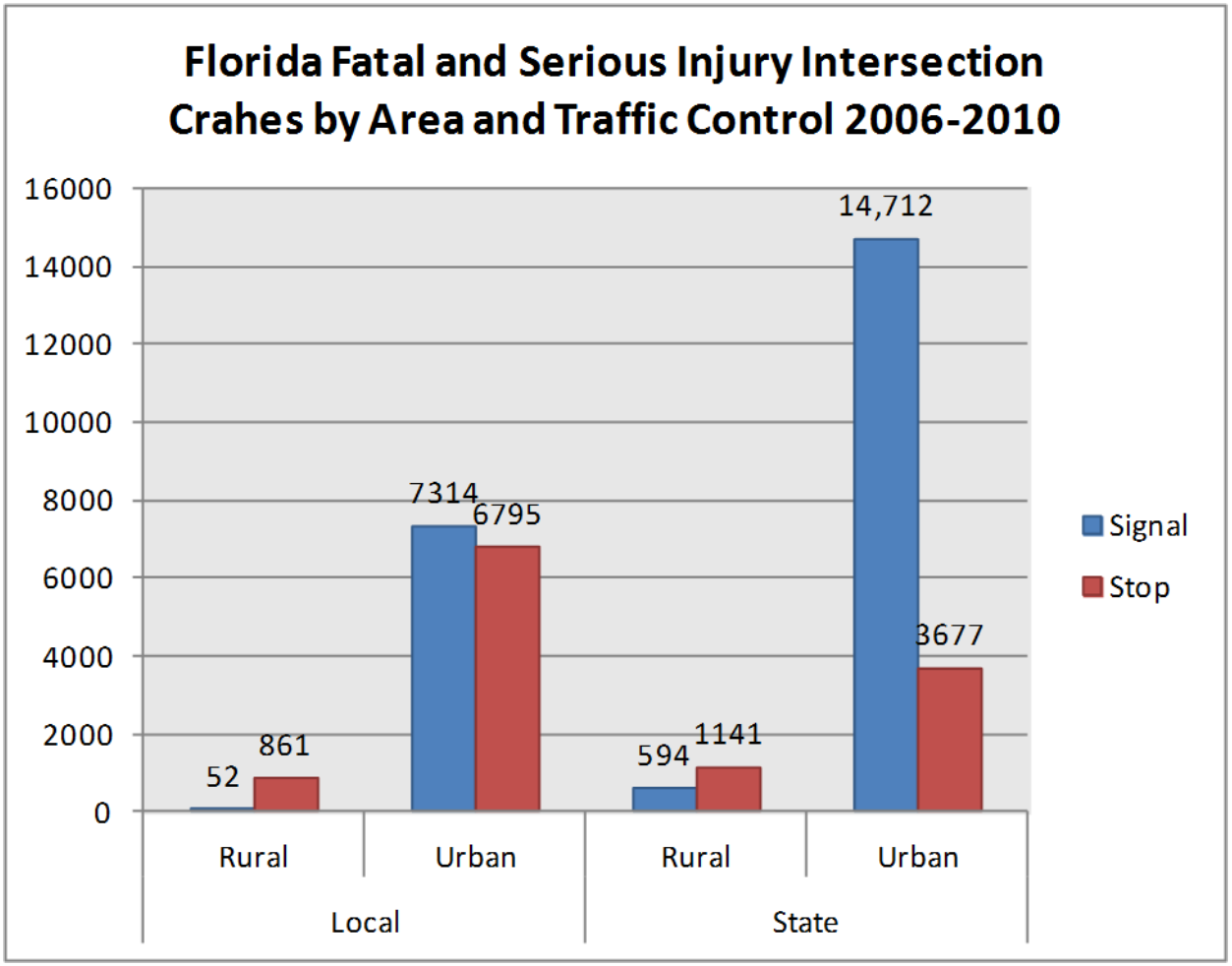


FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

Similarities between Local and State roads:

- Named event types.
- Dispersion amongst event types.

Intersection Crashes - Location



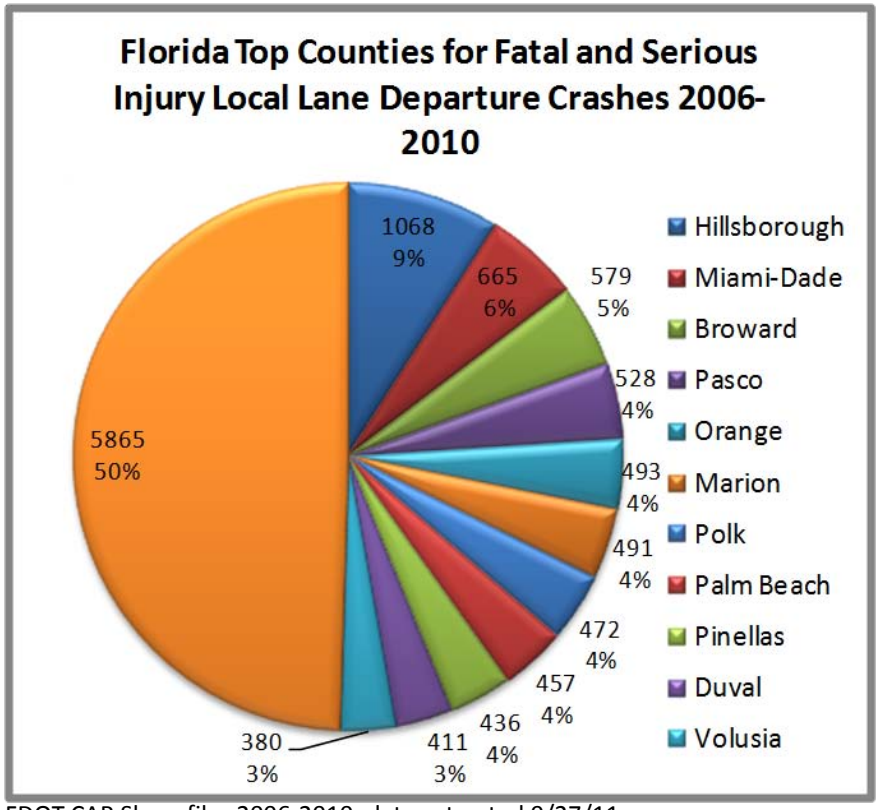
FDOT CAR Shapefiles 2006-2010 data extracted 9/27/11

- Largest percentage occurring at State and Local urban signalized intersections.
- Large percentage occurring at Local urban stop sign intersections.

Lane Departures

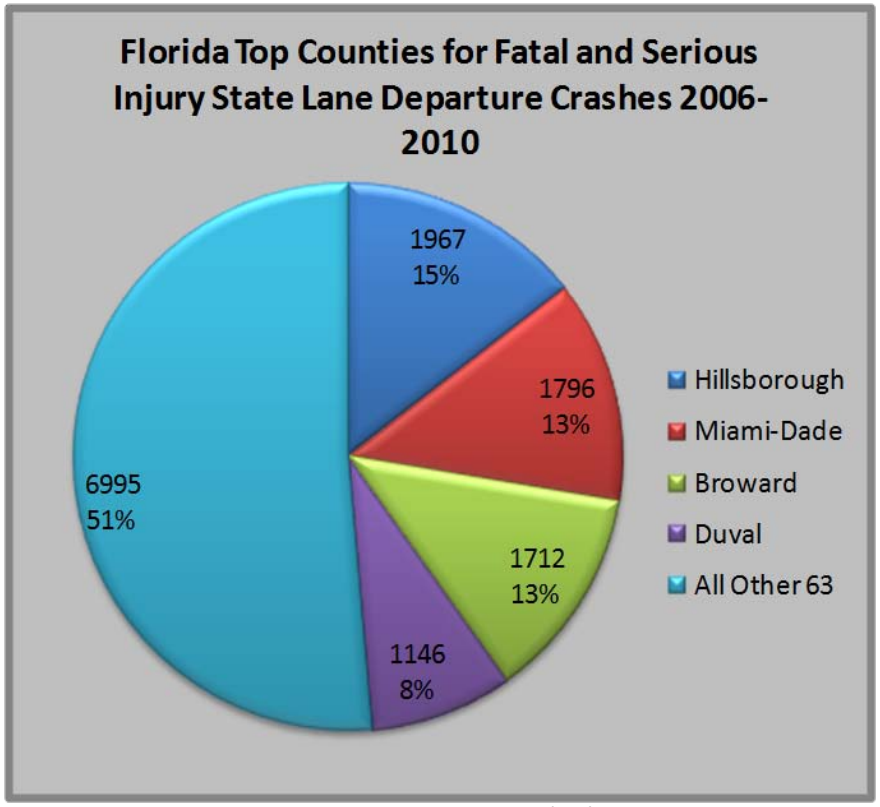
Lane Departure Crashes – Top Counties

LOCAL



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

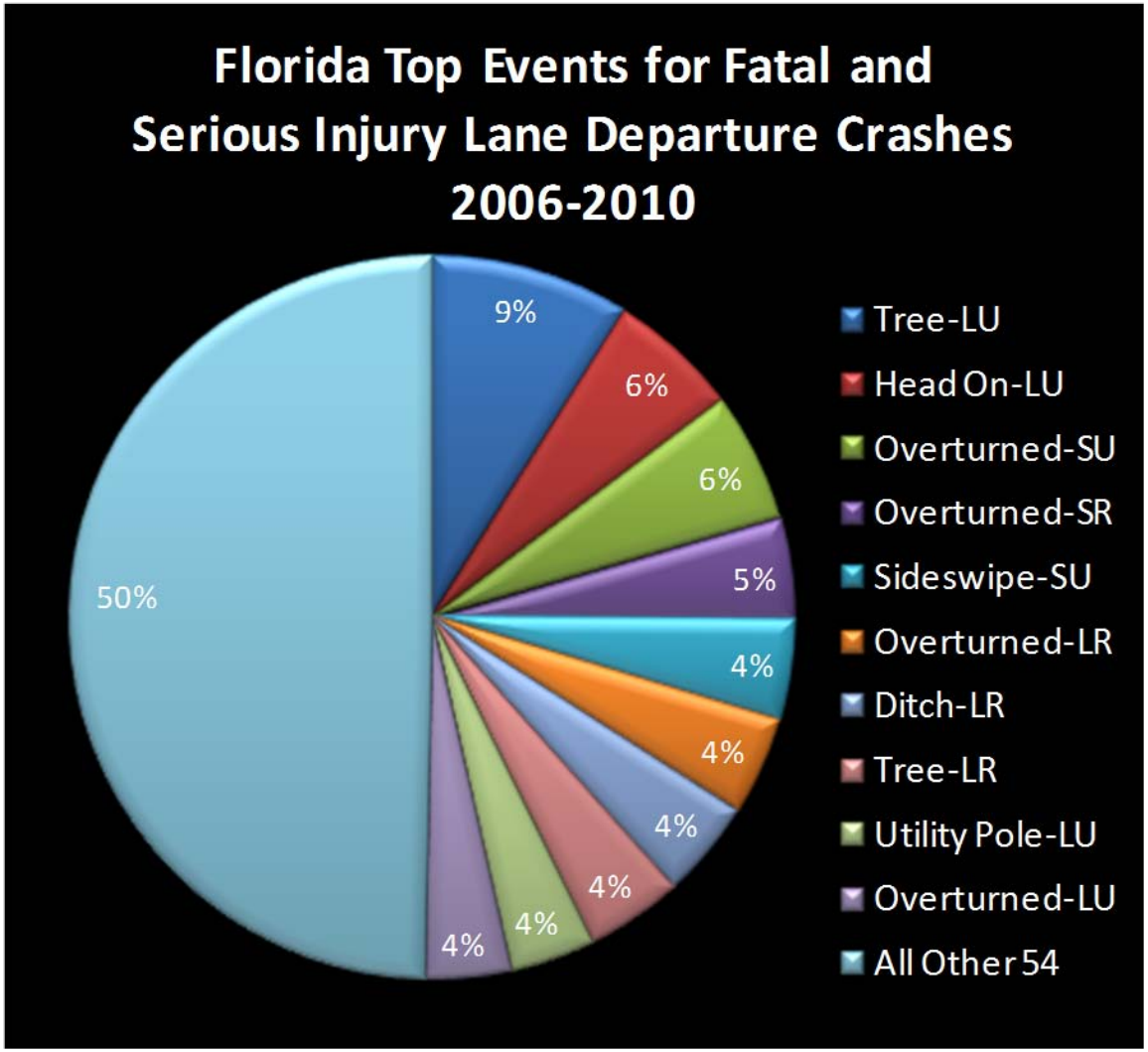
STATE



FDOT CAR Shapefiles 2006-2010; data extracted 9/27/11

- Some similarities with named counties.
- Great differences in dispersion amongst counties.

Lane Departure Crashes - Location



FDOT CAR Shapefiles 2006-2010 data extracted 9/27/11
LU = Local Urban; SU = State Urban
LR = Local Rural; SR = State Rural

- Largest percentage: Overturned (balanced between urban and rural).
- Large percentage: collision with tree.

Summary

- All Focus Areas:
  - Similarities between Local and State recurring named counties except Lane Departures.
  - Great difference in dispersion between Local and State for Lane Departures.

- Pedestrian crashes:
  - Over 50% occur at bus stop zones, and locations other than intersections, railroad crossing, or bridges .
  - Up to 40% occur at intersections.
  - Notable differences between Local and State in intersection category.
  - Similar pattern overall between Local and State, but notable differences between Local and State 31-64 groups.
  - Overall: Largest proportion occur at ages 31+.

- Bicycle crashes:
  - Over 50% occur at intersections.
  - Notable differences in Driveway Access category.

Summary Continued

- Motorcycle crashes:
  - Difference between Local and State:
    - -Occurring at intersections with 42% Local and 45% State, and
    - -Occurring at bus stop zones, and locations other than intersections, railroad crossing, or bridges with 50% Local and 39% State.

- Intersections:
  - Similarities in name and dispersion of event types.
  - Up to 74% of event occur: Angle, Rear-End, Left-Turn, and Pedestrian crashes with Angle having up 38%.
  - Largest percentage occurring at State urban signalized intersections.

- Lane Departures:
  - Largest percentage: Overturned (balanced between urban and rural).
  - Large percentage: collision with tree.

Questions, Resources and Contacts

Questions?

Resources:

FDOT State Safety Office

http://www.dot.state.fl.us/safety/

Unified Basemap Repository:

http://webapp01.dot.state.fl.us/unifiedbasemaprepository/

Contacts:

joseph.santose@dot.state.fl.us

rickey.fitzgerald@dot.state.fl.us

Proven Safety Counter Measures

Proven Safety Countermeasures

Green Book Meeting

Monica Gourdine

FHWA

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives
http://safety.fhwa.dot.gov

Introduction and Background

"While States should still be considering the application of all of the countermeasures listed in the 2008 guidance, this memo supersedes the previous guidance. " – 2012 Countermeasure Guidance

- FHWA Issued Nine Proven Countermeasures Guidance in 2008.
- Many of those countermeasures have been widely applied.
- FHWA is updating our previous guidance.
- We are taking into consideration the latest safety research.

"…we encourage safety practitioners to consider a new set of countermeasures …that are research-proven, but not widely applied on a national basis. " – 2012 Countermeasure Guidance

Process for Selecting Countermeasures

- **Assembled a Team of FHWA Experts from Across the Safety Discipline**
  - Multiple Perspectives (HQ, Divisions, Resource Center)
  - Diverse Focus Areas (Pedestrian, Roadway Departure, Intersections, Data)
  - Countermeasure Experience (Promoting, Technical Assistance, Analysis, Evaluation)
- **Determined the Current Level of Application of 2008 Countermeasure List**
  - Three Carried Over (Roundabouts, Medians / Pedestrian Refuge, and Safety Edge)
  - Rumbles also Carried Over – With a Focus on Two-Lane Roads
- **Expert Group Determined New Countermeasures**
  - Consulted CMF Clearinghouse Data (Star Ratings, CMFs)
  - Narrowed List based on Field Experience and Expertise
  - Developed Business Cases for All Countermeasures
- **Vetted List and Guidance**
  - DA Safety Council
  - HSA / Resource Center Leadership
  - Office of Operations
  - Office of Infrastructure

Countermeasure Selection Process

2008 Countermeasures

1. Rumble Strips and Rumble Stripes*
2. Median Barriers
3. Walkways
4. Left and Right Turn Lanes at Stop-Controlled Intersections
5. Yellow Change Intervals
6. Roadway Safety Audit 1.27**
7. Roundabouts 1.23
8. Medians and Pedestrian Refuge Areas 1.17
9. Safety Edge 1.15

2012 Countermeasures

1. Roundabouts
2. Safety Edge
3. Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
4. Longitudinal Rumble Strips and Stripes on 2-lane Roads*
5. Corridor Access Management
6. Backplates and Retroreflective Borders
7. Enhanced Delineation and Friction for Horizontal Curves
8. Pedestrian Hybrid Beacon
9. “Road Diets” (Roadway Reconfiguration)

* Group decided to retain for two-lane roads only, based on application of countermeasure
** Not a Countermeasure

Data-Driven Safety Process

"…countermeasure selection should continue to be based on appropriate analytical techniques…"

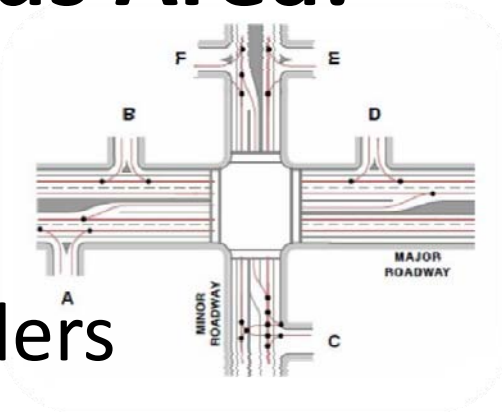
- 2012 Countermeasure Guidance

Encourage States to Use Analytical Site-Specific Approaches (such as the Highway Safety Manual) and Systemic Planning Approaches to Make Safety Investment Decisions

- Conduct Appropriate Analysis of Quality Safety Data
- Use Evidence-Based Framework for Decision-Making
- Use the CMF Clearinghouse to Choose Appropriate Countermeasures
- Consider the Nine Countermeasures as Viable Options

Addressing the Intersection Focus Area:

- Roundabouts
- Corridor Access Management
- Backplates with Retroreflective Borders
- “Road Diet” (Roadway Reconfiguration)
- Pedestrian Hybrid Beacon

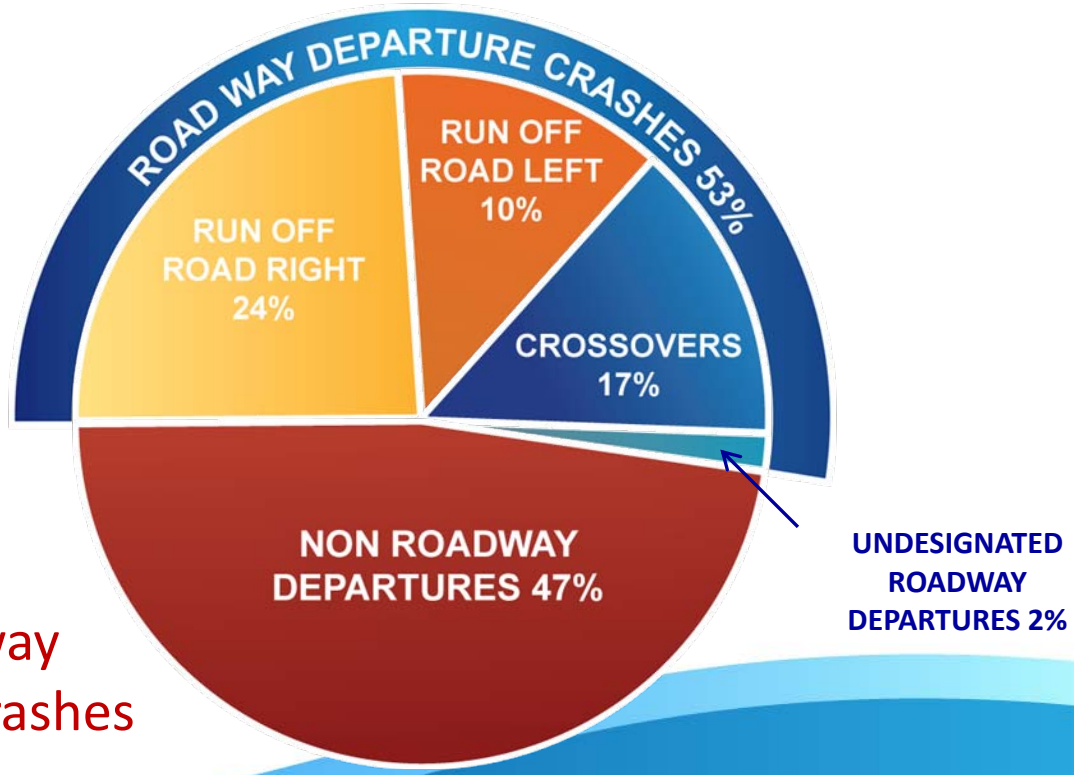


“There are approximately 300,000 signalized intersections in the United States. About 1/3 of all intersection fatalities occur at these locations; resulting in roughly 2,300 people killed in a single year. “

– Roundabouts Fact Sheet

Addressing the Roadway Departure Focus Area

- Longitudinal Rumble Strips and Stripes on 2-Lane Roads
- Enhanced Delineation and Friction for Horizontal Curves
- Safety Edge$_{SM}$

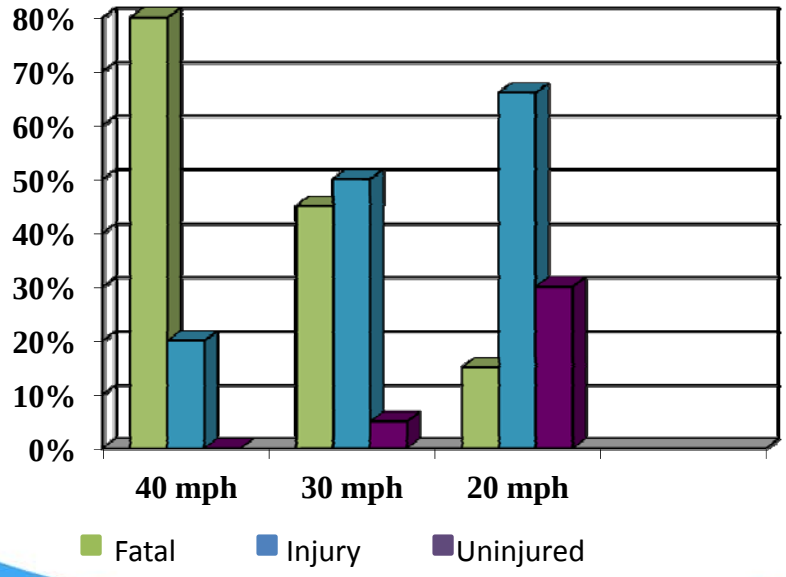


Roadway Departure Risk Management

1. Keep Vehicles on Roadway
2. Reduce Likelihood of Crashes
3. Minimize Severity

Addressing the Pedestrian Safety Focus Area

- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- “Road Diet” (Roadway Reconfiguration)



Pedestrian Safety Facts:

- Pedestrians represent over 12% of Highway Fatalities.
- Midblock locations account for over 70% of pedestrian fatalities.
- Over 80% of pedestrian fatalities hit by vehicles traveling at 40 mph or faster will die, while less than 20% die when hit at 20 mph or less.

Roundabouts

- Modern designs are safer and more efficient than old circles and rotaries
- Can reduce crashes resulting in injury or fatality by nearly 80%[1]
- Should be considered as part of corridor or intersection improvement projects
- Highly adaptable, proven in both low-speed urban and high-speed rural environments

1. *AASHTO Highway Safety Manual, Chapter 14*

Longitudinal Rumble Strips and Stripes on 2-Lane Roads

- Alerts drivers with sound and vibration when vehicles cross the edge or center line.

- Reduction of Severe Crashes:
  - Rural Edge, Run Off Road: 36%
  - Rural Center, Head-ons: 44%
  - Urban Center, Head-ons: 64%

Safety Edge$_{SM}$

- Consolidating the pavement edge into 30° shape during paving to provide stability for vehicles recovering from a roadway departure
- 6% reduction of total crashes
- B/C range: 4 to 63
- Implement as a standard practice for paving and resurfacing projects

Safety Edge$_{SM}$

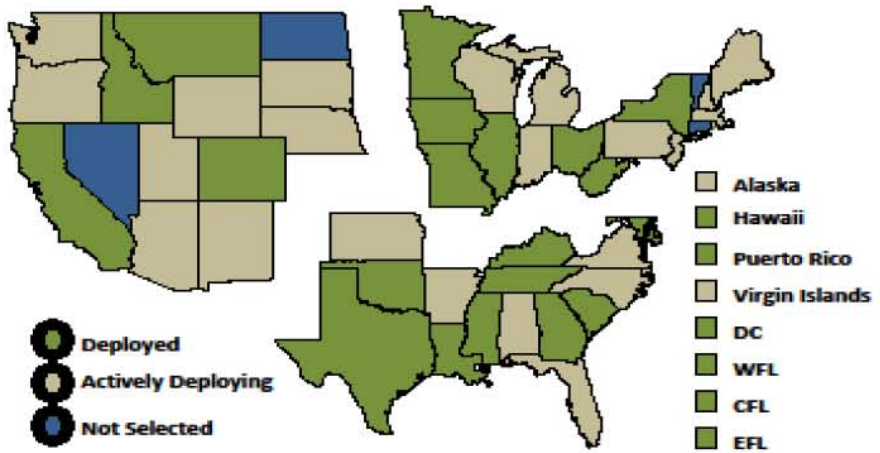
Safety Edge$_{SM}$

Goal 1: By December 2011, 40 State DOTs will have used the Safety Edge$_{SM}$ on projects

Goal 2: By December 2011, 15 State DOTs and all Federal Lands Divisions have adopted Safety Edge$_{SM}$ specifications.

Goal 3: By December 2012, 40 State DOTs will have adopted as a standard for paving projects

- 52 implementing organizations
- 602 projects nationwide since October 2010
- 5 more states with first time use in 2012
- 24 states adopted specifications for statewide use



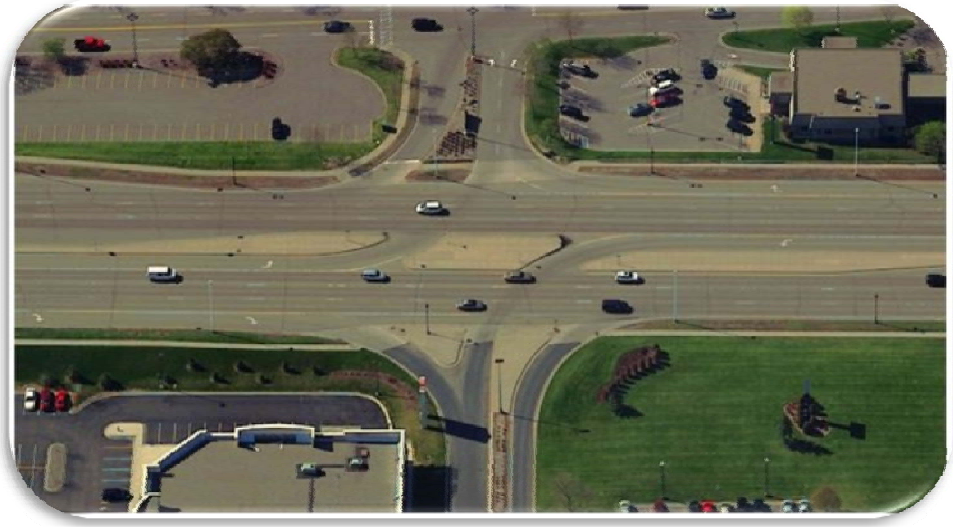
Medians and Pedestrian Crossing Islands in Urban and Suburban Areas

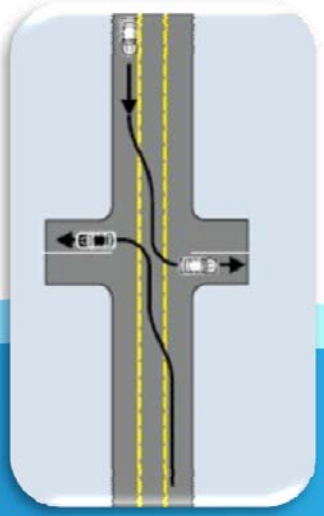
- *Median* is between opposing lanes of traffic, excluding turn lanes (can be paint or concrete).
- Islands can be placed at intersections or midblock locations to separate crossing pedestrians from motor vehicles.
- Use in curbed sections of multi-lane roadways in urban areas with vehicular-pedestrian conflicts and med/high travel speeds.

Safety results:
46% reduction in pedestrian crashes
39% reduction in total crashes

Corridor Access Management

- Involves the design, implementation and control of entry and exit points along a roadway
- Reducing access points along urban/suburban corridor can reduce injury and fatal crashes by about 25%[1]
- May be considered as a component of general corridor improvements or as its own project

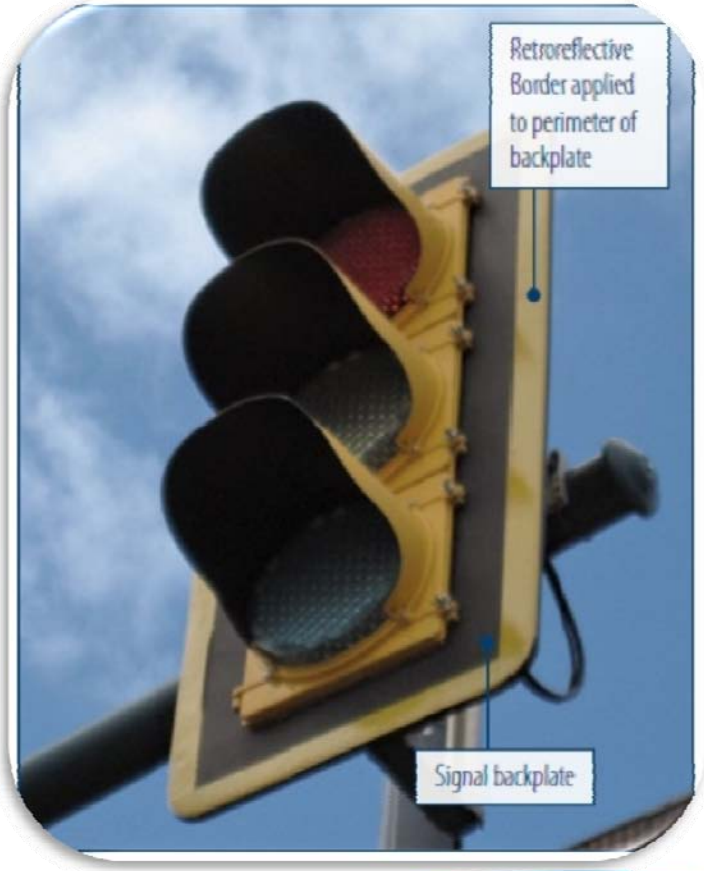


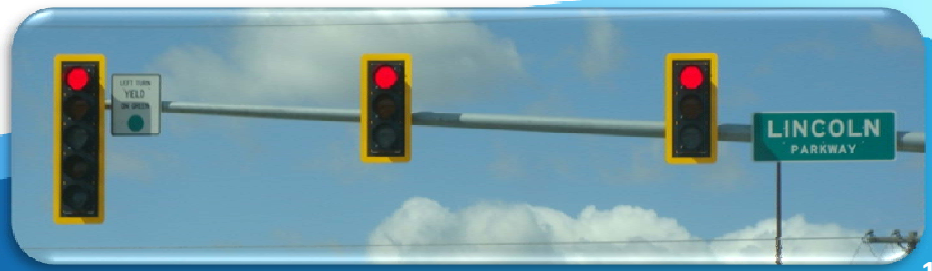


1. *AASHTO Highway Safety Manual, Chapter 14*

Backplates with Retroreflective Borders

- Retroreflective strip added around the border of a signal backplate
- Documented 15% reduction in crashes of all types and severities at urban signalized intersections[1]
- Consider as standard treatment for new and modernized signal projects, or as a systemic retrofit safety improvement





1. *CMF Clearinghouse*

Enhanced Delineation and Friction for Horizontal Curves

- Low-cost treatments
- Includes signs and markings that help drivers safely negotiate curves or…
- Additional pavement friction to address geometric deficiencies

Safety Impacts:

- Vary based on application
- Up to 43% reduction of all fatal crashes

Pedestrian Hybrid Beacon

- Pedestrian-activated beacon located on the roadside or on mast arms over major approaches to an intersection.
- Follow guidance in MUTCD Chapter 4F.

Safety results:
69% reduction in pedestrian crashes
29% reduction in total crashes

“Road Diet” (Roadway Reconfiguration)

- Conversion of four-lane undivided roadway into three lanes with two through-lanes and a center two way left turn.
- Best on Roadways with ADT of 20,000 or less.

Safety results:

29% reduction in all roadway crashes

Fact Sheets and Further Information

FHWA web site:
http://safety.fhwa.dot.gov/provencountermeasures

Contacts for Further Information

Intersection Countermeasures:
Jeffrey Shaw, jeffrey.shaw@dot.gov, (708) 283-3524.

Roadway Departure Countermeasures:
Cathy Satterfield, cathy.satterfield@dot.gov, (708) 283-3552.

Pedestrian Countermeasures:
Tamara Redmon, tamara.redmon@dot.gov, 202-366-4077.

Countermeasure Performance Measure:
Heather Rothenberg, heather.rothenberg2@dot.gov, 202-366-2193.

Questions and Answers

Proposed Updates for 2013 Greenbook

ADA

Florida Greenbook Advisory Committee Meeting

Update on the ADA & Transportation Facilities

New Direction from USDOT-FHWA

Dean Perkins, Archtiect

ADA Coordinator

A Brief history of ADA

- July 26, 1990 – Americans with Disabilities Act (ADA)
  - ADA Accessibility Guidelines (ADAAG) published – July 26, 1991
  - ADA effective – January 26, 1992
- July 23, 2004 – ADAAG updated (ADA Standards)
- September 2005 – Public Rights of Way Accessibility Guidelines (PROWAG)
- October 30, 2006 – USDOT adopts ADA Standards for Transportation Facilities (ADASTF)
  - Effective – November 29, 2006
- September 15, 2011 – USDOJ adopts new ADA Standards
  - Effective – March 15, 2011; Mandatory March 15, 2012

ADA Update

- Current “standards” as adopted by USDOJ
  - ***ADA Standards for Accessible Design*** (ADAS)
  - Applicable to most sites and facilities
- Current “standards” as adopted by USDOT
  - ***ADA Standards for Transportation Facilities***” (ADASTF)
  - ADAS with 4 Modifications
  - Applicable to "transportation facilities"

ADA Update

- **USDOT Modifications (49 CFR Part 37):** *(cont.)*
  - **406.8** A curb ramp shall have a detectable warning complying with 705. The detectable warning shall extend the full width of the curb ramp (exclusive of flared sides) and shall extend either the full depth of the curb ramp or 24 inches deep minimum measured from the back of the curb on the ramp surface.
  - **206.3** - The distance that persons with disabilities must travel to use various (transit) station elements must be minimized
  - **810.2.2** - Public entities must assure bus boarding and alighting areas comply with the required dimensions to the extent construction specs are within their control
  - **810.5.3** - Rail station platform height and rail car door height must be coordinated

ADA Update

- Summary
  - Basically, not much has changed from „old" ADAAG to „new ADASTF"
    - Tightening up of "equivalent facilitation" and "structural impracticability"
    - Confirmation of new design for detectable warnings
  - Biggest changes will likely be with adoption of PROWAG – 1-2 years
    - 48" minimum width of accessible route
    - Accessible pedestrian signals (audible & tactile feature)

PROWAG Concepts

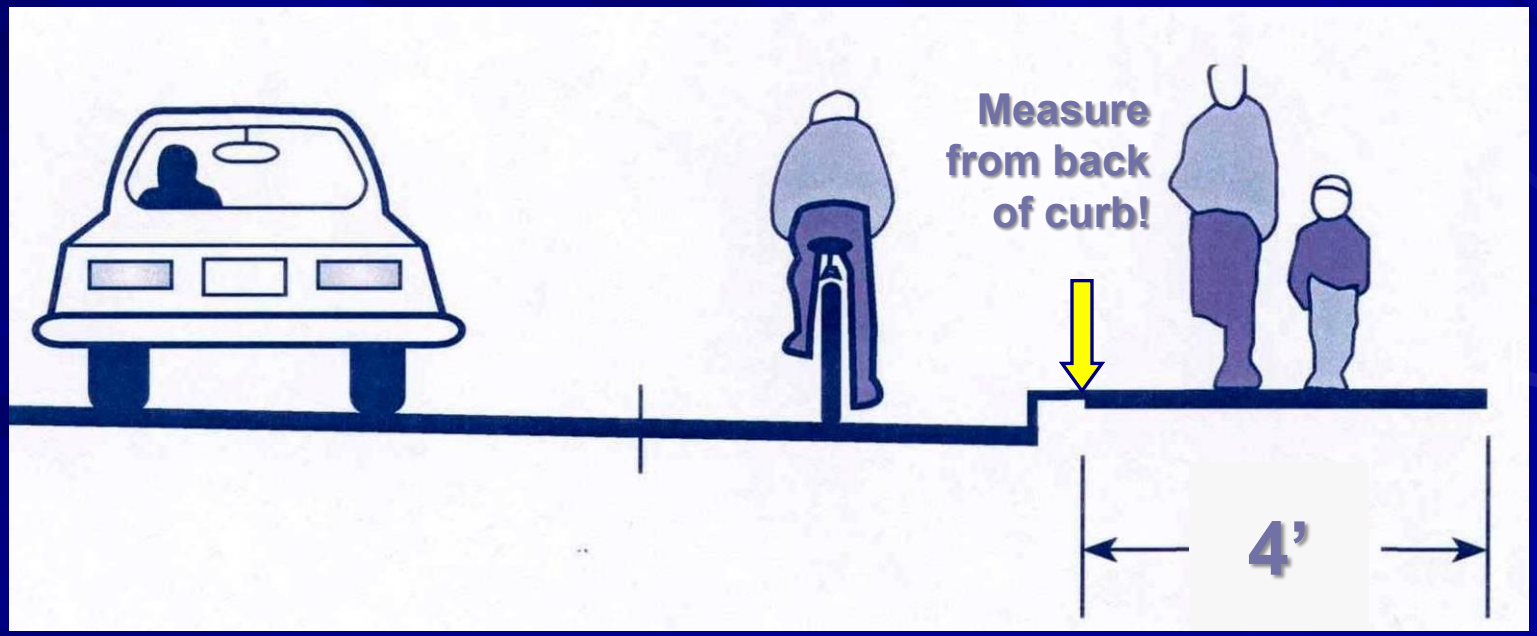
Things to look forward to

Things to plan for

Pedestrian Access Route (PAR)

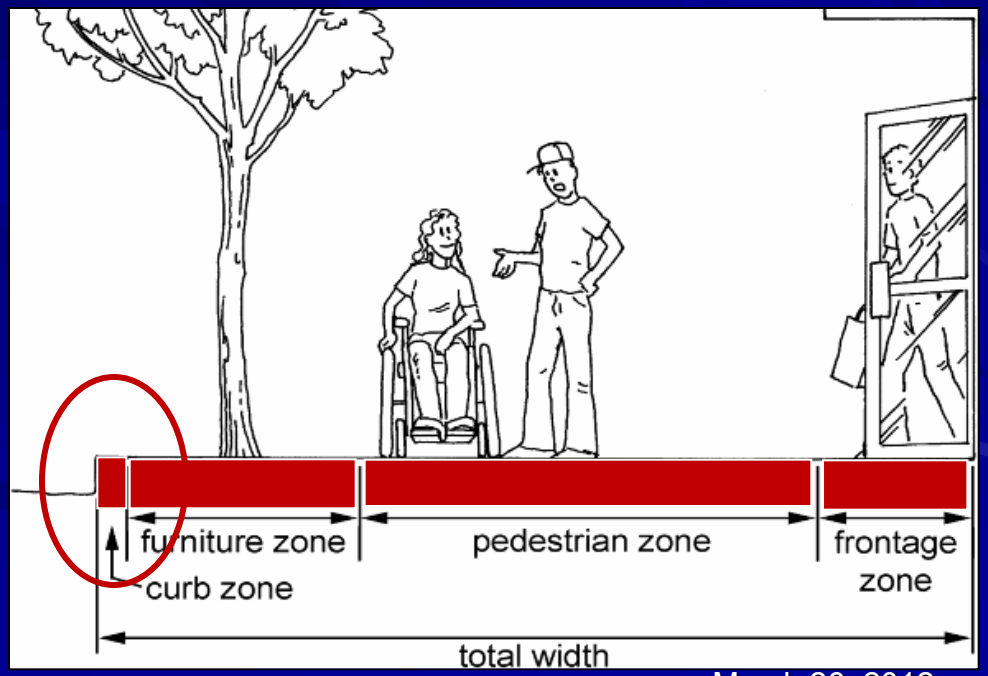
R302.3 Continuous Width

- The minimum continuous and unobstructed clear width of a pedestrian access route shall be 4 ft, exclusive of the width of the curb

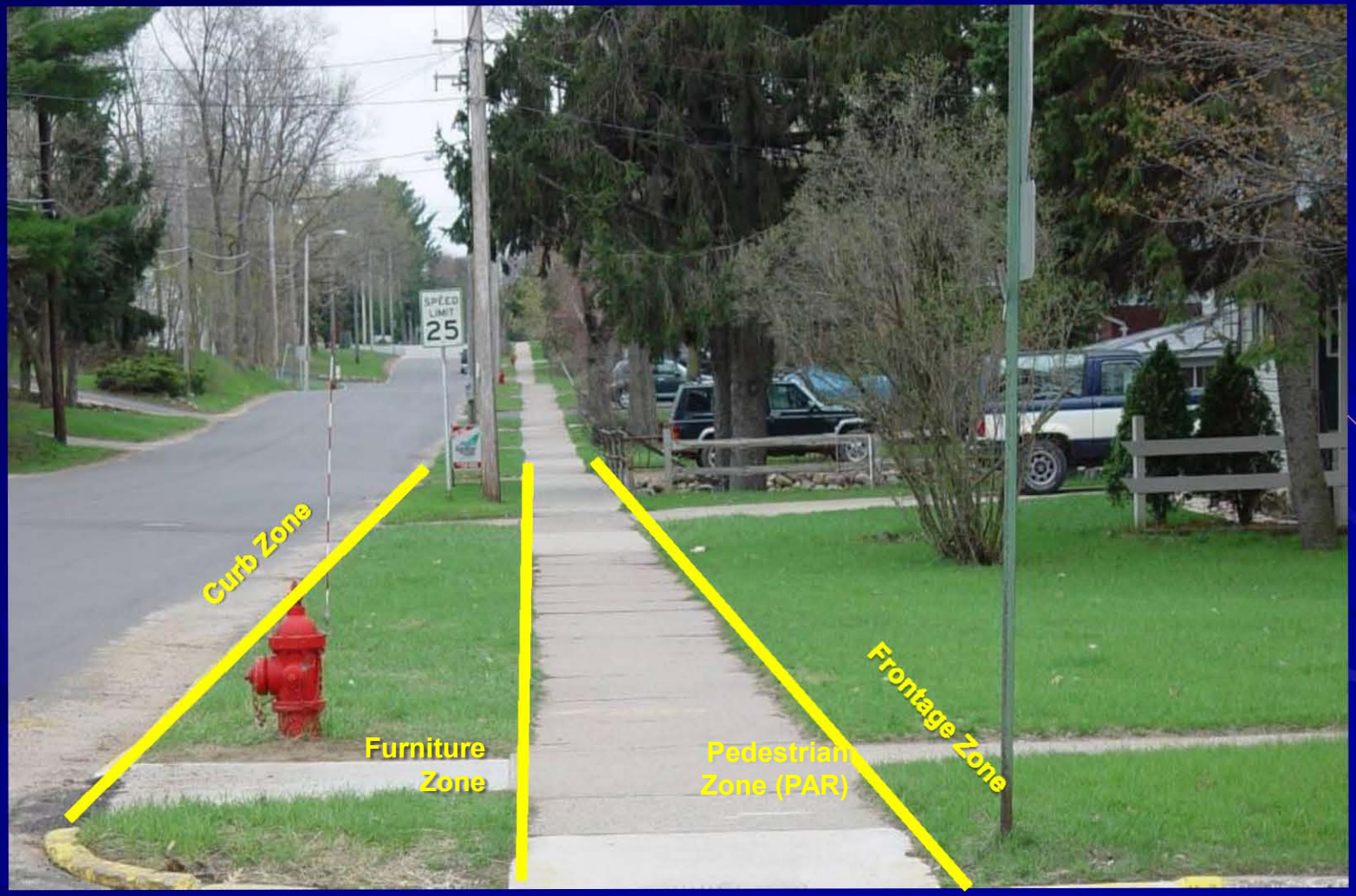


The Sidewalk „Zone" System

- Curb Zone
- Furniture Zone
- Pedestrian Zone (PAR)
- Frontage Zone



Zone System: Residential



Zone System: Commercial

A difference between AR & PAR!

For sidewalks within the public right of way . . .

Sidewalk grade – **ADASTF** vs. **PROWAG**

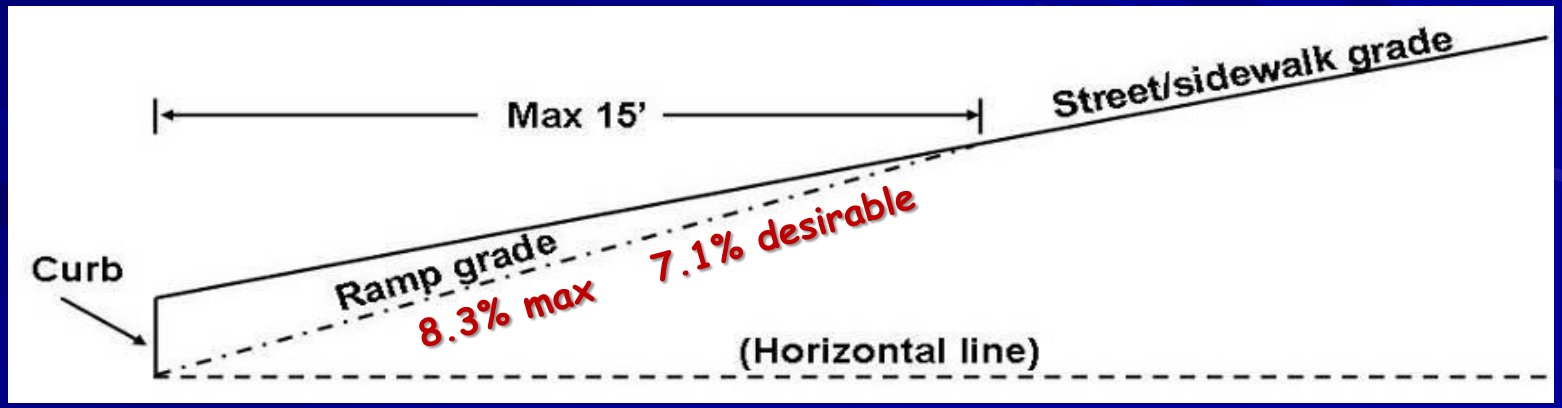
- ADASTF: Provide accessible route (AR)
- PROWAG: Match roadway grade (PAR)

ADASTF

PROWAG

Curb Ramp Grade
R304

- Least slope possible is preferred
- Maximum grade – 8.3%
- Recommended maximum grade to allow for construction tolerance – 7.1%
- Exception: when “chasing grade,” ramp length need not exceed 15‟, but slope must be uniform



Accessible Pedestrian Signals
MUTCD 4E-09

- For pedestrians with vision impairments
- Used in conjunction with pedestrian signal timing
- Add “non-visual” information:
  - Tactile features
  - Audible tones
  - Vibrating surfaces
  - Speech messages
- Must indicate which crossing is served by each device

Speakers

Tactile Arrows

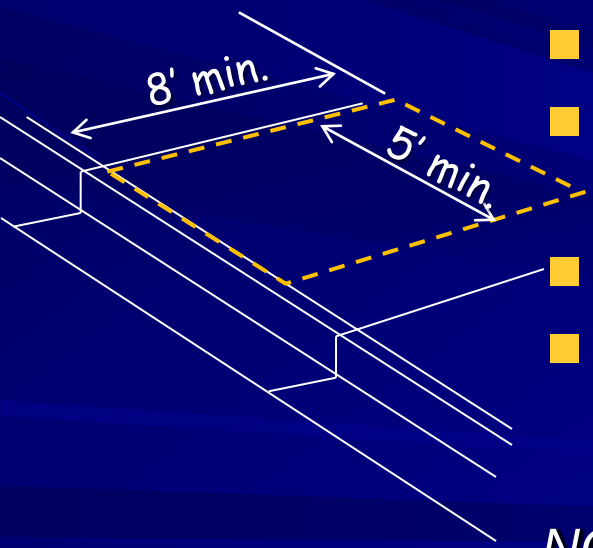
APS Location

Good placement of APSs

Not-so-good placement

Bus Stops

- ***If provided*** – Boarding & Alighting area:
  - Place for bus lift/ramp to deploy
  - "Firm, stable and slip-resistant" surface (ADAS & PROWAG)
  - "Firm and stable" surface (ADASTF)
  - Must connect to streets, sidewalks, etc
    - Sidewalk, curb ramps, etc.
  - 5' min. width – parallel to roadway
  - 8' min. depth – perpendicular to roadway



NOTE: *If low-floor, ramp-equipped bus is used, the B&A area should be raised (curb height).*

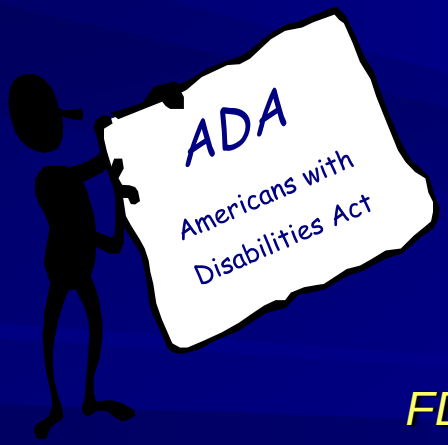
Alternate PARs

- R205 specifies that the alternate pedestrian access route shall be:
  - Provided on the same side of the street as the disrupted route, to the maximum extent feasible
  - Where exposed to adjacent construction, traffic or other hazards, shall be protected with a *pedestrian barricade* or *channelization device*
    - Continuous, stable, non-flexible
    - Consist of features identified in the ***MUTCD*** Chapter 6F

- ***Plastic tape is not acceptable!!!***
- ***Rows of barrels and/or cones is not acceptable… unless they are connected by a continuous 'detectable' edge***

Update on the ADA & Transportation Facilities

Thank You!



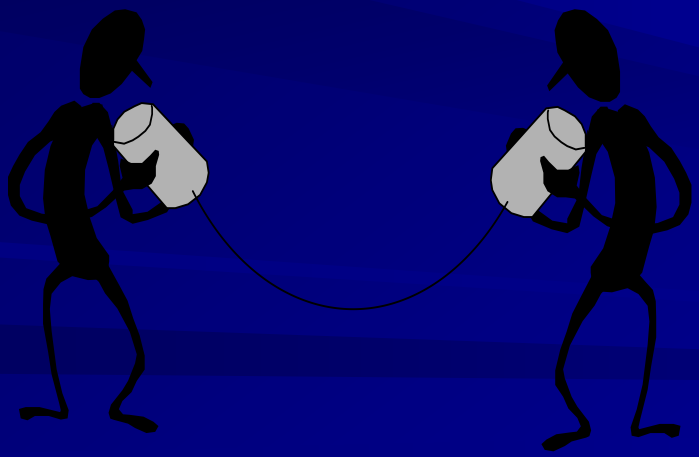
Questions?

Comments?

FDOT ADA Coordinator - Dean Perkins
850-414-4359
dean.perkins@dot.state.fl.us


Very good! Measure before you build (Identity withheld)

Contact us...



Dean Perkins, Architect

ADA Coordinator

850-414-4359

dean.perkins@dot.state.fl.us

or

Your ADA Coordinator(s)

Thank You!

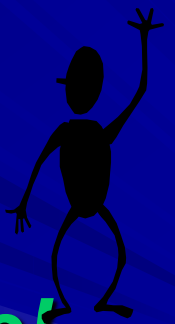
Merci!

Arigato!

Dhanya Vaad!

Xie Xie!

Gracias!



Shokran!

Danke!

LIVE LONG AND PROSPER!


Anna George
What WERE they thinking!?!

Drainage

Greenbook Drainage Task Team Results

The drainage task team was formed as a result of the Greenbook Committee Meeting in March 2011. The members of the Greenbook committee volunteered, or were volunteered by a member of the Greenbook committee to participate in the task team. The drainage task team members are:

Jennifer Green, P.E. – FDOT
Andy Tilton – Johnson Engineering
Alex Barrios – Miami Dade County
Fred Schneider – Lake County
Jim Hunt – City of Orlando
Ken Todd – Palm Beach County
Omelio Fernandez – Palm Beach County

The drainage task team decided to survey cities and counties to determine what criteria was presently being used for design. The team sent a survey to the local agency contacts registered in the FDOT Contact Mailer, the League of Cities and FACERS. After looking at the responses, counties that had not replied were contacted directly by a member of the committee and were encouraged to complete the survey. 44.8% of Counties and 11.6% of Cities responded to the survey.

The current Greenbook guidance, FDOT Drainage Manual policy, AASHTO policy and survey responses were reviewed by the committee and the minimum criteria for each item was established and summarized on the attached table. The committee met monthy, 2 hours each month, for 8 months to complete this task.

Sample email sent to cities and counties:

The Florida Department of Transportation is establishing minimum standards and criteria for drainage design in the Florida Greenbook. ***Section 334.044, F.S.****, sets forth the powers and duties of the Department of Transportation to develop and adopt uniform minimum standards and criteria for the design, construction, maintenance, and operation of public roads.*

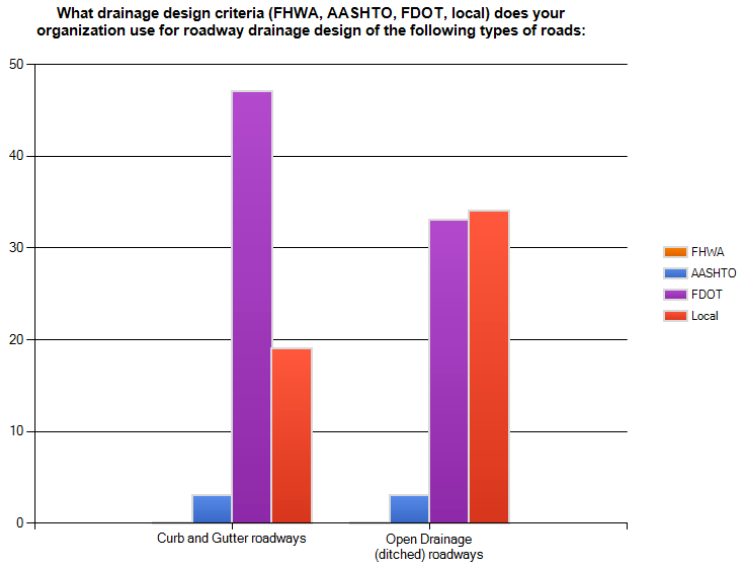
Currently the Florida Greenbook provides limited guidance for drainage design and a task team has been formed to establish minimum standards and criteria for drainage design.

Below is a link to a survey to determine which standards your agency is utilizing for drainage design. Your responses will be used to establish the policies published in the Greenbook. The questions in the survey are specific to Drainage Design, please forward the survey to the appropriate member of your agency familiar with this criteria.

http://www.surveymonkey.com/s/ZKPT7ZY

Please respond by Friday, September 2, 2011.

Results:



FDOT criteria are used most often for closed drainage system designs.

Local and FDOT criteria are equally used for open drainage systems.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Open Channel	Chapter 3 Geometric Design Page 3-17 *Shoulders should be provided on all streets and highways incorporating open drainage.* Chapter 4 Roadside Design Page 4-6 *Proper drainage of the pavement, shoulders, median, and roadsides is important for maintaining a safe street or highway. Techniques utilized for providing drainage should result in safe vehicle operation on or off the roadway.*	2.2 Design Frequency TYPE CHANNEL / FREQUENCY Roadside, Median, and Interceptor ditches or swales: 10-year Outfall ditches: 25-year Canals: 25-year Temporary roadside and median ditches or swales: 2-year Temporary Outfalls and Canals: 5-year	**10.2.3 Roadside Channels** The following criteria apply to the design of roadside channels: • Roadside channels should be designed to collect and convey the peak flow from no less than a 10 percent annual chance flood for most highway functional classifications. Roadside channels along local highways and city streets may be designed to a lesser standard, as determined by the highway agency, if so desired by local authorities. • If a portion of a roadside channel serves as the outlet for a cross drain, the design peak flows used for cross drain should also be used for the design of the roadside channel. Any side drain (driveway) culverts along a segment of the roadside channel should also be designed to convey the higher design peak flows. Overtopping of the drives at a lesser design frequency may be allowed to accommodate local conditions. • Roadside channels should be designed to have a conveyance capacity that is sufficient to ensure that they cause no increase in depth or frequency of flooding to insurable buildings on adjacent properties outside the right-of-way.	4 (4-Lane Roads) 10 (2-Lane Roads) 16 (Local Roads) 22 (Unpaved)	18.0% 25 Year 47.5% 10 Year 14.8% 5 Year 9.8% 3 Year 6.6% N/A 3.3% Other 10.0% 25 Year 55.0% 10 year 21.7% 5 year 10.0% 3 year 1.7% N/A 1.7% Other 9.1% 25 Year 52.7% 10 year 20.0% 5 year 14.5% 3 year 3.6% Other 7.1% 25 Year 71.4% 10 year 21.4% 5 year 0.0% 3 year	Shall 5yr all road types Should consider 10yr frequency for major roadway
		2.3 Hydrologic Analysis: 1. A frequency analysis of observed (gage) data shall be used when available. If insufficient or no observed data is available, one of the procedures below shall be used as appropriate. However, the procedures below shall be calibrated to the extent practical with available observed data for the drainage basin, or nearby similar drainage basins. • Regional or local regression equation developed by the USGS. • 2. Rational Equation for drainage areas up to 600 acres. • 3. For outfalls from stormwater management facilities, the method used for the design of the stormwater management facility may be used. See Chapter 5 for hydrologic methods that may be used for the design of stormwater management facilities. 2. *For regulated or controlled canals, hydrologic data shall be requested from* the controlling entity. Prior to use for design, this data shall be verified to the extent practical.	**9.3.3 Peak Flow Analyses** The peak runoff rate is generally adequate for designing conveyance systems (e.g., culverts, storm drains, open channels). If the design must include storage with flood routing (e.g., storage basins, complex conveyance networks), a flood hydrograph is usually required. Although the development of runoff hydrographs (typically more complex than estimating peak runoff rates) is often accomplished using software, some methods are adaptable to nomographs or other desktop procedures. There are various methodologies to determine the peak flows from gaged or ungaged watersheds. Peak flow values should be estimated using the following acceptable methods: • Gaged Site Methods (see Section 9.3.3.1) + Flow Distribution (log-Pearson Type III) + Rainfall Distribution (Unit Hydrographs) • Ungaged Site Methods (see Section 9.3.3.2) + Regression analysis + Rational and Modified Rational + NRCS Curve Number method			FDOT
		2.4 Hydraulic Analysis: The Manning's Equation shall be used for the design of open channels. Mannings n values are provided in Table 2.1.	**Chapter 9 Hydrology** & **10.4.1 General** In this section, the two methods most commonly used to analyze open channel flow regimes are briefly presented: single-section analysis (Section 10.4.2) and step backwater method (Section 10.4.3). The single-section analysis method is a simple application of Manning's equation to determine tailwater rating curves for culverts, or to analyze other situations in that uniform or nearly uniform flow conditions exist. A second method, the step-backwater method, is used to compute the complete water surface profile in a stream reach to evaluate the unrestricted water surface elevations for bridge hydraulic design, or to analyze other gradually varied flow problems in open channels			Reference to AASHTO mannings n value table.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Open Channel		2.4.2 For ditches where positive flow conditions are required a minimum physical slope of 0.0005 ft/ft shall be used.	**10.2.3 Roadside Channels** • Where possible, roadside channels should be designed to have self-cleaning velocities and to avoid standing water in the roadway right-of-way.			Where possible, roadside channels should be designed to have self-cleaning velocities and to avoid standing water in the roadway right-of-way.
	Chapter 4 Roadside Design Page 4-5 *Drainage swales may be protected from hazardous scouring (alteration of safe ditch contour) by the appropriate vegetation. Grass, vines, or other plants can be beneficial in stabilizing embankments to prevent erosion of material onto adjacent roadways. The appropriate use of grass or shrubbery can also aid in retarding runoff in the vicinity of the roadway, thus benefiting the overall drainage pattern*	2.4.3 Channel Linings and velocities Based on Research and FHWA recommendations.	**10.2.3 Roadside Channels** • Flexible channel linings, where required, should be designed according to the method of allowable tractive force. • When required, permanent roadside ditch linings should be designed to protect the channel and remain stable during passage of a 10 percent annual chance peak flood flow. Temporary channel linings should be designed for no less than the 50 percent annual chance peak flood flow. • Where possible, roadside channels should be designed to have self-cleaning velocities and to avoid standing water in the roadway right-of-way.			FDOT manual table of maximums.
		2.5 Construction and Maintenance Considerations: The design of an open channel shall be consistent with the standard construction and maintenance practices of the Department. Standard ditch linings are detailed in the Standard Index drawings. In the event the standard index drawings are not suitable for a specific project need, a detailed design shall be developed. This information must be specified in the design documents. Due to their minimal silt tolerance, Vee bottom ditches should be avoided where practical. Ditches, outfalls, retention/detention areas, and other drainage related features must be provided with berms and other physical access devices that facilitate maintenance activities. Consideration shall be given to future expansion of the facilities and to possible increased maintenance requirements. Absolute minimum values should only be used in extremely stable areas, in areas requiring infrequent maintenance, or in areas where existing physical constraints require their use. Berms should be based at the narrowest point; right-of-way should be reasonably uniform.	**10.3 GENERAL CHANNEL DESIGN CONSIDERATIONS** • The type and frequency of maintenance that may be required during the life of drainage channels should be considered during their design, and allowances should be made for the access of maintenance equipment.			AASHTO The type and frequency of maintenance that may be required during the life of drainage channels should be considered during their design, and allowances should be made for the access of maintenance equipment.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Open Channel	Chapter 3 Geometric Design Page 3-23 *The design of the roadway must also provide for adequate drainage of the roadway. Drainage swales within the clear zone should be gently rounded and free of protruding drainage discontinuities. Where large volumes of water must be carried, the approach should be to provide wide, rather than deep drainage channels. Side slopes and drainage swales that lie within the clear zone should be free of protruding drainage structures.*	2.6 Safety Clear zone requirements, etc. refers to PPM	**10.2.3 Roadside Channels** • When possible, roadside channels should be located so that the peak water surface elevation during passage of the design flow is outside the clear zone, unless a roadside barrier is provided. **10.3 GENERAL CHANNEL DESIGN CONSIDERATIONS** • The safety and welfare of highway users (and of the owners and occupants of adjacent properties) should be an important consideration in the selection of cross-sectional geometry of drainage channels.			When possible, roadside channels should be located so that the peak water surface elevation during passage of the design flow is outside the clear zone, unless a roadside barrier is provided. The safety and welfare of highway users (and of the owners and occupants of adjacent properties) should be an important consideration in the selection of cross-sectional geometry of drainage channels.
		2.7 Documentation Requirements Design documentation for open channels shall include the hydrologic analysis and the hydraulic analysis, including analysis of channel lining requirements.	**Volume 2 – 4.3.8.5 Storm Drains** The following items shall be included in the documentation file: • computations for drainage areas, inlets, and pipes storm drains, including hydraulic grade lines; • copies of the standard computation sheets given in Volume Two, Chapter 13 “Storm Drainage Systems”; • complete drainage area map; • design frequency; • information concerning outfalls, existing storm drains, and other design considerations; and • a schematic indicating storm drain system layout.			FDOT Design documentation for open channels shall include the hydrologic analysis and the hydraulic analysis, including analysis of channel lining requirements.
Storm Drain Hydrology and Hydraulics		3.2 Pipe Materials (See Optional Materials)	None refer to **11.4.1 Culvert Shape and Material Selection**			Shall for federal funds Refer to FHWA memo regarding optional materials and federal funds and incorporate FDOT Chapter 6 (optional materials) by reference

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Storm Drain Hydrology and Hydraulics	Chapter 3 Geometric Design Page 3-25 *Curbs may be used to provide drainage control and improve the delineation of the roadway.* Chapter 4 Roadside Design Page 4-6 *Proper drainage of the pavement, shoulders, median, and roadsides is important for maintaining a safe street or highway. Techniques utilized for providing drainage should result in safe vehicle operation on or off the roadway.*	3.3 Design Frequency TYPE STORM DRAIN / FREQUENCY General design: 3-year General design work that involves replacement of a roadside ditch with a pipe system by extending side drain pipes.: 10-year General design on work to Interstate Facilities: 10-year Interstate Facilities for sag vertical curves which have no outlet other than a storm drain system, and for the outlet of systems requiring pumping stations: 50-year Site-specific factors may warrant the use of an atypical design frequency. Designs based on frequencies other than listed above shall be supported by a risk assessment or analysis, as appropriate. Any increase over pre-development stages shall not significantly change land use values, unless flood rights are acquired. The acquisition of flood rights shall be based on a risk analysis to select the least total expected cost design.	**13.3.2 Design Frequency** The design storm frequency for pavement drainage is the normally the10-yr return period for surface drainage. Other components of the storm drain system may use other frequencies. For example, a 10-yr return period may be selected to limit spread on grade and a 50-yr return period may be used at a sag location to design the storm drain or pumping system. The following applies to storm drainage systems: • If a storm drain provides the outlet for a cross drain, then the design frequency of the cross drain should be used for the storm drainage system downstream from the cross drain inlet. • If local drainage facilities and practices have provided storm drains of lesser standard, to which the highway system should connect, provide special consideration to whether it is realistic to design the highway system to a higher standard than available outlets. For major sag points on Interstate, United States and State highways, the design frequency should be 50 years where water can pond 2 ft deep or more on the travel lane and where projected 2-way ADT is greater than 5000.	3 (4-Lane Roads) 9 (2-Lane Roads) 15 (Local Roads) 30 (Hydraulic Grade Line)	9.7% 25 Year 54.8% 10 Year 11.3% 5 Year 11.3% 3 Year 8.1% N/A 4.8% Other 6.7% 25 Year 51.7% 10 year 25.0% 5 year 13.3% 3 year 1.7% N/A 1.7% Other 5.6% 25 Year 50.0% 10 year 24.1% 5 year 16.7% 3 year 3.7% Other 2.0% 50 year 25.5% 25 year 23.5% 10 year 17.6% 5 year 9.8% 3 year 13.7% N/A or None 7.8% Other	FDOT Language – 3yr rational. (shall)
		3.4 Design Tailwater For the determination of hydraulic gradient and the sizing of storm drain conduits a tailwater elevation, which can be reasonably expected to occur coincident with the design storm event shall be used. Standard design tailwater conditions for the design of storm drain systems are as follows: Crown of pipe at the outlet, or if higher: • Lakes ---------- Normal High Water • Rivers and Streams -- Normal High Water • Stormwater Ponds --- Peak stage in the pond during the storm drain design event. • Tidal Bays ---------- - Mean High Tide • Ditches: o Free flowing ---------- Normal depth flow in the ditch at the storm drain outlet for the storm drain design storm event. (May differ from ditch design storm event.) o Downstream control-- The higher of: the stage due to free flow conditions (described above) or, the maximum stage at the storm drain outlet due to backwater from the downstream control using flows from the storm drain design storm event. • Existing Systems ----- Elevation of hydraulic grade line of the system at the connection for the design storm event • French Drains --------- Design Head over the outlet control structure • Closed Basin ---------- Varies, depending on site specific conditions • Regulated Canals ---- Agency regulated control elevation	**Volume 2 – 13.13.3 Tailwater** For most design applications where the flow is subcritical, the tailwater will either be above the crown of the outlet or can be considered to be between the crown and critical depth. To determine the EGL, begin with either the tailwater elevation or $(d_c + D)/2$, whichever is higher, add the velocity head for full flow and proceed upstream to adding appropriate losses (e.g., exit, friction, junction, bend, entrance). An exception to the above procedure is an outfall with low tailwater. In this case, a water surface profile calculation would be appropriate to determine the location where the water surface will either intersect the top or end of the barrel and full-flow calculations can begin. In this case, the downstream water surface elevation would be based on critical depth or the tailwater, whichever is higher.	31	50.0% Pond Control Elevation 15.4% Crown of Pipe 13.5% Existing High Water Elevation 3.8% Design High Water Elevation of the Pond 3.8% N/A 13.5% Other	AASHTO

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Storm Drain Hydrology and Hydraulics		3.5 Hydrologic Analysis Rational Method	**Vol. 1 Chapter 9 – Hydrology** **13.2.2 Hydrology** The Rational Method is the most common method in use for the design of storm drains when the momentary peak-flow rate is desired.			AASHTO
		3.5.1 Time of Concentration Minimum time of concentration is 10 minutes	**13.2.2 Hydrology** A minimum time of concentration of seven minutes is generally acceptable.			FDOT
		3.6 Hydraulic Analysis Hydraulic calculations for determining storm drain conduit sizes shall be based on open channel and pressure flow as appropriate. The Manning's equation shall be used.	**13.1.3 General Design Guidelines** A storm drain is defined as that portion of the storm drainage system that receives runoff from inlets and conveys the runoff to some point where it is then discharged into a channel, water body, or piped system. A storm drain may be a closed-conduit, open-conduit or some combination of the two. They may be designed with consideration for future development, if appropriate.			FDOT
		3.6.1 Pipe Slopes The minimum physical slope shall be that which will produce a velocity of 2.5 feet per second when the storm drain is flowing full.	**13.2.5 Storm Drains** A minimum velocity of 3 ft/s is desirable in the storm drain in order to prevent sedimentation from occurring in the pipe.			FDOT and add the note " when possible"
		3.6.2 Hydraulic gradient 1.13' below EOP when minor energy losses are not considered When minor losses are considered it is acceptable to reach the gutter elevation.	**Volume 2 – 13.13.2 Guidelines for Establishing State HGL Practices** If the hydraulic grade line does not rise above the top of any manhole or above an inlet entrance, the storm drainage system is satisfactory. Standard practice is to ensure that the HGL is below the top of the inlet for the design discharge (some states add an additional safety factor which can be up to 12 in.).	29	44.2% 1' Below Grate 21.2% 1' Below EOP 7.7% Grate Elevation/EOP 1.9% Below Roadway Base 19.2% None or N/A 5.8% Other	AASHTO
		3.6.3 Outlet Velocity When discharge exceeds 6fps, consider special channel lining or energy dissipation. For computation of outlet velocity the lowest anticipated tailwater condition for the given storm event shall be assumed.	**13.2.5 Storm Drains** Attention should be given to the storm drain outfalls to ensure that the potential for erosion is minimized.			FDOT
		3.6.4 Manning's Roughness Coefficients Standard table	**Volume 2, Chapter 9 – Hydrology** **Table 9-5. Roughness Coefficients (Manning's *n*) For Sheet Flow** Surface Description — n^1 Smooth surfaces (concrete, asphalt, gravel, bare soil) — 0.011 Fallow (no residue) — 0.05 Cultivated soils: Plant residue cover≤20% — 0.06 Plant residue cover>20% — 0.17 Grasses: Short grass prairie — 0.15 Dense grasses [2] — 0.24 Bermuda grass — 0.41 Range (natural) — 0.13 Woods:[3] Light underbrush — 0.40 Dense underbrush — 0.80 [1] *The n values are a composite of NRCS values (8) and are specific to overland and sheet flow.* [2] *Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue gamma grass and native grass mixtures.* [3] *When selecting n, consider cover to a height of approximately 1 in. This is the only part of the plant cover that will obstruct sheet flow.*			AASHTO (if desired by committee)

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Storm Drain Hydrology and Hydraulics	Chapter 3 Page 3-55 *Roadway conditions should be favorable for bicycling. This includes safe drainage grates…*	3.7 Hydraulic openings Inlets, and other hydraulic structures shall be selected/designed to satisfy hydraulic capacity, structural capacity, safety (vehicular, pedestrian, cyclist) and durability requirements. Alternate "G" (hot dipped galvanized) grates and frames shall be required when the structure is located on any barrier island, the Florida Keys, or within ½ mile of any body of brackish water containing chlorides > 2000 ppm. * Refer to the FDOT Design Standards for the hydraulic structures' dimensions.	**VOLUME 2 – 13.9 INLETS** **13.9.1 GENERAL** Inlets are drainage structures used to collect surface water through a grate, a curb opening, or a combination of both (see inlet types below) and convey it to storm drains or to culverts. This section discusses the various types of inlets used by states and recommends guidelines on the use of each type. Drainage inlets are sized and located to limit the spread of water on the roadway to allowable widths for the design storm as specified in Section 13.7.3. Grate inlets and the depression of curb opening inlets should be located outside the through traffic lanes to minimize the shifting of vehicles attempting to avoid them. All grate inlets should be bicycle safe (like grate inlet shown above) where used on roadways that allow bicycle travel.	8 (4-Lane Roads) 14 (2-Lane Roads) 20 (Local Roads) 28 (General Criteria)	75.0% FDOT 9.4% County 7.8% Local City 1.6% Both FDOT and City 1.6% FDOT w/8" wall thickness 4.7% N/A 80.3% FDOT 11.5% County 4.9% Local City 1.6% Both FDOT and City 1.6% FDOT w/8" wall thickness 75.9% FDOT 13.0% County 1.9% Both FDOT and County 5.6% Local City 1.9% Both FDOT and City 1.9% FDOT w/8" wall thickness 73.3% FDOT 13.3% County 1.7% Both FDOT and County 3.3% Local City 1.7% Both FDOT and City 1.7% FDOT Sizes w/8" wall thickness 1.7% N/A 3.3% Other	Drainage inlets are sized and located to limit the spread of water on the roadway to allowable widths for the design storm. Grate inlets and the depression of curb opening inlets should be located outside the through traffic lanes to minimize the shifting of vehicles attempting to avoid them. All grate inlets shall be bicycle safe where used on roadways that allow bicycle travel. Storm drain handbook is available as a guide.

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Storm Drain Hydrology and Hydraulics	Chapter 4 Roadside Design Page 4-6 *Drainage inlets should not be placed in a bus bay, travel, or bike lane and should not be placed in a shoulder, except at the exterior edge, when drainage restrictions are severe. Drainage inlets within the median or roadsides shall be traversable. A small area around the inlet should be paved to improve drainage and to prevent local erosion. Corner radii inlets should be avoided as they hinder pedestrians, create ponding, create maintenance problems, and complicate intersection design.*	3.7.1.1 Inlet spacing Shall consider the following 1. Inlet capacity and width of spread. 2. Movement of vehicles to and from adjacent property on turnouts. 3. Pedestrian and Bicycle Safety 4. Maximum pipe length without maintenance access (section 3.10.1) 5. Roadway Geometry 6. Hydraulic efficiency of the system 7. Potential for flooding of off-site property	**Volume 2 – 13.10.1 Location** There are a number of locations where inlets may be necessary without regard to contributing drainage area. These locations should be marked on the plans prior to any hydraulic computations regarding discharge, water spread, inlet capacity, or bypass. Examples of such locations are • Regardless of the results of the hydraulic analysis, inlets on grade should be spaced at a maximum of 300 ft for 48 in. or smaller pipes. • Inlets on grade should be spaced at a maximum of 600 ft for pipes larger than 48 in. • Inlets should be placed on the upstream side of bridge approaches. • Inlets should be placed at all low points in the gutter grade. • Inlets should be placed upstream of intersecting streets. • Inlets should be placed on the upstream side of a driveway entrance, curb-cut ramp, or pedestrian crosswalk even if the hydraulic analysis places the inlet further down grade or within the feature. • Inlets should be placed upstream of median breaks. • Inlets should be placed to capture flow from intersecting streets before it reaches the major highway. • Flanking inlets in sag vertical curves are standard practice. See Section 13.10.8. • Inlets should be placed to prevent water from sheeting across the highway (i.e., place the inlet before the superelevation transition begins). • Inlets should not be located in the path where pedestrians walk.	27	96.2% FDOT 1 73.1% FDOT 2 78.8% FDOT 3 69.2% FDOT 4 76.9% FDOT 5 76.9% FDOT 6 73.1% FDOT 7 1.9% Limit Conflicts with other Structures or Utilities 1.9% No Criteria 1.9% N/A 1.9% Other	AASTHO – Shall consider the following • Regardless of the results of the hydraulic analysis, inlets on grade should be spaced at a maximum of 300 ft for 48 in. or smaller pipes. • Inlets on grade should be spaced at a maximum of 600 ft for pipes larger than 48 in. • Inlets should be placed on the upstream side of bridge approaches. • Inlets should be placed at all low points in the gutter grade. • Inlets should be placed upstream of intersecting streets. • Inlets should be placed on the upstream side of a driveway entrance, curb-cut ramp, or pedestrian crosswalk even if the hydraulic analysis places the inlet further down grade or within the feature. • Inlets should be placed upstream of median breaks. • Inlets should be placed to capture flow from intersecting streets before it reaches the major highway. • Flanking inlets in sag vertical curves are standard practice. • Inlets should be placed to prevent water from sheeting across the highway (i.e., place the inlet before the superelevation transition begins). • Inlets should not be located in the path where pedestrians walk.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Drain Hydrology and Hydraulics		3.7.1.1 For curb inlets on a continuous grade, a maximum spacing of 300 feet shall be used unless spread calculations indicate greater spacing is acceptable. Spread standards are provided below in Section 3.9.	**Volume 2 – 13.10.1 Location** There are a number of locations where inlets may be necessary without regard to contributing drainage area. These locations should be marked on the plans prior to any hydraulic computations regarding discharge, water spread, inlet capacity, or bypass. Examples of such locations are • Regardless of the results of the hydraulic analysis, inlets on grade should be spaced at a maximum of 300 ft for 48 in. or smaller pipes. • Inlets on grade should be spaced at a maximum of 600 ft for pipes larger than 48 in.	26	2% 160' (City Ordinance) or FDOT 2% 240' Ideal 74% Use 300' or spread 2% 400' (grades 0.3% to 1.0%) & 300' (grades > 1.0%) 4% 400' max 4% 600' or spread 2% 600' (Miami Curb) or 1200' (FDOT F Type Curb) 4% N/A 6% Other	AASHTO • Regardless of the results of the hydraulic analysis, inlets on grade shall be spaced at a maximum of 300 ft for 48 in. or smaller pipes. • Inlets on grade shall be spaced at a maximum of 600 ft for pipes larger than 48 in.
Storm Drain	Chapter 3 Page 3-11 Consider surface drainage in superelevation sections.	3.7.1.1 Curb inlets shall also be placed at the critical section prior to the level section in superelevation transitions, to avoid concentrated flows across the pavement.	**Volume 2 – 13.10.1 Location** • Inlets should be placed to prevent water from sheeting across the highway (i.e., place the inlet before the superelevation transition begins).			AASHTO
		3.7.1.1 Curb inlets shall not be located within handicap drop curb locations.	Not Found			Included with AASHTO list (Included in FDOT 3.7.1.1)
		3.7.1.1 Inlets in sag vertical curves that have no outlet other than the storm drain system and do not have open throats, should have flanking inlets on one or both sides. These flanking inlets should be located to satisfy spread criteria when the sag inlet is blocked. Even with an open throat inlet, flanking inlets should be considered when the minimum gutter grade cannot be met.	**13.2.4 Inlets** Curb inlets are preferred to grate inlets at major sag locations because of their debris handling capabilities. When grate inlets are used at sag locations, assume that they are half plugged with debris and size accordingly. In locations where significant ponding may occur (e.g., underpasses, sag vertical curves in depressed sections), recommended practice is to place flanking inlets on each side of the inlet at the low point in the sag.			AASHTO (Included in FDOT 3.7.1.1)
		3.8.1 Longitudinal grade minimum 0.3%	**13.4.3.1 Longitudinal Slope** Desirable gutter grades should be greater than 0.5 percent for curbed pavements with a minimum of 0.3 percent. Minimum grades can be maintained in very flat terrain by use of a rolling profile.			FDOT Language Minimum grades can be maintained in very flat terrain by use of a rolling profile.

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Storm Drain Hydrology and Hydraulics	Chapter 5 Pavement Design Page 5-1 *Provide drainage to promote quick drying and to reduce the likelihood of hydroplaning and splashing.*	3.9 Spread The spread resulting from a rainfall intensity of 4.0 inches per hour shall be limited as follows. Typical Section Condition / Design Speed (mph) / Spread Criteria* Parking Lane or Full Width Shoulders / All / No encroachment All Other / Design speed ≤ 45 / Keep ½ of lane clear All Other / 45 < Design Speed ≤ 55 / Keep 8' of lane clear All Other / Design Speed > 55 / No encroachment * The criteria in this column applies to travel, turn, or auxiliary lanes adjacent to barrier wall or curb, in normal or super elevated sections. In addition to the above standards, for sections with a shoulder gutter, the spread resulting from a 10-year frequency storm shall not exceed 1' 3" outside the gutter in the direction toward the front slope. This distance limits the spread to the face of guardrail posts. See Figure 3-2.	**13.3.4 Allowable Water Spread** In general, the water spread for the design storm frequency should be held to the allowable width shown in Table 13-2. For storms of greater magnitude, the spread can be allowed to utilize "most" of the pavement as an open channel. For multi-laned curb and gutter, or guttered roadways with no parking, it is not practical to avoid travel-lane flooding when longitudinal grades are flat (0.2 percent to 1 percent). However, flooding should not exceed the lane adjacent to the gutter (or shoulder) for design conditions. Municipal bridges with curb and gutter should also use this criterion. For single-lane roadways, at least 8 ft of roadway should remain unflooded for design conditions. **Table 13-2. Allowable Water Spread for Roadways** Type of Facility / Allowable Water Spread Interstate / Edge of traveled way United States and State Highways, Local Roads, Ramps / Greater of 8 ft or shoulder width	5 (4-Lane Roads) 11 (2-Lane Roads) 17 (Local Roads) 23 (Unpaved)	1.6% EOP 34.4% No Encroachment 36.1% ½ Outside Travel Lane 9.8% Crown of Roadway 1.6% 1" Above Crown 6.6% N/A 9.8% Other 1.6% EOP 34.4% No Encroachment 31.1% ½ Outside Travel Lane 18.0% Crown of Roadway 1.6% 1" Above Crown 13.1% Other 1.9% EOP 40.4% No Encroachment 1.9% 6" 19.2% ½ Outside Travel Lane 26.9% Crown of Roadway 1.9% 1" Above Crown 7.7% Other 60.0% No Encroachment 26.7% ½ Outside Travel Lane 0.0% Crown of Roadway 6.7% 1" Above Crown 6.7% Other	FDOT Language
		3.10 Construction and Maintenance Design standards and specifications. Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair.	**22.4.1 Maintenance Problems** The maintenance involved in storm drainage systems is the removal of any sand, silt, or debris and the maintenance of a soil-tight seal at each pipe joint. There are occasions where abrasive material is present in the water (or some chemical that has a deleterious effect on the pipe) that causes the pipe material to be worn away. This necessitates relining the pipe to preserve its integrity. The entire storm drainage system should be inspected every 10 years. Components that are more prone to sediment and debris deposition (e.g., catch basins, bubble chambers, inverted siphons) should be inspected yearly.			Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Storm Drain Hydrology and Hydraulics		3.10.1 Pipe size and length 18" minimum diameter The maximum pipe lengths without maintenance access structures are as follows: Pipes without French Drains: 18" pipe 300 feet 24" to 36" pipe 400 feet 42" and larger and all box culverts 500 feet French Drains that have access through only one end: 18" to 30" pipe 150 feet 36" and larger pipe 200 feet French Drains that have access through both ends: 18" to 30" pipe 300 feet 36" and larger pipe 400 feet	**13.2.10.2 Spacing** The spacing of access holes should be in accordance with Table 13-1. **Table 13-1. Access Hole Spacing** Size of Pipe (in.) / Maximum Distance (ft) 12–24 / 300 27–36 / 400 42–54 / 500 ≥60 / 1000 **13.12.4 State Practices** The following documents state practices (not related to the hydraulic analysis) for the underground portion of a storm drainage system. **Minimum Pipe Size** The typical minimum pipe size is 18 in. In special cases, a 12-in. pipe may be used where it is not possible/practical to provide an 18-in. pipe. Justification for a 12-in. pipe should be documented. Pipe sizes increase in 3-in. increments.	2 6 (4-Lane Roads) 12 (2-Lane Roads) 18 (Local Roads)	Shown On First Page 9.4% 12" 48.4% 15" 31.3% 18" 3.1% 24" 6.3% N/A 1.6% Other 15.0% 12" 51.7% 15" 31.7% 18" 0.0% 24" 1.7% Other 18.5% 12" 53.7% 15" 27.8% 18" 0.0% 24"	Minimum 15" FDOT minimums (Department had issue with 15" hubcaps blocking systems which is reason for 18" minimum) Access spacing The maximum pipe lengths without maintenance access structures Pipes without French Drains: 18" pipe 300 feet 24" to 36" pipe 400 feet 42" and larger and all box culverts 500 feet French Drains that have access through only one end: 18" to 30" pipe 150 feet 36" and larger pipe 200 feet French Drains that have access through both ends: 18" to 30" pipe 300 feet 36" and larger pipe 400 feet

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Storm Drain Hydrology and Hydraulics		3.10.2 Minimum Clearances 1. The minimum clearance between the outside crown of a pipe and the gutter elevation at the inlet shall be in accordance with standard index drawing requirements for the specified inlet. If this cannot be achieved, a special detail shall be provided in the plans. 2. Minimum cover between the bottom of the base and the outside crown of the storm drain shall be provided in accordance with Index 205, Roadway and Traffic Design Standards. 3. Utility Clearances: • When a utility crosses a storm drain alignment, the recommended minimum design clearance between the outside of the pipe and the outside of the conflict should be 0.5 foot if the utility has been accurately located at the point of conflict. If the utility has been approximately located, the minimum design clearance should be 1 foot. Actual clearances can vary from these design values, but electrical transmission lines or gas mains shall never come into direct contact with the storm drain. • Storm drain lines shall be located to not disturb existing utilities to the extent practical. If a utility conflict occurs, the Utilities Section shall be contacted to review potential problems and feasible solutions. • When a sanitary line or other utility must pass through a manhole, minimum clearances in accordance with Index 307 shall be provided. The head loss caused by an obstruction shall be accounted for in the computation of the design hydraulic grade line. (Note: Gas mains shall not pass through inlet and manhole structures.) 4. Storm drain systems that cross railroad tracks have special below-track clearance requirements and must use special strength pipe. See Standard Index No. 280 for railroad company design requirements. * Refer to the FDOT Plans Preparation Manual (PPM), Volume 1, Section 2.6, Table 2.6.3 “Criteria for Grade Datum” for the required minimum clearances between the bottom of the roadway base and the high water table elevation: **Table 2.6.3 Criteria for Grade Datum** **CLEARANCE FOR THE ROADWAY BASE COURSE ABOVE THE BASE CLEARANCE WATER ELEVATION** **TYPE FACILITY** / **REQUIRED CLEARANCE** Freeways and Rural Multilane Mainline — 3 ft. Ramps (proper) — 2 ft.[1] Low Point on Ramps at Cross Roads — 1 ft.[1] Rural Two-lane with Design Year ADT Greater than 1500 VPD — 2 ft.[1] All Other Facilities Including Urban — 1 ft.[1] 1. This clearance requires a reduction in the design resilient modulus (see the ***Flexible Pavement Design Manual***). Notify the Pavement Design Engineer that the clearance is less than 3 feet.	**13.2.5 Spacing** Where feasible, the storm drains should be designed to avoid existing utilities. **13.12.4 State Practices** The following documents state practices (not related to the hydraulic analysis) for the underground portion of a storm drainage system. **Minimum Cover and Clearance** A minimum cover of 1 ft should be provided between the top of pipe and the top of subgrade. A minimum clearance of 1 ft should be provided between storm drainage pipes and other underground facilities (e.g., sanitary sewers).	32	0.0% 5’ 5.5% 3’ 7.3% 2’ 3.6% 1.5’ 36.4% 1’ 1.8% 0.5’ 36.4% No Requirement 1.8% N/A 7.3% Other	Utility: (Check DEP criteria related to utilities - FAC) And note that utility companies may have different requirements • When a utility crosses a storm drain alignment, the recommended minimum design clearance between the outside of the pipe and the outside of the conflict should be 0.5 foot if the utility has been accurately located at the point of conflict. If the utility has been approximately located, the minimum design clearance should be 1 foot. Actual clearances can vary from these design values, but electrical transmission lines or gas mains shall never come into direct contact with the storm drain. • Storm drain lines shall be located to not disturb existing utilities to the extent practical. If a utility conflict occurs, the Utilities Section shall be contacted to review potential problems and feasible solutions. Table 2.6.3 – engineering evaluation if less than 1’

<table>
<tr><th></th><th>Current Greenbook</th><th>FDOT Drainage Manual</th><th>AASHTO (AASHTO Drainage Manual – Volume 1)</th><th>Survey #</th><th>Survey Results</th><th>Recommendation</th></tr>
<tr><td>Storm Drain Hydrology and Hydraulics</td><td></td><td>3.12 Documentation Requirements
Tabulation form and supporting calculations</td><td>Chapter 4 Documentation
4.2.3.3 Storm Drainage Systems
The hydraulic design of storm drainage systems will be based on Volume One, Chapter 13 “Storm Drainage Systems.” The following items should be included in the Road Design documentation for storm drainage systems:
Computations for drainage areas, inlets, and storm drains, including hydraulic gradelines.
Copies of the standard computation sheets.
A complete drainage area map.
Design frequency.
Information concerning outfalls, existing storm drains, and other design considerations.
A schematic illustrating the storm drainage system layout.
13.2.8 Property Development Drainage Policy
Developers must provide drainage design plans, analysis, and flood hazard assessment.</td><td></td><td></td><td></td></tr>
<tr><td>Cross Drain Hydrology and Hydraulics</td><td>Greenbook refers to Drainage Manual</td><td>4.2 Cross Drain Hydraulics
Design in accordance with 23 CFR 650 and the National Flood Insurance Program</td><td>Chapter 9 Hydrology &

11.1 INTRODUCTION
This chapter provides guidance on culvert design criteria (Section 11.3), design features (Section 11.4) and related designs (Section 11.5). An overview of the hydraulic design of culverts is provided in the AASHTO Highway Drainage Guidelines, Chapter 4 (1) and detailed information is available in FHWA Hydraulic Design Series No. 5 (HDS-5) (4).</td><td></td><td></td><td>FDOT</td></tr>
<tr><td></td><td>Greenbook refers to Drainage Manual</td><td>4.3 Design Frequency<table><tr><th>FACILITY</th><th>FREQUENCY</th></tr><tr><td>Mainline Interstate</td><td>50 years</td></tr><tr><td>High Use or Essential:
Projected 20 year ADT > 1500, or required for emergency access or evacuation.</td><td>50 years</td></tr><tr><td>Other:
Projected 20 year ADT < 1500, and not required for emergency access or evacuation.</td><td>25 years</td></tr><tr><td>Temporary Detours: Interstate and High Use/Essential</td><td>10 years</td></tr><tr><td>Temporary Detours: Other</td><td>5 years</td></tr><tr><td>Roadside Ditch Culverts</td><td>10 years</td></tr></table>Design frequencies may be higher when justified by risk assessment or risk analysis.

Note: The flood frequencies used for scour analysis differ. See Section 4.9.2.</td><td>11.3.2.1 Design Flood Frequency
The recommended minimum design flood frequency for culverts is shown in Table 11-1. The minimum flood frequency used to design the culvert can be adjusted based on
a risk assessment or analysis to justify the flood frequencies greater or lesser than the minimum flood frequencies listed below (see Volume Two, Chapter 17 “Bridges”); and
the culvert being located in a National Flood Insurance Program mapped floodplain., see Volume Two, Chapter 2 “Permits and Certifications.”
Table 11-1. Recommended Minimum Design Flood Frequency<table><tr><th>Roadway Classification</th><th>Exceedence Probability (%)</th><th>Return Period (Year)</th></tr><tr><td>Interstate and Freeways</td><td>2%</td><td>50</td></tr><tr><td>US and State Highways</td><td>2%</td><td>50</td></tr><tr><td>Local Road and Streets, ADT > 3,000 VPD</td><td>4%</td><td>25</td></tr><tr><td>Local Road and Streets, ADT = < 3,000 VPD</td><td>10%</td><td>10</td></tr><tr><td>Local Road System *</td><td>20%-10%</td><td>5–10</td></tr></table>*At the discretion of the designer, based on Risk Assessment and ADT</td><td></td><td></td><td>AASHTO</td></tr>
</table>

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Cross Drain Hydrology and Hydraulics		4.4 Backwater The design of cross drain openings shall be consistent with backwater conditions as follows: 1. Backwater created by the structure shall be consistent with Flood Insurance Study requirements adopted by the local community in accordance with the National Flood Insurance Program and FEMA guidelines. 2. Any increase in backwater shall not significantly change land use values, unless flood rights are acquired. The acquisition of flood rights shall be based on a risk analysis to select the least total expected cost design. 3. The backwater for design frequency conditions shall be kept at or below the travel lanes.	**11.3.2.2 Allowable Headwater** Allowable headwater is the depth of water that can be ponded at the upstream end of the culvert during the design flood. The allowable headwater for the design frequency should • have a level of inundation that is tolerable to upstream property and roadway for the design discharge; • consider a duration or inundation that is tolerable to the upstream vegetation to avoid crop damage; and • be lower than the upstream shoulder edge elevation at the lowest point of the roadway within the drainage basin. If the allowable headwater depth to culvert height ratio (HW/D) is established to be greater than 1.5, the inlet of the culvert will be submerged. Under this condition, the hydraulics designer should provide an end treatment to mitigate buoyancy.			AASHTO Exception shall be documented
		4.5 Tailwater For the sizing of cross drains and the determination of headwater and backwater elevations, the highest tailwater elevation which can be reasonably expected to occur coincident with the design storm event shall be used	**11.3.2.5 Tailwater Relationship (Channel)** Evaluate the hydraulic conditions of the downstream channel to determine a tailwater depth for a range of discharges, which includes the review discharge (see Volume Two, Chapter 10 “Channels”). A single cross section analysis is acceptable for most culverts. Calculate backwater curves at sensitive locations. Use the following control depths at the culvert outlet if higher than the tailwater depth: • critical depth and the approximate hydraulic gradeline, • headwater elevation of a downstream structure. **11.3.2.6 Tailwater Relationship (Confluence or Large Water Body)** Where the culvert is located on a tributary that joins with a larger body of water immediately downstream • use the downstream high-water elevation that has the same frequency as the design flood if events are known to occur concurrently (statistically dependent), and • if statistically independent, use a likely combination resulting in the greater tailwater depth (worst-case scenario).			FDOT For the sizing of cross drains and the determination of headwater and backwater elevations, the highest tailwater elevation which can be reasonably expected to occur coincident with the design storm event shall be used
	Greenbook refers to Drainage Manual	4.6.1 Vertical Clearance Moved to PPM	**17.3.3 Clearance** For navigational channels, a vertical and horizontal clearance conforming to Federal, or state, or both, requirements should be established based on normally expected flows during the navigation season, see Volume Two, Chapter 2 “Permits and Certifications.” To permit the passage of ice and debris, a minimum clearance of 2 ft should be provided between the design approach water surface elevation and the low chord of the bridge where practical. Where this is not practicable, the clearance should be established by the hydraulics engineer based on the type of stream and level of protection desired.			**Already covered** Add debris clearance of 2 ft
	Greenbook refers to Drainage Manual	4.6.2Horizontal Clearance The following minimum horizontal clearances shall be provided: 1. For crossings subject to boat traffic a minimum horizontal clearance of 10 feet shall be provided. 2. Where no boat traffic is anticipated, horizontal clearance shall be provided consistent with debris conveyance needs and structure economy. Horizontal clearance is defined as the unobstructed clear distance between piers, fender systems, culvert walls, etc. projected by the bridge normal to the flow.	**17.3.3 Clearance** For navigational channels, a vertical and horizontal clearance conforming to Federal, or state, or both, requirements should be established based on normally expected flows during the navigation season, see Volume Two, Chapter 2 “Permits and Certifications.”			Already covered in the Greenbook

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Cross Drain Hydrology and Hydraulics	Greenbook refers to Drainage Manual	4.6.3 Regulatory Requirements Vertical and horizontal clearances will also be subject to the requirements of the Coast Guard, Corps of Engineers, Water Management District and any other regulatory agency having appropriate statutory jurisdiction or authority. Such regulatory agency requirements may exceed Department requirements.	**17.3.3 Clearance** For navigational channels, a vertical and horizontal clearance conforming to Federal, or state, or both, requirements should be established based on normally expected flows during the navigation season, see Volume Two, Chapter 2 “Permits and Certifications.”			Already covered in the Greenbook
	Greenbook refers to Drainage Manual	4.7 Hydrologic Analysis 4.7.1 Freshwater Hydrologic data for freshwater flow conditions used for the design of cross drains shall be based on one of the following methods as appropriate for the particular site: 1. A frequency analysis of observed (gage) data shall be used when available. If insufficient or no observed data is available, one of the procedures below shall be used as appropriate. However, the procedures below shall be calibrated to the extent practical with available observed data for the drainage basin or nearby similar drainage basins. • Regional or local regression equation developed by the USGS. • Rational Equation for drainage areas up to 600 acres. 2. For regulated or controlled canals, hydrologic data shall be requested from the controlling entity. Prior to use for design, this data shall be verified to the extent practical.	**Chapter 9 Hydrology** & **17.4 HYDRAULIC ANALYSIS REQUIREMENTS** **17.4.1 General Considerations** The design for a stream crossing system requires a comprehensive engineering approach that includes the consideration of alternatives, data collection, and selection of the most cost effective alternative according to established criteria and documentation of the final design. Water surface profiles are computed for a variety of technical uses including: • flood insurance studies, • flood hazard mitigation investigations, • drainage crossing analyses, and • longitudinal encroachments. In many cases, there may be existing studies for the reach of stream where the proposed crossing is to be located. These studies should be evaluated to determine if they are accurate and are representative of the terrain or topographic conditions in the proximity of the site in question.			Already covered in the Greenbook
	Greenbook refers to Drainage Manual	4.7.2 Tidal Flow Hurricane rainfall runoff should be considered in conjunction with surge-driven tailwater when analyzing creeks and small rivers flowing into tidal water bodies. In such cases, since hurricane rainfall is independent of peak surge stage, the ACOE tropical storm rainfall runoff procedure from the 1986 Engineering and Design Storm Surge Analysis manual (EM1110-2-1412), Chapter 4, should be used to estimate runoff from any design surge regardless of the surge return frequency being analyzed. The above procedure may be found at the website: www.dot.state.fl.us/rddesign/dr/FCHC.shtm . USGS Regression Equations and NRCS methodology should not be used to quantify hurricane rainfall runoff.	**11.3.2.6 Tailwater Relationship (Confluence or Large Water Body)** Where the culvert is located on a tributary that joins with a larger body of water immediately downstream • use the downstream high-water elevation that has the same frequency as the design flood if events are known to occur concurrently (statistically dependent), and if statistically independent, use a likely combination resulting in the greater tailwater depth (worst-case scenario). **17.7.5 Tidal Waterways** The analysis of tidal waterways is very complex. The procedure is described in detail in the FHWA publication HEC-25 *(9)* and discussed in Volume One, Chapter 19 “Coastal Zone.” The hydraulics engineer must consider the magnitude of the 100-yr and the 500-yr storm surge including associated or appropriate wave crests, the characteristic of the tidal body, and the effect of any constriction of the flow due to natural geometry of the waterway or the presence of a roadway and bridge. In addition, the hydraulics engineer must consider the longer effects of the normal tidal cycles or long-term aggradation or degradation, contraction scour, local scour and stream instability.			Already covered in the Greenbook
	Greenbook refers to Drainage Manual	4.9 Bridges	**Chapter 17 - Bridges**			Already covered in the Greenbook

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Cross Drain Hydrology and Hydraulics		4.10 Culverts Optional Materials (Chapter 6)	**11.4.1 Culvert Shape and Material Selection** The material selected should be based on a comparison of the total cost of alternative materials over the design life of the structure, which is dependent upon the following: • durability (service life), • structural strength, • hydraulic roughness, • constructability, • initial/replacement cost, • bedding conditions, • abrasion and corrosion resistance, and • water-tightness requirements.			Federal projects note use optional materials
		4.10.2 Manning's Coefficients	**Volume 2, Chapter 9 – Hydrology**			Field verification of n value – general discussion of n value
		4.10.3 End Treatment The selection of end treatment facilities and other hydraulic structures shall be selected/designed to satisfy hydraulic capacity, structural capacity, and safety (vehicular, pedestrian, cyclist) requirements. Treatments are presented in the Standard Drawing Indexes of the Roadway and Traffic Design Standards. The Standard Indexes provide guidance on end treatment selection.	**11.4.9 End Treatment (Inlet or Outlet)** The culvert inlet type and the inlet coefficient (k_E) should be selected from Volume Two, Chapter 11 "Culverts." Consideration should also be given to safety, see Section 11.4.10. All culverts 48-in. diameter and larger should have headwalls on the inlet end to protect the culvert from buoyancy force. Buoyancy is more serious with steepness of the culvert slope, depth of the potential headwater, flatness of the upstream fill slope, and height of the fill. Projecting/mitered inlets or outlets should include anchoring the inlet to strengthen the weak, leading edge for culverts 48-in. diameter and larger. Tapered inlets should be considered only for culverts that will operate in inlet control, when practicable. Slope tapered inlet is not recommended when fish passage is required: • When the culvert outlet flow velocity is excessive (greater than 6 ft/s for vegetated covered flow line or 12 ft/s for bedrock flow line), provide protection to downstream channel from scour and erosion problems. See Volume One, Chapter 12 "Energy Dissipators" for more details. • Wingwalls are used where the side slopes of the channel are unstable or when the culvert is skewed. Wingwalls provide the best hydraulic efficiency if the flare angle is between 30 degrees and 60 degrees. • Where applicable, aprons should extend at least twice the box rise/pipe diameter upstream, but should not be more than 10 ft and should not protrude above the normal streambed elevation. Cut-off walls should be used on all culverts with headwalls or slope paving. The depth of the cut-off walls should be at least 1.5 ft or deeper.			The selection of end treatment facilities and other hydraulic structures shall be selected/designed to satisfy hydraulic capacity, structural capacity, and safety (vehicular, pedestrian, cyclist) requirements.
		4.10.3.1 Protective Treatment Drainage designs shall be reviewed to determine if some form of protective treatment will be required to prevent entry to facilities that present a hazard to children and, to a lesser extent, all persons. General guidance on protective treatment is presented in Appendix D. When grates are used, consideration shall be given to the effect of the grate and potential debris on the hydraulic capacity of the cross drain.	**11.4.10 Safety Considerations** • Where applicable, aprons should extend at least twice the box rise/pipe diameter upstream, but should not be more than safety treated with a grate or a safety apron (90 degrees wingwalls) if the consequences of clogging and causing a potential flooding hazard is less than the hazard of vehicles impacting an unprotected end. If a grate is used, the net area of the grate (excluding the bars) should be 1.5 times to 3.0 times the culvert entrance area. See FHWA HDS-5 *(4)* for information on grate design.			(check maintenance requirements) Drainage designs shall be reviewed to determine if some form of protective treatment will be required to prevent entry to facilities that present a hazard to children and, to a lesser extent, all persons. When grates are used, consideration shall be given to the effect of the grate and potential debris on the hydraulic capacity of the cross drain.

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Cross Drain Hydrology and Hydraulics		4.10.3.2 Roadside safety The type and location of end treatment shall comply with roadside safety and clear zone requirements. See the Plans Preparation Manual for clear zone requirements and the Standard Indexes for end treatment safety guidance.	**11.4.10 Safety Considerations** Traffic should be protected from culvert ends as follows: • Small culverts (30-in. diameter or less) should use an end section or slope paving. • Culverts greater than 30-in. diameter should receive one of the following: + be extended to the appropriate "clear zone" distance *(2)*. + safety treated with a grate or a safety apron (90 degrees wingwalls) if the consequences of clogging and causing a potential flooding hazard is less than the hazard of vehicles impacting an unprotected end. If a grate is used, the net area of the grate (excluding the bars) should be 1.5 times to 3.0 times the culvert entrance area. See FHWA HDS-5 *(4)* for information on grate design. + shielded with a traffic barrier if the culvert is very large, cannot be extended, has a channel that cannot be safely traversed by a vehicle, or has a significant flooding hazard with a grate. Periodically inspect each site to determine if safety problems exist for traffic or for the structural safety of the culvert and embankment.			The type and location of end treatment shall comply with roadside safety and clear zone requirements. See the Florida Greenbook for clear zone requirements.
		4.10.4 Construction and Maintenance The design of culverts shall be consistent with the standard construction and maintenance practices of the Department. Standard details for inlets, manholes, junction boxes, end treatments, and other miscellaneous drainage details are provided in the standard index drawings. Specifications are provided in the Standard Specifications for Road and Bridge Construction. In the event standard index drawings are not suitable for a specific project need, a detailed design shall be developed and included in the plans; and, as appropriate, special provisions shall be provided for inclusion with the project specifications. Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair.	**17.6.3.7 Maintenance Considerations** The drainage system will not function properly if it becomes clogged with debris. Therefore, maintenance requirements should be considered in the design. The bridge designer should avoid drainage designs that provide inadequate room for maintenance personnel on the bridge deck or access beneath the bridge or that provide unsafe working areas for maintenance personnel. **22.5 CULVERTS** **22.5.1 Culvert Maintenance** Culverts (see Volume One, Chapter 11 "Culverts") must be kept free of obstructions. Sand or sediment deposits that restrict the capacity of the culvert should be removed as soon as possible. Inlet and outlet channels should be kept in alignment and vegetation controlled to minimize any significant restriction of flow. Reinforced concrete box culverts require little maintenance, but they should be inspected on a regular schedule. Bridge size culverts will be inspected every 2 years using the National Bridge Inspection criteria. Other culverts should be inspected on a 5 year cycle for cracks, bottom erosion, and undermining at outlets. Undermining is generally the result of high outlet velocities. Correction of undermining usually requires adding an energy dissipator. For more details, see FHWA, *Culvert Inspection Manual (4)*. Refer to **Section 22.11 BRIDGES** for more Maintenance considerations for bridges			Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair. AASHTO reference

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Cross Drain Hydrology and Hydraulics		4.10.4.1 Minimum Culvert Sizes Minimum culvert sizes are as follows: Culvert Type — Minimum Size Cross Drain — 18” Median Drain — 15” * Side Drain — 15” * Box Culvert (Precast) — 3’ x 3’ Box Culvert (Cast in Place) — 4’ x 4’ Drains from inlets on high fills (e.g., gutter drains) — 15” ** * Some locations require 18” minimum. Verify project specific requirements with the District Drainage Engineer. ** When debris control is not provided by grates, use 18” minimum. For culverts requiring more than a double line of pipe, other alternatives shall be investigated.	**11.4.2 Culvert Size** The selected culvert size and shape should be based on engineering and economic criteria related to site conditions: • The following minimum sizes should be used to avoid maintenance problems and clogging: + 18-in. diameter or equivalent size for all highway systems, + 12-in. diameter or equivalent size for a side drain or driveway, and + 3 ft by 3 ft minimum box size for all cross drain systems. • Land-use requirements (e.g., need for a cattle pass) can dictate a larger or different barrel geometry than required for hydraulic considerations. Use pipe arch or oval/elliptical shapes when required by hydraulic limitations, site characteristics, structural criteria, or environmental criteria.	2 7 (4-Lane Roads) 13 (2-Lane Roads) 19 (Local Roads) 24 (Unpaved Cross Drains) 25 (Unpaved Side Drains)	Shown On First Page 9.5% 12” 42.9% 15” 34.9% 18” 4.8% 24” 6.3% N/A 1.6% Other 14.8% 12” 42.6% 15” 34.4% 18” 6.6% 24” 1.6% Other 18.5% 12” 44.4% 15” 29.6% 18” 7.4% 24” 6.7% 12” 46.7% 15” 40.0% 18” 6.7% 24” 6.7% 12” 46.7% 15” 46.7% 18” 0.0% 24”	FDOT minimums (Department had issue with 15” hubcaps blocking systems which is reason for 18” minimum)

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Stormwater Management Facilities		5.2 Stormwater Management Regulatory Requirements **5.2.1 Chapter 14-86, Florida Administrative Code** The design of stormwater management systems for Department projects shall comply with the water quality, rate, and quantity requirements of Section 334.044(15), F.S., Chapter 14-86, F.A.C., Rules of the Department of Transportation. **5.2.2 Section 373.4596, Florida Statutes** Section 373.4596, Florida Statutes requires the Department of Transportation to fully comply with state, water management district and, when delegated by the State, local government stormwater management programs. **5.2.3 Chapter 62-25, Florida Administrative Code** Chapter 62-25. F.A.C., rules of the Florida Department of Environmental Protection specifies minimum water quality treatment standards for new development. **5.2.4 Chapter 62-40, Florida Administrative Code** Chapter 62-40, F.A.C., rules of the Florida Department of Environmental Protection outlines basic goals and requirements for surface water protection and management to be implemented and enforced by the Florida Department of Environmental Protection and Water Management Districts. **5.2.5 National Pollutant Discharge Elimination System** The National Pollutant Discharge Elimination System (NPDES) permit program is administered by the U. S. Environmental Protection Agency. This program requires permits for stormwater discharges into waters of the United States from industrial activities; and from large and medium municipal separate stormwater systems.	**2.4.3 Section 402 NPDES Permits** **2.4.3.2 Purpose** The purpose of the NPDES Program is to restore or maintain, or both, the chemical, physical, and biological integrity of the Nation's waters through the prevention, reduction, and elimination of pollution. **AASHTO Highway Drainage Guidelines, Chapter 12, Section 12.2.1 Federal Regulations** "The enabling legislation for all Federal stormwater management regulations stems from the 1972 Water Pollution Control Act as amended by the 1977 Clean Water Act (CWA) and the 1987 Water Quality Act (WQA). The goals of these laws are to control the discharge of pollutants into 'waters of the United States'."… "The CWA provided that the States develop, implement and enforce a Water Quality Certification Program. The WQA provided for the application of the CWA as it related to stormwater discharges through implementation of the NPDES program."… "In November of 1990, U.S. EPA published regulations to expand permit requirements under the CWA for the discharge of industrial stormwater and to bring municipal stormwater discharges under the authority of the Act."… "The Coastal Zone Reauthorization Act Amendments (CZRAA) of 1990 require States to adopt nonpoint pollution control programs for the purpose of improving water quality."… "There are no Federal regulations regarding flood control as related to quantity management for peak attenuation." **Section 12.2.2 State and Local Regulations** "State regulations reflect the implementation requirements of the NPDES program"… "Local or regional requirements may provide an additional level of regulation for protection of special ecosystems or habitats."			**5.2.3 Chapter 62-25, Florida Administrative Code** Chapter 62-25. F.A.C., rules of the Florida Department of Environmental Protection specifies minimum water quality treatment standards for new development. **5.2.4 Chapter 62-40, Florida Administrative Code** Chapter 62-40, F.A.C., rules of the Florida Department of Environmental Protection outlines basic goals and requirements for surface water protection and management to be implemented and enforced by the Florida Department of Environmental Protection and Water Management Districts. **5.2.5 National Pollutant Discharge Elimination System** The National Pollutant Discharge Elimination System (NPDES) permit program is administered by the U. S. Environmental Protection Agency. This program requires permits for stormwater discharges into waters of the United States from industrial activities; and from large and medium municipal separate stormwater systems.
		5.3.1.1 Design of systems Stormwater management facilities should be designed to provide the necessary quantity, rate, and quality control based on the presumption that for the existing discharge all necessary quantity, rate, and quality control of stormwater from upper property has occurred prior to reaching the right-of-way. Consistent with this presumption, the most economically feasible of the following shall be provided: 1. Separation of offsite discharges from the Departments stormwater management facilities; 2. When separation of offsite discharges is not feasible, consideration shall be given to joint use, and/or regional treatment facilities in cooperation with local, regional and/or private organizations.	**14.3 DESIGN CRITERIA** **14.3.1 General Criteria** Storage may be concentrated in large basin-wide or regional facilities, or distributed throughout an urban drainage system. Storage may be developed in depressed areas in parking lots, road embankments and freeway interchanges, parks, and other recreational areas and small lakes, ponds and depressions within urban developments. The utility of any storage facility depends on the amount of storage, its location within the system, and its operational characteristics. An analysis of such storage facilities should consist of comparing the design flow at a point or points downstream of the proposed storage site with and without storage. In addition to the design flow, other flows in excess of the design flow that might be expected to pass through the storage facility should be included in the analysis (e.g., 100-yr flood). The design criteria for storage facilities should include • release rate (Section 13.3.2), • storage volume (Section 13.3.3), • grading and depth requirements (Section 13.3.4), • outlet works (Section 13.3.5), • location (Section 13.3.6), • construction considerations (Volume One, Chapter 21), and • maintenance considerations (Volume One, Chapter 22) (e.g., berms, access ramps).			Stormwater management facilities should be designed to provide the necessary quantity, rate, and quality control based on the presumption that for the existing discharge all necessary quantity, rate, and quality control of stormwater from upper property has occurred prior to reaching the right-of-way. Consistent with this presumption, the most economically feasible of the following shall be provided: 1. Separation of offsite discharges from the Departments stormwater management facilities; When separation of offsite discharges is not feasible, consideration shall be given to joint use, and/or regional treatment facilities in cooperation with local, regional and/or private organizations.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Stormwater Management Facilities		5.3.1.2 Watersheds with positive outlets For projects located in watersheds with positive outlets, e.g., streams and some sinks, a detention system is required of sufficient size to ensure that the post developed discharge rates do not exceed pre-developed discharge rates for the critical duration (1-hour through 3-day) storm. Discharge rates shall be determined for several storm event frequencies through the 100-year. These systems must also address water quality requirements.	**14.3.2 Release Rate** The release rate of control structures should • approximate predeveloped peak runoff rates for the design storm, • provide for emergency overflow of the 100-yr discharge, and • provide for multi-stage control if required to control both runoff from the 2-yr and 100-yr storms.			WMD requirements will cover this topic – no further discussion in greenbook required
		5.3.1.3 Watersheds without Positive Outlets For projects that are located within a watershed that contributes to a depressed low area, or a lake that does not have a positive outlet such as a river or stream to provide relief (i.e., closed basin or isolated depression), a detention/retention system is required. The detention/retention system shall be of sufficient size to ensure that the post developed discharge volumes do not exceed the pre-developed discharge volumes for the critical duration (1-hour through 10-day) storm. Discharge volumes shall be determined for several storm event frequencies through the 100-year. The retention volume should recover at a rate such that one-half of the volume is available in 7 days with the total volume available in 30 days, with a sufficient amount recovered within the time necessary to satisfy applicable water treatment requirements. The detention requirements are the same as those described in 5.3.1.2.	**14.1.1 Design Practice** For a watershed without an adequate outfall, the total volume of runoff is critical and storage facilities are used to store the increases in volume and to control discharge rates. In rare cases, reservoir routing may be used to minimize a drainage structure size where there is considerable natural storage immediately upstream. **14.3.2 Release Rate** The release rate of control structures should • approximate predeveloped peak runoff rates for the design storm, • provide for emergency overflow of the 100-yr discharge, and • provide for multi-stage control if required to control both runoff from the 2-yr and 100-yr storms.			WMD requirements will cover this topic – no further discussion in greenbook required
		Exceptions to 5.3.1.2 &3 **5.3.1.4.1 Tidal Areas** Water quantity and rate control criteria are not applicable for projects which discharge directly into tidal areas. This is subject to permission of the appropriate permitting authority. **5.3.1.4.2 Downstream Improvement** Water quantity and rate control criteria are not applicable where it can be demonstrated that downstream conveyance and storage systems have adequate capacity, or will be improved to have adequate capacity for the increased quantity and rate of runoff created by the project. This is subject to permission of the downstream property owner(s), and the appropriate permitting authority. **5.3.1.4.3 Replacement Treatment** For projects where available right-of-way is insufficient and cannot be feasibly obtained for proper treatment (quantity, rate, quality), treatment of existing untreated offsite areas which discharge to the same receiving water body may be substituted in lieu of treating the project. This is subject to permission of the property owner downstream of the untreated project area, and the appropriate permitting authority. **5.3.1.4.4 Permission from the Downstream Property Owner(s)** Water quantity and rate control criteria can be waived when the downstream property owner(s) agrees to accept the increased quantity and rate of runoff created by the project. This approach is subject to appropriate exemption by the permitting authority.	None found			WMD requirements will cover this topic – no further discussion in greenbook required

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Stormwater Management Facilities		5.3.2 Hydrologic Methods The hydrologic method used shall be one of the following: 1. Modified Rational for basins having a time of concentration of 15 minutes or less. 2. SCS Unit Hydrograph Method	**9.3.3 Peak Flow Analyses** The peak runoff rate is generally adequate for designing conveyance systems (e.g., culverts, storm drains, open channels). If the design must include storage with flood routing (e.g., storage basins, complex conveyance networks), a flood hydrograph is usually required. Although the development of runoff hydrographs (typically more complex than estimating peak runoff rates) is often accomplished using software, some methods are adaptable to nomographs or other desktop procedures. There are various methodologies to determine the peak flows from gaged or ungaged watersheds. Peak flow values should be estimated using the following acceptable methods: • Gaged Site Methods (see Section 9.3.3.1) + Flow Distribution (log-Pearson Type III) + Rainfall Distribution (Unit Hydrographs) • Ungaged Site Methods (see Section 9.3.3.2) + Regression analysis + Rational and Modified Rational + NRCS Curve Number method			WMD requirements will cover this topic – no further discussion in greenbook required
		5.3.3 Protective Treatment Stormwater management facilities shall be designed with due consideration of the need for protective treatment to prevent hazards to persons. General guidance on protective treatment is provided in Appendix D. Flat slopes shall be used when practical. Retention areas shall be fenced in accordance with 5.3.4, and to prevent entry into areas of unexpected deep standing water or high velocity flow. Grates shall be considered to prevent persons from being swept into long or submerged drainage systems. Guards shall be considered to prevent entry into long sewer systems under no-storm conditions, to prevent persons from being trapped.	**14.3.4.1 General** The construction of storage facilities usually requires excavation or placement of earthen embankments to obtain sufficient storage volume. Vegetated embankments should be less than 25 ft in height and should have side slopes no steeper than 1V:3H (follow Federal/state dam safety regulations). Other considerations when setting depths include flood elevation requirements, public safety, land availability, land value, present and future land use, water table fluctuations, soil characteristics, maintenance requirements, and required freeboard. **14.4 NATIONAL DAM SAFETY PROGRAM** The National Dam Safety Program (NDSP), which was formally established by the *Water Resources and Development Act of 1996*, includes: grant assistance to the states, dam safety research, and dam safety training. National responsibility for the promotion and coordination of dam safety lies with FEMA. **14.5.3 Design Considerations for Pedestrians** Drainage features adjacent to schools, recreational areas or urban areas subject to frequent visits by the public may need to be fenced.			Stormwater management facilities shall be designed with due consideration of the need for protective treatment to prevent hazards to persons. General guidance on protective treatment is provided in Appendix D. Flat slopes shall be used when practical. Retention areas shall be fenced in accordance with 5.3.4, and to prevent entry into areas of unexpected deep standing water or high velocity flow. Grates shall be considered to prevent persons from being swept into long or submerged drainage systems. Guards shall be considered to prevent entry into long sewer systems under no-storm conditions, to prevent persons from being trapped. Drainage features adjacent to schools, recreational areas or urban areas subject to frequent visits by the public may need to be fenced.

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Stormwater Management Facilities		5.3.4 Construction and Maintenance The design of stormwater management systems shall be consistent with the standard construction and maintenance practices of the Department. Standard details for inlets manholes and junction boxes, end treatments, and other miscellaneous drainage details are provided in the standard index drawings. Specifications are provided in the Standard Specifications for Road and Bridge Construction. In the event standard index drawings are not suitable for a specific project need, a detailed design shall be developed and included in the plans; and, as appropriate, special provisions shall be provided for inclusion with the project specifications. Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair.	**14.5 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS** **14.5.1 General** An important step in the design process is identifying whether special provisions are warranted to properly construct (see Volume One, Chapter 21 “Construction”) or maintain (see Volume One, Chapter 22 “Maintenance”) proposed storage facilities. To ensure acceptable performance and function, storage facilities that require extensive maintenance are discouraged. Design facilities to minimize the following maintenance problems typical with urban detention facilities: • weed growth, • grass and vegetation maintenance, • sedimentation control, • bank deterioration, • standing water or soggy surfaces, • mosquito control, • blockage of outlet structures, • litter accumulation, and • maintenance of fences and perimeter plantings. Proper design should focus on the elimination or reduction of maintenance requirements by addressing the following potential problems: • Address weed growth and grass maintenance by constructing side slopes that can be maintained using available power-driven equipment (e.g., tractor mowers). • Control sedimentation by constructing traps to contain sediment for easy removal or low-flow channels to reduce erosion and sediment transport. • Control bank deterioration with protective lining or by limiting bank slopes. • Eliminate standing water or soggy surfaces by sloping basin bottoms toward the outlet, constructing low-flow pilot channels across basin bottoms from the inlet to the outlet, or constructing underdrain facilities to lower water tables. If standing water is addressed, mosquito control should not be a major problem. • Select outlet structures to minimize the possibility of blockage (i.e., very small pipes tend to block easily and should be avoided). Ice accumulation should also be considered. • Locate the facility for easy access so that maintenance can be conducted on a regular basis where litter or damage to fences and perimeter plantings is expected.			Proper design shall also consider maintenance concerns of adequate physical access for cleaning and repair. Reference AASHTO

	Current Greenbook	FDOT Drainage Manual	AASHTO (AASHTO Drainage Manual – Volume 1)	Survey #	Survey Results	Recommendation
Stormwater Management Facilities		5.3.4.2 Detention and Retention Ponds Standard Features 1. Maintenance Berm: Ponds shall be designed to provide a minimum 20 feet of horizontal clearance between the top edge of the normal pool elevation and the right-of-way line. At least 15 feet adjacent to the pond shall be at a slope of 1:8 or flatter. The berm area shall be sodded. 2. Corners: Corners of ponds shall be rounded to provide an acceptable turning radius for maintenance equipment. 3. Freeboard: To compensate for grading irregularities, 1 foot of freeboard is required above the maximum design stage. Less freeboard is acceptable when a permanent containment feature such as concrete is provided. 4. Fencing: Ponds having side slopes steeper than 1:4 shall be provided a protective barrier (e.g., wall, fence, etc.) to prevent unauthorized entry. Refer to Appendix D (Part 2 - Protective treatment) for other considerations. Appendix D is a guideline and not a standard. Gates for maintenance equipment access shall be placed at appropriate locations. 5. Access Easements: When pond areas are not accessible directly from the road right-of-way, an access easement shall be provided.	**14.3.4.1 General** The construction of storage facilities usually requires excavation or placement of earthen embankments to obtain sufficient storage volume. Vegetated embankments should be less than 25 ft in height and should have side slopes no steeper than 1V:3H (follow Federal/state dam safety regulations). Side slopes should be benched at intervals of 5 ft. Riprap-protected embankments should be no steeper than 1V:2H. Geotechnical slope stability analysis is recommended for embankments greater than 10 ft in height and is mandatory for embankment slopes steeper than those given above. A minimum freeboard of 1 ft above the 100-yr storm high-water elevation should be provided for impoundment depths of less than 25 ft. Impoundment depths greater than 25 ft or volumes greater than 50 acre•ft are subject to the requirements of the National Dam Safety Program (see Section 14.4), unless the facility is excavated to this depth. Other considerations when setting depths include flood elevation requirements, public safety, land availability, land value, present and future land use, water table fluctuations, soil characteristics, maintenance requirements, and required freeboard. Aesthetically pleasing features are also important in urbanizing areas.			WMD requirements will cover this topic – no further discussion in greenbook required
		5.3.4.3 Exfiltration Trenches Exfiltration systems (French drains) shall be designed using Roadway Standard Index Drawing 285. Designs shall include provisions for overflow resulting from floods exceeding the design storm condition.	None Found			Refer to FDOT handbook for design guidance
		5.4 Documentation Requirements	**Chapter 4 – Documentation** & **AASHTO Highway Drainage Guidelines, Chapter 12, Section 12.3.4 Documentation** Compliance with Federal regulations on stormwater discharges requires the maintenance of facility records. The following information should be available in a stormwater management design report: • Drainage area maps… • Field notes describing preconstruction conditions… • Survey data references and critical channel cross-sections • Flood hazard maps • Soil-boring logs • Pre- and post-development hydrological and hydraulic calculations… • Any design assumptions used…			WMD requirements will cover this topic – no further discussion in greenbook required
Optional Materials		6.1 Optional Materials All projects involving Federal or State contributions shall use Optional Culvert Materials	**11.4.1 Culvert Shape and Material Selection** The material selected should be based on a comparison of the total cost of alternative materials over the design life of the structure, which is dependent upon the following: • durability (service life), • structural strength, • hydraulic roughness, • constructability, • initial/replacement cost, • bedding conditions, • abrasion and corrosion resistance, and water-tightness requirements.			Federal projects note requiring use optional materials

***1. Please provide your contact information below. Responses will only be used to verify agencies contacted or to clarify any questions we may have.**

Name:	
Company:	
Address:	
Address 2:	
City/Town:	
Email Address:	
Phone Number:	

2. What drainage design criteria (FHWA, AASHTO, FDOT, local) does your organization use for roadway drainage design of the following types of roads:

	FHWA	AASHTO	FDOT	Local
Curb and Gutter roadways	◯	◯	◯	◯
Open Drainage (ditched) roadways	◯	◯	◯	◯

For the following questions, please provide your agency's requirements for design storm frequencies and flood limits for 4+ lane roads, divided or undivided, in high density, high traffic areas.

3. Rainfall frequency (closed drainage system):
(An example of a closed drainage system is a storm sewer system in a curb and gutter roadway section)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

4. Rainfall frequency (open drainage system):
(An example of an open drainage system is a ditch or swale)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

5. Flood limit of roadway:

- ◯ No encroachment
- ◯ 1/2 outside travel lane
- ◯ Crown of roadway

Other (please specify)

6. Minimum pipe size for storm sewer system:

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

7. Minimum pipe size for cross drain (culverts, crossing perpendicular to roadway discharging to a ditch, swale, or other waterbody):

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

8. Minimum structure size:

- ◯ We use FDOT standard structures
- ◯ We use County standard structures

Other (please specify)

For the following questions, please provide your agency's requirements for design storm frequencies and flood limits for 2 lane roads (with or with out two way left turn lanes).

9. Rainfall frequency (closed drainage system):
(An example of a closed drainage system is a storm sewer system in a curb and gutter roadway section)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

10. Rainfall frequency (open drainage system):
(An example of an open drainage system is a ditch or swale)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

11. Flood limit of roadway:

- ◯ No encroachment
- ◯ 1/2 outside travel lane
- ◯ Crown of roadway

Other (please specify)

12. Minimum pipe size for storm sewer system:

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

13. Minimum pipe size for cross drain (culverts, crossing perpendicular to roadway discharging to a ditch, swale, or other waterbody):

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

14. Minimum structure size:

- ◯ We use FDOT standard structures
- ◯ We use County standard structures

Other (please specify)

For the following questions, please provide your agency's requirements for design storm frequencies and flood limits for local residential streets or alleyways.

15. Rainfall frequency (closed drainage system):
(An example of a closed drainage system is a storm sewer system in a curb and gutter roadway section)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

16. Rainfall frequency (open drainage system):
(An example of an open drainage system is a ditch or swale)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

17. Flood limit of roadway:

- ◯ No encroachment
- ◯ 1/2 outside travel lane
- ◯ Crown of roadway

Other (please specify)

18. Minimum pipe size for storm sewer system:

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

19. Minimum pipe size for cross drain (culverts, crossing perpendicular to roadway discharging to a ditch, swale, or other waterbody):

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

20. Minimum structure size:

- ◯ We use FDOT standard structures
- ◯ We use County standard structures

Other (please specify)

*21. Does your agency have design criteria for unpaved roads?

- ◯ Yes
- ◯ No

For the following questions, please provide your agency's requirements for design storm frequencies and flood limits for unpaved roads.

22. Rainfall frequency (open drainage system):
(An example of an open drainage system is a ditch or swale)

- ◯ 10 year
- ◯ 5 year
- ◯ 3 year

Other (please specify)

23. Flood limit of roadway:

- ◯ No encroachment
- ◯ 1/2 outside travel lane
- ◯ Crown of roadway

Other (please specify)

24. Minimum pipe size for cross drains:

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

25. Minimum pipe size for side drains:

- ◯ 12"
- ◯ 15"
- ◯ 18"
- ◯ 24"

Other (please specify)

What criteria does your agency use for inlet spacing, inlet locations, or inlet types?

26. Inlet spacing:

- ◯ FDOT Drainage Manual (300' unless spread calcs indicate greater spacing is acceptable)

Other (please specify)

27. Inlet selection and location considerations:
(When chosing inlets what do you consider? If your agency has additional considerations, please list them in the additional considerations box.)

- ☐ Inlet capacity and width of spread.
- ☐ Movement of vehicles to and from adjacent property on turnouts.
- ☐ Pedestrian and Bicycle Safety
- ☐ Maximum pipe length without maintenance access
- ☐ Roadway Geometry
- ☐ Hydraulic efficiency of the system
- ☐ Potential for flooding of off-site property

Additional Considerations (please specify)

28. Inlet Types:

- ◯ FDOT Standard Index
- ◯ County Standard

Other (please specify)

29. For closed drainage systems, please describe your agency's criteria for the maximum hydraulic gradient in relation to the inlet grate elevation, i.e. one foot below the inlet grate? (What factor of safety is used for design purposes?)

- ◯ One foot below grate elevation
- ◯ One foot below edge of pavement elevation

Other (please specify)

30. For what frequecy event to does your agency require the above hydraulic gradient relationship?

- ◯ 50 yr
- ◯ 25 yr
- ◯ 10 yr
- ◯ 5 yr
- ◯ 3 yr

Other (please specify)

31. What criteria does your agency use for a starting elevation of the hydraulic gradient in drainage calculations, i.e. control elevation, high water mark, etc.?

- ◯ at the control elevation for pond
- ◯ at the top (crown) of pipe
- ◯ at an existing high water mark

Other (please specify)

32. What distance is allowed between the bottom of the roadway base and the high water table elevation?

- ◯ 5 feet
- ◯ 3 feet
- ◯ 1 foot
- ◯ no requirement

Other (please specify)

33. Please describe the permissible limits of flooding for the following roadway types:

	Flood limits	Design Frequency
collector		
arterial		
minor		
residential		

Other (please specify)

For example: Minor roads are designed to have no encorachment for the 3 yr storm event.

Thank you for participating in this survey. The results will be used to establish the minimum criteria for drainage design documented in the Florida Greenbook.

Focus of 2013 Updates

Workshops for Updates

Chapter 3- Geometric Design

Sidewalk

expectation of additional demand, should a sidewalk be made available.

The minimum sidewalk width shall be 5 feet when separated from the back of curb by a buffer strip. The minimum sidewalk width may be reduced to 4 feet when physical constraints exist. See Section 3.3.10.1.3~~C.10.a.3~~ of this chapter for additional clear width criteria. When sidewalks must be constructed adjacent to the curb, the minimum width shall be 6 feet. Sidewalks should be constructed as defined in this Manual - CHAPTER 8 - PEDESTRIAN FACILITIES. In areas of high use, refer to Chapter 18 of the Highway Capacity Manual for calculation of appropriate width. ~~As noted in the Department's Bicycle Facilities Planning and Design Handbook,~~ ~~e~~Excessively wide sidewalks may not necessarily add to pedestrian and bicycle safety. Wide sidewalks may encourage higher speed bicycle use and can increase the potential for conflict with motor vehicles at intersections and driveways, as well as with pedestrians and fixed objects.

Maximum cross slope shall be 2%, and grades shall not exceed 8.33%. Curb ramps shall be provided at all intersections (Section 336.045 (3), Florida Statutes). For additional details, refer to the ~~current~~ 2006 Americans with Disabilities Act (ADA) Standards for Transportation Facilities ~~Accessibility Guidelines~~ (as described in the Federal Register), and the 2012 Florida Accessibility Code ~~For Building Construction~~ (Rule 9B-7.0042).

intersections are given in CHAPTER 4 - ROADSIDE DESIGN.

3.3.10~~C.10~~ Other Design Factors

3.3.10.1~~C.10.a~~ Pedestrian Facilities

The layout and design of the highway network should include provisions for pedestrian traffic in urban areas. All pedestrian crossings and pathways within the highway right of way should be considered and designed as in integral part of any street or urban highway. Design shall be in compliance with the 2006 Americans with Disabilities Act ~~Accessibility Guidelines~~Standards for Transportation Facilities ~~Accessibility Guidelines~~ (as described in the Federal Register), and the 2012 Florida Accessibility Code ~~For Building Construction~~ (Rule 9B-7.0042).

3.3.10.1.1~~C.10.a.1~~ Policy and Objectives - New Facilities

The planning and design of new streets and highways shall include provisions for the safe, orderly movement of pedestrian traffic. Provisions for pedestrian traffic outside of the highway right of way should be considered.

The overall objective is to provide a safe, secure, continuous, convenient, and comfortable trip continuity and access environment for pedestrian traffic.

3.3.10.1.2~~C.10.a.2~~ Accessibility Requirements

Pedestrian facilities, such as walkways and sidewalks, shall be designed to accommodate physically disabled persons whose mobility is dependent on wheelchairs and other devices. Note: Design shall be in compliance with the 2006 ADA ~~Accessibility Guidelines~~Standards for Transportation Facilities (as described in the Federal Register), and the 2012 Florida Accessibility Code ~~For Building Construction~~ (Rule 9B-7.0042). Complete design criteria can be found in this publication.

3.3.10.1.3~~C.10.a.3~~ Sidewalks

Sidewalks should provide a safe, comfortable space for pedestrians. The width of sidewalks is dependent upon the roadside environment, volume of pedestrians, and the presence of businesses, schools, parks, and other pedestrian attractors. The minimum width for sidewalks is covered in Section 3.3.7.4~~C.7.d~~ of this chapter. To ensure compliance with the 2006 ADA ~~Accessibility Guidelines~~Standards for Transportation Facilities (as described in the Federal Register), and the 2012 Florida Accessibility Code ~~For Building Construction~~, sidewalk design shall meet the following criteria:

Minimum clear width	-	36 inches[1, 2]
Maximum cross slope	-	2.0%
Maximum slope	-	1:20[3]

[1] Sidewalks less than 60 inches wide must have passing spaces of at least 60 inches by 60 inches, at intervals not to exceed 200 feet.

[2] The minimum clear width may be reduced to 32 inches for a short distance. This distance must be less than 24 inches long, and separated by 5-foot long sections with 36 inches of clear width.

[3] Slopes greater than 1:20 are considered ramps and must be designed as such.

Sidewalks 5 feet wide or wider will provide for two adults to walk comfortably side by side.

3.3.10.5~~C.10.e~~ Bus Benches and Transit Shelters

Due to the length of exposure and discomfort from traffic, bus benches should be set back at least 10 feet from the travel lane in curbed sections and outside the clear zone (Table 3-~~-~~12) in non curbed sections.

Any bus bench or transit shelter located adjacent to a sidewalk within the right of way of any road on the State Highway or County Road System shall be located so as to leave at least 36 inches clearance for pedestrians and persons in wheelchairs. Such clearance shall be measured in a direction perpendicular to the centerline of the road. A separate bench pad or sidewalk flareout ~~should be considered~~that providew a 30 inch by 48 inch wheelchair space adjacent to the bench shall be provided. Transit shelters should be set back, rather than eliminated during roadway widening.

3.3.10.6~~C.10.f~~ Traffic Calming

Often there are community concerns with controlling travel speeds impacting the safety of a corridor such as in areas of concentrated pedestrian activities, those with narrow right of way, areas with numerous access points, on street parking, and other similar concerns. Local authorities may elect to use traffic calming design features that could include, but not be limited to, the installation of speed humps, speed tables, chicanes, or other pavement undulations. Roundabouts are also another method of dealing with this issue at intersections. For additional details and traffic calming treatments, refer to CHAPTER 15 – TRAFFIC CALMING.

3.3.11~~C.11~~ Reconstruction

3.3.11.1~~C.11.a~~ Introduction

The reconstruction (improvement or upgrading) of existing facilities may generate equal or greater safety benefits than similar expenditures for the construction of new streets and highways. Modifications to increase capacity should be evaluated for the potential effect on the highway safety characteristics. The long-range objectives should be to bring the existing network into compliance with current standards.

Roundabouts

turn lanes should not be excessive or continuous, since they complicate pedestrian crossings and bicycle/motor vehicle movements.

Storage (or deceleration lanes) to protect turning vehicles should be provided, particularly where turning volumes are significant.

Acceleration lanes are desirable for entrance maneuvers onto high-speed streets and highways.

Special consideration should be given to the provisions for deceleration, acceleration, and storage lanes in commercial or industrial areas with significant truck/bus traffic.

3.3.8.2.5~~C.8.b.5~~ Grade Separation

Grade separation interchange design should be considered for junctions of major arterial streets and highways.

Grade separation (or an interchange) should be utilized when the expected traffic volume exceeds the intersection capacity.

Grade separation should be considered to eliminate conflict or long waiting periods at potentially hazardous intersections.

3.3.8.2.6~~C.8.b.6~~ Roundabouts

Roundabouts have proven safety and operational characteristics and should be evaluated as an alternative to conventional intersections whenever practical. Modern roundabouts, when correctly designed, are a proven safety countermeasure to conventional intersections, both stop controlled and signalized. In addition, when constructed in appropriate locations, drivers will experience less delay with modern roundabouts. NCHRP Report 672, Roundabouts: An Informational Guide, is adopted by FHWA and establishes criteria and procedures for the justification, operational and safety analysis of modern roundabouts in the United States.

~~Roundabouts are another tool for the designer to consider in intersection design. These have been used extensively in Europe and Australia.~~ The modern ~~true~~ roundabout is characterized by the following:

- A central island of sufficient diameter to accommodate vehicle tracking and to provide sufficient deflection to promote lower speeds
- Entry is by gap acceptance through a yield condition at all legs
- Speeds through the intersection are 25 mph or less

~~The use of roundabouts should be determined by a detailed documented intersection analysis, as is also necessary for other type designs.~~

~~For further guidance, refer to the Federal Highway Administration (FHWA) Roundabout Guide, and the Florida Roundabout Guide~~Roundabouts should be considered under the following conditions:

1. New construction
2. Reconstruction
3. Traffic Operations improvements
4. Resurfacing (3R) with Right of Way acquisition
5. Need to reduce frequency and severity of crashes
6. Implement traffic calming

3.3.8.3~~C.8.c~~ Control for All Limited Access Highways

Entrances and exits on the right side only are highly desirable for all limited access highways. Acceleration and deceleration lanes are mandatory. Intersections shall be accomplished by grade separation (interchange) and should be restricted to connect with arterials or collector roads.

Bridges on Very-Low Volume Local Roads (ADT<400)

CHAPTER 3
GEOMETRIC DESIGN

C.12 Very Low-Volume Local Roads (ADT ≤ 400)

Where criteria is not specifically provided in this section, the design guidelines presented in Chapter 4 of the AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400) may be used in lieu of the policies in Chapter 5 of the AASHTO *Policy on Geometric Design of Highways and Streets.* The term local road is used to refer to the functional classification of the road and is not intended to imply that the road is under the jurisdiction of a local government. The design guidelines are intended to provide flexibility, without compromising safety, allowing the designer to exercise engineering judgment about the appropriate geometric and roadside designs for specific projects.

C.12.a Traffic Volumes

Traffic volumes on very low-volume roads are categorized into three levels:

- 100 vehicles per day or less
- 100 to 250 vehicles per day
- 250 to 400 vehicles per day

C.12.b Cross Section

The design guidelines for roadway cross sections in new construction projects on very low-volume roads differ between rural and urban areas. Design guidelines, by functional subclass, are presented below.

Design speed (mph)	Total roadway width (ft) by functional subclass					
	Major access	Minor access	Recreational and scenic	Industrial/ commercial access	Resource recovery	Agricultural access
15	–	18.0	18.0	20.0	20.0	22.0
20	–	18.0	18.0	20.0	20.0	24.0
25	18.0	18.0	18.0	21.0	21.0	24.0
30	18.0	18.0	18.0	22.5	22.5	24.0
35	18.0	18.0	18.0	22.5	22.5	24.0
40	18.0	18.0	20.0	22.5	–	24.0
45	20.0	20.0	20.0	23.0	–	26.0
50	20.0	20.0	20.0	24.5	–	–
55	22.0	–	22.0	–	–	–
60	22.0	–	–	–	–	–

Note: Total roadway width includes the width of both traveled way and shoulders.

Exhibit 1. Guidelines for Total Roadway Width for New Construction of Very Low-Volume Local Roads in Rural Areas

Development density	Total roadway width (ft)
Low	20 to 28
Medium	28 to 34
Note: Low development density represents 2.0 or fewer dwelling units per acre; medium development density represents 2.1 to 6.0 dwelling units per acre.	

Exhibit 2. Guidelines for Total Roadway Width for New Construction of Urban Residential Streets

C.12.c Bridge Width

Bridges are considered functionally obsolete when the combination of ADT and bridge width is used in the National Bridge Inventory Item 68 for Deck Geometry to give a rating of 3 or less. To accommodate future traffic and prevent new bridges from being classified as functionally obsolete, the minimum roadway width for new two lane bridges on low volume roads with 20 year ADT between 100 and 400 vehicles/day shall be a minimum of 22 feet. If the entire roadway width (traveled way plus shoulders) is paved to a width greater than 22 feet, the bridge width should be equal to the total roadway width. If significant ADT increases are projected beyond twenty years, a bridge width of 28 feet should be considered. One-lane bridges may be provided on single-lane roads and on two-lane roads with ADT less than 100 vehicles/day where a one-lane bridge can operate effectively. The roadway width of a one-lane bridge shall be 15 ft. One-lane bridges should have pull-offs visible from opposite ends of the bridge where drivers can wait for traffic on the bridge to clear.

C.12.d Horizontal Alignment, Stopping Sight Distance and Intersection Sight Distance

Specific guidelines for the design of horizontal curves and stopping sight distance are presented in Chapter 4 of the AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400).

C.12.e Roadside Design

It is not generally cost effective to provide large clear zones, also known as clear recovery areas, on very low-volume local roads. Where clear zones can be provided on very low-volume local roads at little or no additional cost, their incorporation in designs should be considered. Roadside clear zone width on very low-volume local roads should be provided as follows:

1. At locations where a clear recovery area of 6 feet or more in width can be provided at low cost and with minimum social or environmental impacts, provision of such a clear recovery area should be considered.
2. Where constraints of cost, terrain, right of way, or potential social/environmental impacts make the provision of a 6 foot clear recovery area impractical, clear recovery areas less than 6 feet in width may be used, including designs with 0 feet clear recovery areas.
3. Designers should fit the roadside design to site-specific conditions, considering cost-effectiveness and safety tradeoffs. It is appropriate to use wider clear zone widths at sharp horizontal curves where there is a history of run-off-road crashes, or where there is evidence of vehicle encroachments such as scarring of trees or utility poles. Narrow clear zone widths may be appropriate on tangent sections of the same roadway.
4. Other factors to consider in designing clear zone widths include the crash history, the expectation for future traffic volume growth on the facility, and the presence of vehicles wider than 8.5 feet, and vehicles with wide loads, such as farm equipment.

The use of guardrail or other traffic barriers to shield or protect drivers from roadside obstructions is generally not cost-effective for very low-volume local roads. Designers should place guardrail at locations where the potential consequences of departure from the roadway are likely to be severe. Bridge traffic barriers on low volume roads must have been successfully crash tested to a Test Level 2 (minimum) in accordance with ***NCHRP Report 350*** or ***Manual for Assessing Safety Hardware (MASH).***

C.12.f Unpaved Roads

Crash rates for unpaved roads are lower for narrower roadway widths. Existing unpaved roads should not generally be widened as a safety measure unless there is evidence of a site-specific safety problem that may be corrected by widening. Wide roadside clear zones, flatter slopes, or traffic barriers is generally inconsistent with the economic decision to build and maintain an unpaved surface and is generally not necessary for the low-speed environment of an unpaved road.

C.12.g Two-Way Single-Lane Roads

Two-way single-lane roads may be used in locations where traffic volumes are less than 50 vehicles per day. Operational speeds are typically no more than 30 mph and are often unpaved. Roadway widths are typically in the range between 11.5 to 13.0 feet. Design values of stopping sight distance for two-way single-lane roads should be twice the stopping sight distance for a comparable two-lane road. Turnouts should be provided at regular intervals on two-way single-lane roads to allow opposing vehicles to pass one another safely. In cases where increased sight distances are impractical, widening of the roadway at crests should be considered.

CHAPTER 3
GEOMETRIC DESIGN

C.12 Very Low-Volume Local Roads (ADT ≤ 400)

Where criteria is not specifically provided in this section, the design guidelines presented in Chapter 4 of the AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400) may be used in lieu of the policies in Chapter 5 of the AASHTO *Policy on Geometric Design of Highways and Streets.*

C.12.a Bridge Width

Bridges are considered functionally obsolete when the combination of ADT and bridge width is used in the National Bridge Inventory Item 68 for Deck Geometry to give a rating of 3 or less. To accommodate future traffic and prevent new bridges from being classified as functionally obsolete, the minimum roadway width for new two lane bridges on low volume roads with 20 year ADT between 100 and 400 vehicles/day shall be a minimum of 22 feet. If the entire roadway width (traveled way plus shoulders) is paved to a width greater than 22 feet, the bridge width should be equal to the total roadway width. If significant ADT increases are projected beyond twenty years, a bridge width of 28 feet should be considered. One-lane bridges may be provided on single-lane roads and on two-lane roads with ADT less than 100 vehicles/day where a one-lane bridge can operate effectively. The roadway width of a one-lane bridge shall be 15 ft. One-lane bridges should have pull-offs visible from opposite ends of the bridge where drivers can wait for traffic on the bridge to clear.

C.12.b Roadside Design

Bridge traffic barriers on low volume roads must have been successfully crash tested to a Test Level 2 (minimum) in accordance with ***NCHRP Report 350*** or ***Manual for Assessing Safety Hardware (MASH).***

Chapter 5 - Pavement Design and Construction

CHAPTER 5

PAVEMENT DESIGN AND CONSTRUCTION

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CHAPTER 5

PAVEMENT DESIGN AND CONSTRUCTION

A INTRODUCTION

The function of the pavement or roadway surface is to provide a safe and efficient travel path for vehicles using the street or highway. The pavement should provide a good riding surface with a minimum amount of distraction to the driver. The pavement friction characteristics should be such that adequate longitudinal and lateral forces between the vehicle tires and the pavement can be developed to allow a margin of safety for required vehicle maneuvers. These characteristics should be provided at the highest reasonable level for the expected pavement surface, weather conditions, and the anticipated operational characteristics of the facility. Resurfacing Rehabilitation and Restoration of existing pavements are discussed and included under Chapter 10 (~~Maintenace~~Maintenance) of the manual.

In order for the pavement to perform its function properly, the following objectives shall be used to guide the design and construction of the pavement:

- Provide sufficient pavement structure and the proper pavement material strength to prevent pavement distress prior to the end of the design period.
- Develop and maintain adequate skid resistance qualities to allow for safe execution of braking, cornering, accelerating, and other vehicle maneuvers.
- Provide drainage to promote quick drying and to reduce the likelihood of hydroplaning and splashing.
- Provide a Safety Edge treatment adjacent to the travel lane on roadways with unpaved shoulders. (*or at the edge of traveled lanes with paved shoulder where the drop off is 2 inches or greater, for discussion at meeting).*

B PAVEMENT DESIGN

B.1 Pavement Type Selection

For new construction and major reconstruction projects, the designer should determine the type of pavement to be constructed utilizing formal analysis of existing and anticipated conditions. High volume roadways where a significant amount of truck traffic (>10%) exists may warrant consideration for special asphalt pavement designs and for rigid pavement designs. ~~—~~The Department has a documented procedure patterned after the ~~1986~~ 1993 AASHTO Guide for Design of Pavement Structures, Appendix B. This procedure may be found in Department's ~~Flexible~~ Pavement Type Selection ~~Design~~ Manual.

B.2 Structural Design

The pavement shall be designed and constructed so the required surface texture is maintained and its structure retains an adequate level of serviceability for the design period. The strength of the pavement materials shall be sufficient to maintain the desired roadway cross section without the formation of ruts or other depressions which would impede drainage. Subgrade strength and subgrade drainage are major factors to be considered in pavement design.

The Department's pavement design manuals are recommended as a guide for both flexible and rigid pavement design. Other design procedures are available including the AASHTO Guide for Design of Pavement Structures, ~~1986~~1993; ~~the AASHTO Interim Guide for Design of Pavement Structures, 1972;~~ and procedures which have been developed by the Portland Cement Association, the American Concrete Pavement Association, and the Asphalt Institute. The selection of the design procedure and the development of the design data must be managed by professional personnel competent to make these evaluations.

B.3 Skid Resistance

Pavements shall be designed and constructed so as to maintain adequate skid resistance for as long a period as the available materials, technology, and economic restraints will permit, thus eliminating cost and hazardous maintenance operations.

The results of relevant experience and testing (i.e., tests conducted by the Department's Materials Office) should be used in the selection of aggregate and

other materials, the pavement mix design, the method of placement, and the techniques used for finishing the pavement surface. The design mixes should be monitored by continuous field testing during construction. Changes to the design mix or construction procedures must be made by qualified pavement designers and laboratory personnel ONLY.

The use of grooving (across the roadway) in concrete pavements frequently improves the wet weather skid resistance and decreases the likelihood of hydroplaning. This technique should be considered for locations requiring frequent vehicle maneuvers (curves, intersections, etc.) or where heavy traffic volumes or high speeds will be encountered. The depth, width, and spacing of the grooves should be such that control of the vehicle ~~operations are~~ is not hindered[mak1].

B.4 Drainage

Adequate drainage of the roadway and shoulder surfaces should be provided. Factors involved in the general pavement drainage pattern include: pavement longitudinal and cross slopes, shoulder slopes and surface texture, curb placement, and the location and design of collection structures. The selection of pavement cross slopes should receive particular attention to achieve the proper balance between drainage requirements and vehicle operating requirements. The use of curbs or other drainage controls adjacent to the roadway surface should be avoided, particularly on high speed facilities. Specific requirements for cross slopes and curb placement are given in CHAPTER 3 - GEOMETRIC DESIGN.

~~The use of grooving (across the roadway) in concrete pavements frequently improves the wet weather skid resistance and decreases the likelihood of hydroplaning. This technique should be considered for locations requiring frequent vehicle maneuvers (curves, intersections, etc.) or where heavy traffic volumes or high speeds will be encountered. The depth, width, and spacing of the grooves should be such that vehicle operations are not hindered.~~

B.5 Shoulder Treatment

The primary function of the shoulder is to provide an alternate travel path for vehicles in an emergency situation~~ and preferred path for bicyclists~~. Shoulders should be capable of providing a safe path for vehicles traveling at roadway speed,

and should be designed and constructed to provide a firm and uniform surface capable of supporting vehicles in distress. Particular attention ~~should~~ shall be given to provid~~e~~ing a smooth transition from pavement to unpaved shoulders ~~and~~ to minimize vertical drop-offs greater than 2 inches. ~~avoiding hazardous "drop-offs."~~

Safety Edge is a technology that mitigates vertical drop offs. The Safety Edge provides a higher probability of a vehicle returning safely to the travel lane when it drifts off the pavement. The wedge shape eliminates tire scrubbing and improves vehicle stability as it crosses a drop-off. Details for the Safety Edge are included in Figures 5 - 1 and 5 - 2.

FIGURE 5 – 1
TWO LANE ROAD WITH SAFETY EDGE

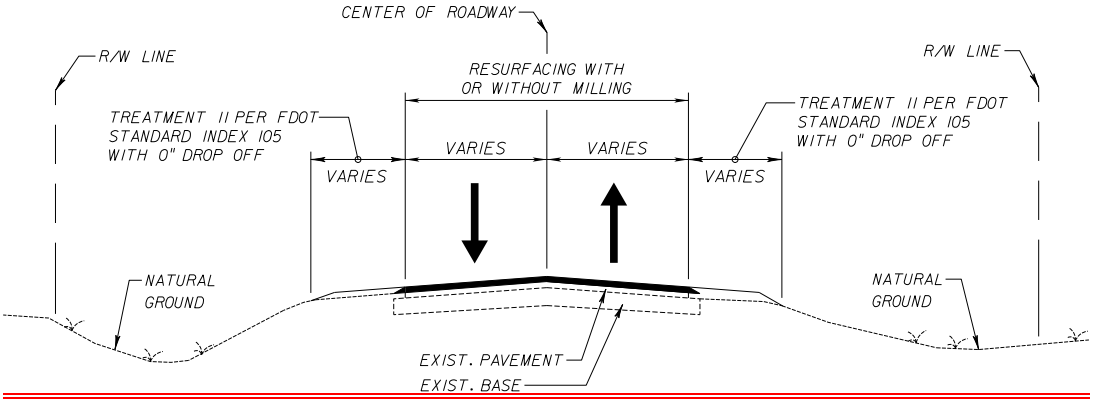
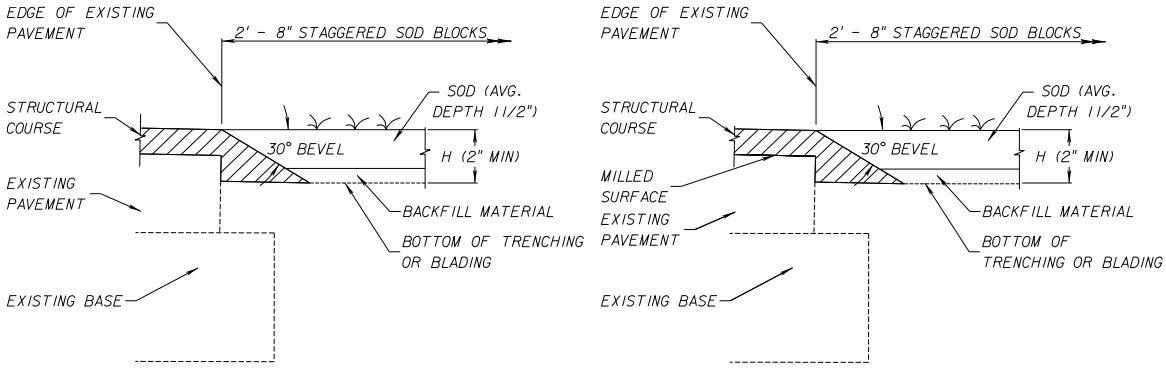


FIGURE 5 – 2
SAFETY EDGE DETAIL (NO PAVED SHOULDERS)



FOR 2" ≤ H ≤ 5"

SINGLE LIFT
SAFETY EDGE DETAIL

Safety Edge shall be applied adjacent to the pavement edge on roadways with no paved shoulder. (*or at the edge of traveled lanes with or without paved shoulder where the drop off is 2 inches or greater, for discussion at meeting*)

~~Paved shoulders~~Shoulder pavement may be provided to improve drainage of the roadway, to serve bicycles, pedestrians and transit users, and to minimize shoulder maintenance.

C PAVEMENT CONSTRUCTION

A regular program of inspection and evaluation should be conducted to ensure the pavement criteria are satisfied during the construction process. Any regular inspection program should include the following:

- The use of standard test procedures, such as AASHTO and the American Society for Testing and Materials (ASTM).
- The use of qualified personnel to perform testing and inspection.
- The use of an independent assurance procedure to validate the program.

After construction, the pavement surface shall be inspected to determine the required surface texture and smoothness was achieved and the surface has the specified slopes. Spot checking ~~of~~ skid resistance by approved methods should be considered. ~~Inspection of the roadway during wet weather conditions should be carried out as soon as possible to quickly locate drainage problems such as depressions in the pavement surface.~~ Periodic reinspection should be undertaken in conformance with the guidelines described in CHAPTER 10 – MAINTENANCE, Section F.4 Pavement Maintenance.

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Chapter 8 – Pedestrian Facilities

assure the pedestrian that a legal crosswalk exists at a particular location.

Marked crosswalks shall not be installed in an uncontrolled environment (without signals, stop signs, or yield signs) when the posted speeds are greater than 40 mph, or on multilane roads where traffic volumes exceed 12,000 vpd (without raised median) or 15,000 vpd (with raised median).

Marked crosswalks can also be used to create midblock crossings.

8.6.1.2~~F.1.b~~ Midblock Crosswalks

Midblock crossings help meet crossing needs within an area. At specific locations where intersections are spaced relatively far apart or substantial pedestrian generators are located between intersections, midblock crossing may be used; however, since midblock crossings are not generally expected by motorists, they should be well signed and marked. Midblock crossings are located according to a number of factors including pedestrian volume, traffic volume, roadway width, traffic speed and type, desired paths for pedestrians, land use, and to accommodate transit connectivity. Midblock crossings should not be installed where sight distance or sight lines are limited for either the motorist or pedestrian. Midblock crossings should be illuminated, marked, and outfitted with advanced warning signs or warning flasher in accordance with the MUTCD.

8.6.1.3~~F.1.c~~ Crossing Distance Considerations

At midblock locations where roadway crossings exceed sixty feet, or where there are a limited number of gaps in traffic, a median or crossing island should be considered and be accessible. When a midblock crossing is provided along a multilane arterial, a median or crossing island is desirable, and consideration should be given to providing supplementary traffic control devices (signs, beacons, signals, etc.).

8.6.2~~F.2~~ Curb Ramps

Curb ramps provide access between the sidewalk and the street for people who use mobility aids such as wheelchairs and scooters, people pushing strollers and pulling suitcases, children on bicycles, and delivery services. Curb ramps, with detectable warnings, meeting the requirements of 2006 ADA Standards for

~~Accessible Design~~Transportation Facilities and the 2012 Florida ~~Building~~ Accessibility Code (Rule 9B-7.0042), Chapter 11, shall be provided at all pedestrian crossings, including mid block crossings and intersections to give persons with disabilities safe access. A level landing is necessary for turning, maneuvering, or bypassing the sloped surface.

8.6.3~~F.3~~ Controls

Signs, signals, and markings should be utilized to provide the necessary information and direction for pedestrians. All directions and regulations should be clear, consistent and logical, and should, at a minimum, conform to the requirements given in the MUTCD. The use of accessible pedestrian signals that include audible and/or vibro-tactile, and visual signals, should be considered for pedestrian traffic control and regulation.

8.6.4~~F.4~~ Sight Distance

The general requirements for sight distances for the driver are given in CHAPTER 3 - GEOMETRIC DESIGN.

Stopping sight distances greater than the minimum should be provided at all pedestrian crossings. These sight distances should include a clear view of the pedestrian approach pathway for at least 15 feet from the outside travel lane. Where parallel pedestrian pathways are within the roadside recovery area, or where casual pedestrian crossings are likely, the normal required stopping sight distance should also include a clear view of the entire roadside recovery area.

Sight distances shall be based upon a driver's eye and object height as discussed in CHAPTER 3 – GEOMETRIC DESIGN. Due to the small size of some pedestrians (particularly children), they are generally easy to confuse with other background objects.

Parking shall be prohibited where it would interfere with the required sight distance. Particular care should be exercised to ensure ample mutual sight distances are provided at all intersections and driveways.

Chapter 10 – Maintenance and 3R Criteria

CHAPTER 10

MAINTENANCE AND RESURFACING

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CHAPTER 10

MAINTENANCE AND RESURFACING

10.1~~A~~ INTRODUCTION

In order to provide for the safe and efficient movement of all modes of traffic, it is essential to maintain all aspects of the road and right of way at the highest reasonable level of safety. Improvements consistent with upgrading safety standards or accommodating changes in traffic are also required to maintain the facility in a quality condition. Maintenance is a costly operation, therefore, every effort should be made to provide the maximum safety benefit from each maintenance operation. The fact that a major portion of the maintenance effort is necessary to merely preserve the economic investment in a facility should not be considered as justification for sacrificing the requirements for maintaining or improving the safety characteristics of a street or highway.

10.2~~B~~ OBJECTIVES

The major objectives of a maintenance program include the following:

- Maintain all highway features and components in the best possible condition
- Improve sub-standard features, with the ultimate goal to at least meet minimum standards
- Provide for minimum disruptions and hazards to traffic during maintenance operations
- Location and reporting of inadequate safety features

10.3C POLICY

Each highway agency responsible for maintenance shall develop and maintain a program of highway maintenance for the entire highway network under its jurisdiction. This program should include the following activities:

- Identify needs
- Establish priorities
- Establish procedures
- Establish and maintain a regular program of maintenance for all aspects

The program should be regularly evaluated and suitably modified to promote the maintenance of streets and highways in the best practicable condition.

10.4~~D~~ IDENTIFICATION OF NEEDS

The identification of maintenance needs is the first stage in the development of a successful maintenance program, and is required when any portion of the highway system is in a sub-standard condition. Action is also required to correct any situation which is hazardous or may become hazardous in the near future. This may be accomplished by both regular inspection of the highway network and proper analysis of crash records.

10.4.1~~D.1~~ Inspection

Periodic and systematic inspection of the entire highway network under each agency's jurisdiction is required to identify situations requiring improvements, and corrections or repairs. These inspections should be conducted by maintenance or traffic operations personnel, or other qualified personnel who are trained in the aspects of highway maintenance requirements.

10.4.2~~D.2~~ Crash Records

A regular program of crash investigations, record keeping, and analysis should be established to provide information for recommended highway modification and corrective maintenance requirements. Cooperation among maintenance, traffic operations, and police agencies is required, and activities of these agencies should be coordinated in accordance with the guidelines set forth in Highway Safety Program Guideline 21 (II)~~9~~ Identification and Surveillance of Accident Locations. Inspection of the highway network and analysis of crash records should be utilized to provide feedback for modification of design and construction procedures.

10.5~~E~~ ESTABLISHMENT OF PRIORITIES

The maintenance activities determined to be necessary by the identification program should be carried out on a priority basis. The establishment of priorities should be based, to a large extent, upon the objective of promoting highway safety. A high priority should be given to the improvement or correction of situations that may result in fatal or serious crashes. Preservation of highway investment and promotion of efficient traffic operations are important maintenance objectives. Every effort should be made to ensure the highest safety payoff from the maintenance dollar.

10.6~~F~~ESTABLISHMENT OF PROCEDURES

Standard procedures and methods for maintenance operations should be established for efficient, rapid, and safe completion of the required work. All maintenance work shall be conducted in accordance with the Standards set forth in CHAPTER 11 - WORK ZONE SAFETY. Each maintenance agency should develop its own Maintenance Manual or utilize the Maintenance Manuals of the Department. Such manuals should specify the methods, procedures, equipment, personnel qualifications, and other aspects of the work necessary to ensure successful completion of maintenance operations. Procedures should be developed for emergency, routine, and special operations.

10.6.1~~F.1~~ Emergency Maintenance

Emergency maintenance operations are those required to immediately restore the highway to a safe condition. Emergency maintenance work should be carried out by personnel who are specially trained and qualified. Work units, which should be available on a twenty-four hour basis, should be connected with the emergency response communications system. Emergency operations would include the following:

- The removal of debris from crashes, cargo spillage, or other causes. This activity should be conducted in accordance with the guidelines set forth in Highway Safety Program Guideline 16, Debris Hazard Control and Cleanup.
- Replacement of inoperative traffic control devices
- Repair or replacement of damaged highway safety components such as lighting, traffic control devices, redirection, and energy absorbing devices
- Repair or correction of any situation that provides an immediate or unexpected hazard to the public
- Assistance in any activity during emergency response operations

10.6.2~~F.2~~ Routine Maintenance

Routine maintenance operations are those that may be predicted and planned in advance. These operations, which may be preventive or corrective in nature, should be conducted on a regularly scheduled basis using standard procedures. Proper scheduling of these operations should be utilized to provide minimum

disruptions and hazards to the driving public. Routine maintenance would include operations such as:

- Cleaning and debris removal from the pavement, shoulders, and roadside clear zones
- Mowing and other vegetation control operations to provide a smooth recovery area and to maintain proper sight distance
- Cleaning and inspection of gutters, ditches, and other drainage structures
- Structural inspection and preventive maintenance on bridges and other structures
- Cleaning, replacement, and maintenance of roadway lighting fixtures
- Replacement and maintenance of traffic control devices
- Inspection and maintenance of redirection and energy absorbing devices (CHAPTER 4 - ROADSIDE DESIGN)
- Inspection and maintenance of emergency response communication systems and access facilities
- Inspection and maintenance of pavement and shoulders, with particular emphasis on maintaining shoulders flush with the pavement (CHAPTER 5 - PAVEMENT DESIGN, CONSTRUCTION AND MAINTENANCE)
- Inspection and maintenance of all highway components and safety features
- Inspection and maintenance of pedestrian pavements, crossings, etc., with particular emphasis on meeting the intent of ADA

10.6.3~~F.3~~ Special Maintenance

Special maintenance operations are defined as those projects that are neither urgent or routine in nature, but are occasionally required to improve or maintain a street or highway in a quality condition. Since these projects can be planned in advance of the initiation of any work, procedures that provide for efficient, rapid, and safe operations can be developed. To avoid continuing disruptions of traffic, the quality and durability of these improvements, corrections, and repairs should be maintained at the highest practicable level. Special maintenance should include the

upgrading of the highway safety features, as well as the repair or replacement of damaged or deteriorated highway components. These operations should be designed to upgrade or maintain the street or highway in accordance with the Standards presented in this Manual.

10.6.4~~F.4~~ Pavement Maintenance

The primary purpose of pavement maintenance is to ensure the pavement characteristics prescribed in CHAPTER 5 – PAVEMENT DESIGN AND CONSTRUCTION, are reasonably maintained. Each agency with responsibility for maintenance of streets and highways shall establish a meaningful pavement maintenance system (including shoulders and drainage structures) for the entire system under its jurisdiction. This program should include:

- A process that monitors the serviceability of the existing streets and highways and identifies the pavement sections that are inadequate
- A systematic plan of maintenance activities designed to correct structural deficiencies and to prevent rapid deterioration
- A preservation program, with assigned priorities, designed to resurface, reconstruct, or replace pavements when they are no longer structurally serviceable

Pavement maintenance requires a substantial portion of the total maintenance budget for streets and highways. It is necessary to ensure highway safety. A smooth-riding, skid-resistant surface must be provided at all times to allow for safe vehicle maneuvers. The reduction of hydroplaning and splashing is essential for promoting safe and efficient operation during wet weather conditions. The elimination of driving discomfort, and vehicle damage caused by deteriorated pavements, provides additional economic justification for maintaining the pavement in a fully serviceable condition.

It is recognized that a comprehensive preservation program is expensive. Adequate financing is required to successfully carry out these activities. The establishment of appropriate budget priorities and careful planning can assist in developing and conducting a pavement maintenance and preservation program that will, within a reasonable number of years, bring substandard pavements up to the required level of serviceability and will maintain the adequacy of the entire system.

10.6.4.1 Resurfacing

Resurfacing work is defined as work undertaken to extend the pavement service life and/or enhance highway safety. This includes the placement of additional surface materials and/or other work necessary to return an existing roadway pavement to a condition of structural and functional adequacy.

10.6.5 ADA Requirements

On resurfacing projects, detectable warnings and curb ramps shall be brought into compliance with ADA requirements. This includes installing new detectable warnings for both flush shoulder and curbed roadway connections and signalized driveways where none exist or do not meet current requirements. New curb ramps shall be provided on curbed roadways where none exist; existing substandard curb ramps shall be replaced. Existing ramps not meeting detectable warning requirements which otherwise comply with ADA, shall be retrofitted with detectable warnings. (See Index 304 & 310 of the Design Standards, for guidance on detectable warnings.)

When compliance with ADA curb ramp requirements is determined to be technically infeasible documentation as a Design Exception is required. This may occur where existing right of way is inadequate and where conflicts occur with existing features that cannot be feasibly relocated or adjusted, e.g., drainage inlets, signal poles, pull boxes, etc...

Other than meeting detectable warning and curb ramp requirements, existing sidewalks and flared driveway turnouts are not required to be upgraded for the sole purpose of meeting ADA requirements, unless included in the project scope. All new sidewalk and driveway construction or reconstruction included on resurfacing projects shall be designed in accordance with ADA requirements. However, even if new sidewalk is to be constructed, non-conforming driveways are not required to be upgraded.

10.6.6 Railroad-Highway Grade Crossing Near or Within Project Limits

Federal-aid projects must be reviewed to determine if a railroad-highway grade crossing is within the limits of or near the terminus of the project. If such railroad-highway grade crossing exists, the project must be upgraded to meet the latest ***MUTCD*** requirements in accordance ***Title 23 United States Code (U.S.C.), Chapter 1, Section 109(e)*** and ***CFR 646.214(b)***. These requirements are located in ***Chapter 8*** of the ***MUTCD***. "Near the terminus" is defined as being either of the following:

1. If the project begins or ends between the crossing and the MUTCD-mandated advanced placement distance for the advanced (railroad) warning sign. See ***MUTCD, Table 2C-4*** (on page 2C-6, Condition B, column "0" mph) for this distance.
2. An intersection traffic signal within the project is linked to the crossing's flashing light signal and gate.

ADA

disruptions and hazards to the driving public. Routine maintenance would include operations such as:

- Cleaning and debris removal from the pavement, shoulders, and roadside clear zones
- Mowing and other vegetation control operations to provide a smooth recovery area and to maintain proper sight distance
- Cleaning and inspection of gutters, ditches, and other drainage structures
- Structural inspection and preventive maintenance on bridges and other structures
- Cleaning, replacement, and maintenance of roadway lighting fixtures
- Replacement and maintenance of traffic control devices
- Inspection and maintenance of redirection and energy absorbing devices (CHAPTER 4 - ROADSIDE DESIGN)
- Inspection and maintenance of emergency response communication systems and access facilities
- Inspection and maintenance of pavement and shoulders, with particular emphasis on maintaining shoulders flush with the pavement (CHAPTER 5 - PAVEMENT DESIGN, CONSTRUCTION AND MAINTENANCE)
- Inspection and maintenance of all highway components and safety features
- Inspection and maintenance of pedestrian pavements, crossings, etc., with particular emphasis on meeting the intent of ADA (especially sidewalk cracks, joint separations, accumulated debris, adjacent landscape materials, etc.)
-

10.6.3~~F.3~~ Special Maintenance

Special maintenance operations are defined as those projects that are neither urgent or routine in nature, but are occasionally required to improve or maintain a street or highway in a quality condition. Since these projects can be planned in advance of the initiation of any work, procedures that provide for efficient, rapid, and

Chapter 13 – Public Transit

13.3C TRANSIT COMPONENTS

13.3.1C.1 Stops and Station Areas

Where new bus stops pads are constructed located at bus stopswith bus, bays, or other areas where a lift or ramp is to be deployed, they shall have a boarding and alighting area consisting of a firm, stable and slip-resistant surface, minimum clear length of 96 inches (measured from the curb or vehicle roadway edge), minimum clear width of 60 inches (measured parallel to the vehicle roadway) to the maximum extent allowed by legal or site restraints, and shall be connected to streets, sidewalks, or pedestrian paths by an accessible route. The slope of the boarding and alighting area pad parallel to the roadway shall, to the extent practicable, be the same as the roadway. For water drainage, a maximum slope of 1:50 (2%) perpendicular to the roadway is allowed. In cases where there are no sidewalks or curbs, bus stop boarding and alighting area pads may be necessary to allow the wheelchair passengers to board or alight from a transit vehicle. Coordination with the appropriate public transit provider(s) is necessary.

13.3.2C.2 Shelters

Every public transit system has different needs with regards to shelters and corresponding amenities (e.g., benches, information kiosks, leaning posts, trash receptacles, etc.). Shelter foundation and associated pad size vary from stop to stop based on right of way availability, line of sight, facility usage, etc. New or replaced bus shelters shall be installed or positioned as to permit a wheelchair or mobility aid user to enter from the public way and to reach a location therein having a minimum clear floor area of 30 inches by 48 inches, entirely within the perimeter of the shelter. Such shelters shall be connected by an accessible route to the boarding and alighting area provided under 13.3.1C.1 Stops and Station Areas, this Chapter. Coordination with the appropriate public transit provider(s) is necessary. All shelters should provide a location for a bicycle rack. Shelters should be installed at locations where demand warrants installation and in accordance with clear zone criteria in CHAPTER 3 – GEOMETRIC DESIGN (3.3.10.5C.10.e and Table 3-12) of this Manual.

13.3.3C.3 Benches

Bench placement should shall be in an accessible location (i.e., not on the far side of a drainage ditch from the actual bus stop), but appropriately out of the path of

travel on a sidewalk and shall have an adjacent surface at least 30 inches wide and 48 inches deep to allow a wheelchair user to sit next to the bench permitting shoulder-to-shoulder seating with a companion. Connection between the sidewalk and/or bus stop boarding and alighting area shall pad should be provided. Coordination with the Public Transportation Office and the local public transit provider(s) is necessary.

13.3.4C.4 Concrete Bus Stop Boarding and Alighting AreasPads

Although not always practical, there are situations where concrete bus stop boarding and alighting area pads should be incorporated into the pavement design of a project. Frequent stopping transit vehicles in a particular location is an example where concrete pads may be warranted.

13.3.5C.5 Bus Bays (Pullout or Turnout Bays)

In some situations, turnout bays for transit vehicles are appropriate (i.e., consistent slow boarding, layover needs, safety reasons, high speed traffic, etc.). Bus bays can be designed for one or more buses. Coordination with the Public Transportation Office and/or the local public transit provider(s) will help determine the need for and justification of bus bays. When possible, bus bays should be located on the far side of a signalized intersection. The traffic signal will create the critical gap needed for bus re-entry into traffic. There are several publications available which provide additional design information for transit system applications. The Department District Public Transportation Office(s) maintains a library of these publications.

13.3.6C.6 Promote Public Transit

All citizens and businesses in the State of Florida are encouraged to promote public transit. This can be done in many ways, from providing employees reduced fares to providing route maps and schedules. Work with your local transit agency to provide service to large employment areas and major attractions. Assist local transit agencies in providing such things as bus lanes, park and ride lots and easements for bus shelters and bicycle parking. Encourage businesses or neighborhoods to hold a "Commuter Choices Week" and invite your transit agencies to provide information on the advantages of using transit. "Commuter Choices Week" is a state sponsored event that promotes alternative transportation in the work place (walk, bike, bus, transit, telecommuting).

13.4D PUBLIC TRANSIT FACILITIES

When a project includes a public transit route, curb-side and street-side transit facilities for bus stops should be considered in the roadway design process.

The "Accessing Transit: Design Handbook for Florida Bus Passenger Facilities" and "Transit Vehicle and Facilities on Streets and Highways" provide guidance relating to provisions for curb-side and street-side facilities. Both may be found on the Public Transportation Office website: http://www.dot.state.fl.us/transit/.

13.4.1D.1. Curb-Side Facilities

Curb-side facilities are the most common, simple and convenient form of facilities at a bus stop. These include bus stop signs, passenger waiting shelters, bus stop wheelchair access pad, benches, leaning rails, and shelter lighting. Chapter 1 of "Accessing Transit" provides additional details for each facility that may be considered as guidelines. Coordination with the appropriate public transit provider(s) may be necessary in developing the plans.

13.4.2D.2 Street-Side Facilities

Bus stop locations can be categorized as far side, near side and mid block stops. Bus stops may be designed with a bus bay or pullout to allow buses to pick up and discharge passengers in an area outside of the travel lane. This design feature allows traffic to flow freely without the obstruction of stopped buses. See Figure 13-1 for typical detail for the bus stop and bus bay categories. Chapter 2 of "Accessing Transit" provides additional details that may be considered as guidelines.

The greater distance placed between waiting passengers and the travel lane increases safety at a stop. Bus bays are classified as closed, open or bulbs. Detailed standard drawings that may be considered for various bus bay configurations are provided in "Transit Facilities Guidelines" on the Public Transportation Office website: http://www.dot.state.fl.us/transit/.

The total length of the bus bay should allow room for an entrance taper, a stopping area, and an exit taper as a minimum. However, in some cases it may be appropriate to consider providing acceleration and deceleration lanes depending on

13.5E REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications that may be referenced for further guidance:

- FDOT "Accessing Transit Design Handbook for Florida Bus Passenger Facilities" on the Public Transportation Office web site: http://www.dot.state.fl.us/transit/Pages/NewTransitFacilitiesDesign.shtm
- ~~http://www.dot.state.fl.us/transit/~~
- "Transit Facilities Guidelines" on the Public Transportation Office web site: http://www.dot.state.fl.us/transit/
- "Transit Vehicle and Facilities on Streets and Highways", from Transit Cooperative Research Program (TCRP) of the Transportation Research Board of the National Research Council January 2007

Chapter 17 – Bridges and Other Structures

CHAPTER 17

BRIDGES AND OTHER STRUCTURES

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CHAPTER 17

BRIDGES AND OTHER STRUCTURES

17.1~~A~~ INTRODUCTION

Bridges provide safe passage for multimodal traffic over various obstacles along a road or path. This chapter presents guidelines and standards for designing, constructing, inspecting, and maintaining bridges as well as other structures such as walls and supports for signs, lights, and traffic signals. These standards and criteria are necessary due to the critical function these structures serve to communities throughout their lifespan. This chapter establishes uniform minimum standards and criteria for all bridges used by the public for vehicular and/or pedestrian traffic as well as other structures such as walls and supports for signs, lights, and traffic signals. The geometry of structures shall follow the standards and criteria set forth in Chapters 3, 8, 9, and 13. Exceptions to these standards and criteria must be processed in accordance with the procedures described in Chapter 14.

All bridges constructed on and over the Department's system, as well as all bridges ~~constructed~~ that will be maintained by the Department ~~will maintain~~, must comply with all Department policies, procedures, standards and specifications, and this Manual does not apply.

17.2~~B~~ OBJECTIVES

The objectives of this chapter are as follows:

- To prescribe uniform criteria with respect to bridge design loads, design methodology, and geometric layout.
- To alert owners to the various federal and state ~~mandated considerations~~requirements to be included in the design, construction, maintenance, and inspection of their bridges.
- To provide practical suggestions specific to Florida on prudent bridge engineering based on past experience with statutes, standards, and criteria.

17.3C DESIGN

The design of bridges and other structures shall be led by a licensed professional engineer who shall assume responsible charge of the work. The standards and criteria included herein are directed only toward specific considerations that shall be followed. Other considerations are necessary to create a comprehensive bridge design allowing owners and their engineers flexibility in design.

17.3.1C.1 General

All bridges and other structures shall be designed in accordance with specifications (including guide specifications) published by the American Association of State Highway and Transportation Officials (AASHTO). At a minimum, the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 5th 6th Edition (20102012) shall be used.

The design of all bridge facilities shall consider both the economic use of materials and the sound application of aesthetic principles. According to Section 336.045, Florida Statutes:

> "*In developing such standards and criteria, the department shall consider design approaches which provide for the compatibility of such facilities with the surrounding natural and manmade environment; …and the appropriate aesthetics based upon scale, color, and architectural style, materials used to construct the facility, and the landscape design and landscape materials around the facility…*"

17.3.2C.2 Bridge Live Loads

All elements of the bridge should be designed for the vehicular and pedestrian live loads specified in AASHTO LRFD Specifications Sections 3.6.1 and 3.6.2.

In addition to the notional design loadvehicles specified in LRFDthe code, designbridges shall also require for a FL 120 permit load rating greater than 1vehicles as define in the FDOT Structures Manual Structures Design Guidelines. This vehicle allows for a more consistent load rating comparisonprocess considering the current bridge inventory.with different characteristics are legal on the Department's system. These vehicles are illustrated in the Department's "Bridge Load Rating, Permitting and Posting Manual" and should be considered.

17.3.3~~C.3~~ Bridge Superstructure

The superstructure of a bridge is that portion of the structure that spans between its supports or piers. Considerations that shall be incorporated into the design of all superstructures will include the following:

17.3.3.1 Girder Transportation

The EOR is responsible for investigating the feasibility of transportation for heavy, long and/or deep girder field sections. In general, the EOR should consider the following during the design phase:

- Whether or not multiple routes exist between the bridge site and a major transportation facility.
- The transportation of field sections longer than 130 ft or weighing more than 160,000 pounds requires coordination through the Department's Permit Office during the design phase of the project. Shorter and/or lighter field sections may be required if access to the bridge site is limited by roadway~~(s)~~ with sharp horizontal curvature or weight restrictions.
- On steel superstructures, where field splice locations required by design result in lengths greater than 130 feet, design and detail "Optional Field Splices" in the plans.
- For curved steel box girders, prefabricated trusses, and integral pier cap elements, size field pieces such that the total hauling width does not exceed 16 feet.

17.3.3.2 ~~C.3.a~~ Vertical Clearance

All new bridges over roadways and shared use paths shall be designed to meet the vertical clearance standards specified in Chapter 3, Section 3.3.7.10.4.2~~C.7.j.4.(b)~~, and Chapter 9, Section 9.3.4~~C.4~~.

All new bridges over water shall be designed to meet the following vertical clearance standards:

- To allow debris to pass without causing damage, the clearance between the design flood stage and the low member of bridges shall be a minimum of two feet. This standard does not apply to culverts and bridge-culverts.

- For crossings subject to boat traffic, the minimum vertical navigation clearance should be:

Tidewater bays and streams	6 feet above Mean High Water *
Freshwater rivers, streams, non-regulated/controlled canals, and lakes	6 feet above Normal High Water
Regulated/controlled lakes and canals	6 feet above control elevation

* For locations subject to tidal salt / brackish water splashing, a 12 foot vertical clearance above Mean High Water should be considered for bridge durability reasons.

Higher clearances apply for crossings over legislated channels under the control of the U.S. Coast Guard (USCG). Designers should also consider future navigation demands and future shared use path demands in setting the vertical clearance of a bridge.

17.3.3.3~~2~~C.3.b Railings

All traffic, pedestrian, and bicycle railings shall comply with the requirements in Section 13 of ~~AASHTO's~~ LRFD ~~Bridge Design Specifications, 5th Edition (2010)~~. Traffic railings shall meet the crash requirements of at least Test Level 3 (TL-3) for bridges with design speeds greater than 45 mph and at least TL-2 for design speeds less than or equal to 45 mph.

For pedestrian/bicycle railings, two-pipe guiderails and details (similar to the Department's Design Standards, Indexes 870 or 880) ~~shall not~~may be mounted on walls or other structures where drop-off hazards ~~exceed 2'-6"~~are 5 feet or less. ~~Instead, c~~Concrete, aluminum~~,~~ or steel~~, or composite picket~~ railing and details (similar in strength and geometry to the Department's Design Standards, Indexes 820 thru 862~~, 850 or 860~~) sh~~ould~~all be used (or modified to suit environmental runoff concerns) where drop-off hazards are greater than 5 feet. See the appropriate Instructions for Design Standards (IDS) for more information.

17.3.3.4~~3~~C.3.c Expansion Joints

The number of joints should be minimized to reduce the inspection and maintenance needs of the bridge.

17.3.3.5~~4~~C.3.d Drainage

All bridge designs shall include a drainage design that is specific to its site. Conveyance of drainage off the bridge roadway should be designed to meet spread standards contained in the Department's Drainage Manual, Chapter 3 and may include open systems (i.e., scuppers) or closed systems (i.e., inlets and pipes) based on environmental permitting restrictions. Drainage from the bridge should not drop onto traffic below. Longitudinal conveyance piping attached to bridges is expensive and maintenance-intensive, and should be avoided whenever possible. Conveyance of drainage off pedestrian facilities shall meet the provisions of the Americans with Disabilities Act (ADA). Further guidance on the design of bridge deck drainage may be found in the current version of FHWA Publication HEC-21, "Bridge Deck Drainage Systems."

17.3.3.6~~5~~C.3.e ADA

All bridges that include provisions for pedestrians shall provide pedestrian accommodations and design considerations that meet the provisions of

the ADA. Significant ADA design considerations exist for all facilities with grades that exceed 5%.

17.3.3.76C.3.f End Treatments

Requirements for end treatments of structures are given in CHAPTER 4 – ROADSIDE DESIGN. Bridge barriers shall be designed to accommodate connection of a guardrail transition or energy absorbing system.

17.3.4C.4 Bridge Substructure

The substructure of a bridge consists of all elements below the superstructure including its bearings, piers, and foundations. For guidance on bridges vulnerable to coastal storms, see SDG Section 2.5. Considerations that shall be incorporated into the design of all substructures include the following:

17.3.4.1C.4.a Scour

A hydrologic/hydraulic analysis shall be performed to quantify expected stages and flows at the bridge site. Anticipated substructure scour shall be developed for the following:

- Worst case scour condition up through the 100-year frequency flood event (Scour Design Flood Event).
- Worst case scour condition up through the 500-year frequency flood event (Scour Check Flood Event).

Any exceptions to the standards above hydrologic/hydraulic and scour analysis requirements shall be approved in writing by the Department's local District Drainage Engineer. Methodology for computing bridge hydrology/hydraulics and bridge scour should follow the guidelines set forth in the most recent versions of the Department's "Drainage Manual." Further guidance and training may be obtained through FHWA Hydraulic Engineering Circulars (HEC) "HEC-18" and "HEC-20" and the Department's training courses on these topics. Additionally, for larger bridges (>120,000 sq. ft.), hydraulic designers may wish to consult with the local Department District Drainage Engineer for case-specific guidance. Scour load combinations with other loads shall be as per the Department's Structures Manual Volume 1 -Structures Design Guidelines (SDG), Section 2.12 (and subsequently Section 2.11 of the SDG, the Department's Drainage Manual, Chapter 4, and the AASHTO LRFD Bridge Design Specifications, Sections 3.3.2, 3.14.1 and Table 3.4.1-1 as

applicable).

{Add reference to FDOT fender design standard}
{Add guidance for hurricane susceptibility to storm surge}

17.3.4.2~~C.4.b~~ Vessel Impact

All bridges over USCG designated navigable waterways shall include consideration for potential vessel collision. Such collisions generally occur from barges or oceangoing ships. The engineer shall conduct a vessel risk analysis to determine the most economical method for protecting the bridge. This shall include either designing the bridge to withstand the vessel collision, or protecting it with dolphin cells. Fender systems should only be used to designate the channel width and not for pier protection. The above risk analysis may be conducted utilizing the Department's computer program "Vessel Impact Risk Analysis." For load combinations, use Load Combination "Extreme Event II" as follows:

(Permanent Dead Loads) + WA+FR+CV

With all load factors equal to 1.0 where WA are water loads, FR are friction forces and CV are the vessel collision loads. Nonlinear structural effects must be included and can be significant. It is anticipated that the entire substructure (including piles) may have to be replaced and the superstructure repaired if a bridge is subjected to this design impact load; however, the superstructure must not collapse.

Note: Further refinement or complication of this load case is unwarranted.

Further guidance ~~and training~~ may be obtained from the SDG, Section 2.11 and ~~AASHTO's~~ LRFD ~~Bridge Design Specifications,~~ Section 3.14.

For guidance on bridge fender system design, see SDG Section 3.14 and FDOT Design Standard Indexes 21900 and 21930.

{add reference to FDOT vessel traffic data for ships and barges}

17.3.4.3~~C.4.c~~ Pier Locations

All bridges over roadways shall have substructures supports set back from vehicular traffic lanes in accordance with Chapter 3, Section

3.3.7.10.4.1~~C.7.j.4.(a)~~.

All bridges over water shall have substructure supports located with horizontal clearance requirements as listed below. In this case, horizontal clearance is defined as the clear distance between piers, fender systems, culvert walls, etc., projected by the bridge normal to the flow.

- For crossings subject to boat traffic a minimum horizontal clearance of 10 feet shall be provided.
- Where no boat traffic is anticipated, horizontal clearance shall be provided consistent with debris conveyance needs and structure economy.

~~**C.4.d Bearings**~~

~~The bridge superstructure and substructure should be designed for the complete replacement of the interfacing bearings.~~

17.4~~D~~ CONSTRUCTION

During the construction of a bridge or any structure at, over, or near a public facility, safety awareness is necessary and precautions shall be taken to protect the public. Provisions for protecting the public during construction shall be in accordance with the MUTCD work zone traffic control procedures and the standards and criteria described in Chapter 11. Worker safety is the responsibility of the contractor. Temporary barriers shall be installed on all bridges being widened or whose new construction is phased. Spread of stormwater on the bridge deck should be considered in planning temporary traffic routing.

During the construction of a bridge or any structure, records to be kept and maintained throughout its life shall include foundation construction records (pile driving records, shaft tip elevations, borings) and as-built plans. These records provide critical information necessary for future inspection, maintenance, emergency management, enhancement, reconstruction, and/or demolition of these structures. These records shall be delivered to the Department's local District Structures Maintenance Engineers.

Any proposed changes to the construction details or specifications shall be signed, sealed, and dated by a professional engineer licensed in the State of Florida.

17.5E ROUTINE INSPECTION AND MAINTENANCE

Title 23, Code of Federal Regulations, Part 650, Subpart C, sets forth the National Bridge Inspection Standards (NBIS) for bridges on all public roads. Section 650.3 defines bridges, specifies inspection procedures and frequencies, and indicates minimum qualifications for personnel. Each state is permitted to modify its bridge inspection standards to deviate from the NBIS standards but only following approval from the FHWA.

Section 335.074, F.S., mandates safety inspection of bridges as follows:

"At regular intervals not to exceed 2 years, each bridge on a public transportation facility shall be inspected for structural soundness and safety for the passage of traffic on such bridge. The thoroughness with which bridges are to be inspected shall depend on such factors as age, traffic characteristics, state of maintenance, and known deficiencies. The governmental entity having maintenance responsibility for any such bridge shall be responsible for having inspections performed and reports prepared in accordance with the provisions contained herein."

This statute also defines the minimum dimensions of bridge structures that must be inspected as follows:

"Those bridges having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches or extreme ends of openings for multiple boxes and those bridges consisting of multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening…"

Bridge inspectors shall be certified in accordance with Chapter 14-48, F.A.C. Safety inspection of bridges shall be conducted in accordance with Chapter 14-48, F.A.C.

The Department inspects all bridges in Florida, both on-system and off-system. The Department provides each local government with copies of its inspection reports. Each local government should maintain these reports to be responsive to Metropolitan Planning Organization requests for bridge rehabilitation, replacement, or enhancement designations.

All on-system and off-system bridges are assigned a Bridge Number by the Department. For new bridges, ~~L~~local agencies shall contact the Department's local District Structures Maintenance Engineers to have a number assigned.

{Add information on policy for inspecting pedestrian bridges}

17.6~~F~~ RECONSTRUCTION

Any reconstruction (i.e., lengthening, widening, and/or major component replacement) shall be designed as specified in Section 17.3~~C~~ of this chapter. Record of such reconstruction shall be maintained as specified in Section 17.4~~D~~ of this chapter. The remaining design life should be considered in the design of a repair on the project.

~~G~~17.7 BRIDGE LOAD RATING, PERMITTING, AND POSTING

Section 335.07, F.S., mandates a sufficiency rating system for roads on the State Highway System. This statute also applies to bridges. This rating system considers the structural adequacy, safety, and serviceability of the road/bridge. The Department provides the posting information, if required, to the local agency owner and requires the owner to provide the appropriate signage to be promptly installed in accordance with the MUTCD. Bridge load ratings~~For bridges, the determination of this rating~~ shall be accomplished using procedures in the Department's ~~2006~~ "Bridge Load Rating~~, Permitting and Posting~~ Manual", ~~and~~ Structures Design Guidelines Section 7.1.1 ~~Department's Structures Manual Volume 8 - FDOT Modifications to Manual for Condition Evaluation~~ and AASHTO's Bridge Evaluation Manual~~Load and Resistance Factor Rating (LRFR) of Highway Bridges~~. If necessary, the bridge owner shall post all bridges in the National Bridge Inventory (NBI) within 90 or 180 days of ~~opening or~~ a change in load rating for on-system or off-system bridges, respectively.

For new construction or reconstruction, the bridge owner shall perform a load rating and provide the Department with a completed Bridge Load Rating Summary Form (see the Department's "Bridge Load Rating Manual"~~Structures Manual Volume 8~~) within 90 or 180 days of opening for on-system or off-system bridges, respectively. The bridge owner should consider requiring the engineer of record to perform the load rating.

17.8~~H~~ OTHER STRUCTURES

17.8.1~~H.1~~ Retaining Walls ~~(Retaining~~ and Sound Barriers~~)~~

The design of conventional, anchored, mechanically stabilized, and prefabricated modular retaining wall structures shall meet the requirements of ~~AASHTO's~~ LRFD ~~Bridge Design Specifications,~~ Section 11. Local agencies should consider using only wall types approved by the Department. These are described in Section 3.12 of the SDG. Local agencies should also follow the design criteria for retaining walls found in Section 3.13 of the SDG.

The design of sound walls shall meet the requirements of the SDG and LRFD~~AASHTO's Guide Specifications for Structural Design of Sound Barriers (1989) with the 2002 Interims~~. For sound walls within the clear zone, the~~ir~~ design and/or protection shall comply with the following:

- ~~Do not attach~~ For sound barriers attached to the top of traffic railings ~~unless the system has been~~only use crash tested systems consistent with the design speed of the facility. The Department has standards for TL-4 systems that meet the requirements of NCHRP Report 350.

- Non-crash tested sound barriers may be attached to structures if located behind an approved traffic railing and mounted at least five feet from the face of the traffic railing at deck level.

Potential existing off-site stormwater inflows through the proposed wall location should be verified in the field and considered in the wall design. Additional considerations for the design of sound barrier walls may be found in Volume 1, Chapter 32 of the Department's Plans Preparation Manual (PPM). For railings on top of walls, see Section 17.3.3.32C.3.b.

17.8.2H.2 Sign, Lighting, and Traffic Signal Supports

The design of sign, lighting, and traffic signal support these structures shall meet the requirements of AASHTO's Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals Fifth Edition (2009) with 2010 and 2011 Interims, and the Department's Structures Manual Volume 9 - FDOT Modifications to Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals (LTS-5).

The Department maintains a Qualified Products List (QPL) for the supply of single column ground signs, aluminum light poles, high mast light poles, strain poles, and mast arm assemblies for use on the State Highway System.

{add guidance for Dynamic Message Signs}

17.8.3 Pedestrian Bridges

For guidance on pedestrian bridges, see SDG Chapter 10.

17.9I RECOMMENDATIONS

- Involve the public in determining "*the appropriate aesthetics based upon scale, color, and architectural style, materials used to construct the facility, and the landscape design and landscape materials around the facility…" (Section 336.045, F.S.).*
- Resist the temptation to enhance the aesthetics of a bridge with non-structural appurtenances and features that are novel and therefore may have safety challenges (otherwise, consult with the Department on these safety issues).
- Consider the potential for future expansion of a bridge's capacity (vehicular transit and pedestrian) in its layout and bridge-type selection.
- Use the Department's objective construction unit prices (contained in the Structures Design Guidelines, Sections 9.2 and 9.3) to select bridge type(s) to consider for final design.
- Consider the use of alternative designs (i.e., steel superstructures vs. concrete superstructures) to increase bidding competition on very large bridge construction projects.
- Consider factors other than economics in decisions on a bridge's basic design and its discretionary features.
- Invest in a comprehensive subsurface investigation of the site before any significant design of the bridge occurs (which will also help avoid unforeseen conditions during construction).
- Consult with other local officials on experiences relating to construction of other bridges in the area.
- Consider using the Department's Standard Specifications for Road and Bridge Construction with notes on the plans referencing the Owner as the local governmental agency and the Engineer as the owner's engineer.
- Consider the constructability, inspectability, and maintainability of all bridge components before they are incorporated into the project's final design.
- Include drainage pass-throughs in wall designs.
- Preclude contractors without company or individual bridge experience from bidding on a bridge construction project.
- Provide qualified construction inspection personnel for all phases of bridge construction.
- Maintain all design and construction records in a safe, protected, and secure location throughout the life of the bridge.

17.10J REFERENCES FOR INFORMATIONAL PURPOSES

The following is a list of publications referenced used in the preparation of this chapter can be obtained from the following websites:.

- AASHTO, all publications may be ordered from:
  bookstore.transportation.org
- FDOT "Bridge Load Rating, Permitting and Posting Manual" may be found atordered from:
  http://www2.dot.state.fl.us/proceduraldocuments/procedures/bin/850010035.pdf
  http://www.dot.state.fl.us/statemaintenanceoffice/CBR/BridgeInformation.shtm
- FDOT "Bridge Maintenance and Repair Manual" contact the State Maintenance Office - 2740 Centerview Drive, Tallahassee, Florida 32399; 850-410-5757
- FDOT "Bridge Operations and Maintenance" may be ordered from:
  https://www.fldotmpubs.com/pls/orbit/orbit.show_page?version=FLDOT
- All other FDOT Publications may be found at:FDOT "Design Standards":
  http://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtmhttp://www.dot.state.fl.us/rddesign/DesignStandards/Standards.shtm

  - http://www.dot.state.fl.us/mapsandpublications/FDOT "Drainage Manual":
    http://www.dot.state.fl.us/rddesign/dr/Manualsandhandbooks.shtm
- FDOT "Plans Preparation Manual":
  www.dot.state.fl.us/rddesign/PPMManual/PPM.shtm
- FDOT "Qualified Products List":
  http://www2.dot.state.fl.us/SpecificationsEstimates/ProductEvaluation/QPL/QPLIndex.aspx
- FDOT "Standard Specifications for Road and Bridge Construction"
  www.dot.state.fl.us/specificationsoffice/
- FDOT Structures Manual Volume 1 – "Structures Design Guidelines":
  www.dot.state.fl.us/structures/StructuresManual/CurrentRelease/StructuresManual.shtm
- FHWA "HEC-18" and "HEC-20" may be ordered from:

http://www.fhwa.dot.gov/engineering/hydraulics/library_listing.cfm