Energy Conservation Study – Madison County: 2010 Survey of Roadside Vegetation

Contract No. PR4516611

FINAL REPORT
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METRIC CONVERSION TABLE

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2

TECHNICAL REPORT DOCUMENTATION

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16. Abstract

The current mowing frequency goal for the clear zone on I-10 in Madison County (FDOT Maintenance District 2) is seven times per year. In addition, herbicide is applied twice per year via wet-blade mowing to a swath about 15 ft wide adjacent to the pavement, a practice that was instituted in 2010. To conserve energy and reduce expenses associated with mowing, a pilot study was implemented in 2009 in cooperation with District 2 maintenance personnel (FDOT Research Center Contract No. PR4170440). The location of the study was the western most mile of Madison County (from the Aucilla River and eastward one mile). Until the time of the fall cleanup mowing, mowing was limited to a 10-ft safety strip along the edge of pavement; wet-blade herbicide mowing (twice per year) was limited to the 10-ft safety strip. Reducing the area and frequency of mowing conserved energy without negatively affecting turf quality or normal highway operation so the pilot study was continued in 2010 and through the cleanup mowing in fall 2011 to determine longer-term effects of the modified mowing regime. Twice per year, spring before the first mowing and fall just before the cleanup mowing, vegetation surveys of the clear zone were conducted by walking forays. The main objective was to document the presence and approximate extent of a) desirable and showy native wildflower and grass species, and b) nonnative species, especially those listed as undesirable by FDOT's Maintenance Rating Program (MRP) standards. In addition, management practices for the predominantly-occurring species in the clear zone were suggested. The modified mowing regime has not and is not expected to interfere with normal highway operation in the near future. The widespread occurrence of the MRP undesirable species *Ambrosia artemisiifolia* (Common Ragweed), *Bidens alba* (Spanish Needles), *Eupatorium capillifolium* (Dogfennel), and *Paspalum urvillei* (Vaseygrass) has not resulted in any erosion, or sites likely to erode. Moreover, in locations where non-turfgrass species may be outcompeting traditional turf species, the non-turfgrass species appeared to have provided the same soil stabilization functions of traditional turfgrass species. Other significant outcomes of the modified mowing regime were a) improved safety to motorists because of the reduced presence of mowers and string trimmer operators, b) typical mowing costs in this one-mile segment were reduced by nearly $1,100 per year, c) the likelihood of infestation by nonnative noxious weed species was reduced by enhancing the apparent density and extent of native herbaceous species, d) overall roadside aesthetics is likely to be enhanced as the density and extent of showy native wildflowers is increasing, and e) evidence was provided that MRP "undesirable species" is a context sensitive issue. In conclusion, this pilot study clearly provides preliminary evidence that mowing costs can be reduced and energy conserved without negatively impacting normal highway operation. The best locations to implement reduced strategies are rural areas where motorists appear to accept a less manicured turf.

17. Key Word	18. Distribution Statement
Bahiagrass, *Paspalum notatum*, mowing frequency, mowing practices, conservation, native wildflowers, normal highway operation	No restrictions

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
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PREFACE

Contract PR4516611 specified pilot studies to be conducted in Madison and Polk counties. However, in Polk County the pilot study that was implemented in mid-March 2010 on US Route 17 and State Road 471 to evaluate the effects of reducing the areas and frequency of mowing was terminated less than five months later by Florida Department of Transportation District 1 maintenance personnel. Excessive weed growth at all sites was cited as the reason to resume normal vegetation management regimes.

Details of all work conducted in Polk County under Contract PR4516611 are in the Progress Report dated 2 April 2010.

In Madison County, Contract PR4516611 essentially is a continuation of Contract No. PR4170440 that was conducted in 2009. The final report for Contract No. PR4170440 was submitted 20 November 2009. Contract PR4516611 was revised after the Polk County portion of the study was terminated.

This final report is the Madison County portion of Contract PR4516611.

EXECUTIVE SUMMARY

The current mowing frequency goal for the clear zone on I-10 in Madison County (Florida Department of Transportation [FDOT] Maintenance District 2) is seven times per year. In addition, herbicide is applied twice per year via wet-blade mowing to a swath about 15 ft wide adjacent to the pavement, a practice that was instituted in 2010. To conserve energy and reduce expenses associated with mowing, a pilot study was implemented in 2009 in cooperation with District 2 maintenance personnel (FDOT Research Center Contract No. PR4170440). The location of the study was the western most mile of Madison County (from the Aucilla River and eastward one mile). Until the time of the fall cleanup mowing, mowing was limited to a 10-ft safety strip along the edge of pavement; wet-blade herbicide mowing (twice per year) was limited to the 10-ft safety strip. Reducing the area and frequency of mowing conserved energy without negatively affecting turf quality or normal highway operation so the pilot study was continued in 2010 (PR4516611) and through the cleanup mowing in fall 2011 to determine longer-term effects of the modified mowing regime.

Twice per year, spring before the first safety strip mowing and fall just before the cleanup mowing, vegetation surveys of the clear zone were conducted by walking forays. The main objectives were to:

- Document the presence and approximate extent of a) desirable and showy native wildflower and grass species, and b) nonnative species, especially those listed as undesirable by FDOT Maintenance Rating Program (MRP) standards.
- Suggest management practices for the predominantly-occurring species in the clear zone.

The modified mowing regime has not and is not expected to interfere with normal highway operation in the near future. The widespread occurrence of the MRP undesirable species *Ambrosia artemisiifolia* (Common Ragweed), *Bidens alba* (Spanish Needles), *Eupatorium capillifolium* (Dogfennel), and *Paspalum urvillei* (Vaseygrass) has not resulted in any erosion, or sites likely to erode in the near future. Moreover, in locations where non-turfgrass species may be outcompeting traditional turf species, the non-turfgrass species appeared to have provided the same soil stabilization functions of traditional turf species.

Other significant outcomes of the modified mowing regime:

- Improved safety to motorists because of the reduced presence of mowers and string trimmer operators.
- Reduced typical mowing costs by nearly $1,100 per year in this one-mile segment.
- Reduced the likelihood of infestation by nonnative noxious weed species by enhancing the apparent density and extent of native herbaceous species.
- Likely to enhance overall roadside aesthetics as the density and extent of showy native wildflowers is increasing.

- Provided evidence that MRP “undesirable species” is a context sensitive issue.

In conclusion, this pilot study clearly provides preliminary evidence that mowing costs can be reduced and energy conserved without negatively impacting normal highway operation. The best locations to implement reduced strategies are rural areas where motorists appear to accept a less manicured turf.

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FDOT	Florida Department of Transportation
GPS	Global Positioning System
IFAS	Institute of Food and Agricultural Sciences
MRP	Maintenance Rating Program
PI	Principal Investigator
ROW	Right-of-Way

INTRODUCTION

The current mowing frequency for the clear zone on I-10 in Madison County, Florida Department of Transportation (FDOT) Maintenance District 2) is seven times per year. To conserve energy and reduce expenses associated with mowing, a pilot study was implemented in 2009 in cooperation with District 2 maintenance personnel (FDOT Research Center Contract No. PR4170440). The objective was to evaluate the effects of reducing the area and frequency of mowing along I-10 within the western most mile of Madison County (from the Aucilla River and eastward one mile). Until the time of the fall cleanup mowing, mowing was limited to a single pass, approximately 10 ft wide from the edge of pavement along the roadsides and in the median; litter control was not affected. The cleanup mowing occurred on 8 October 2009.

After the cleanup mowing in October 2009, it was concluded that:

- Reducing the area and frequency of mowing conserved energy without negatively affecting turf quality.
- No adverse effects on erosion were observed.
- No apparent evidence that either safety or aesthetics were compromised.
- *Paspalum urvillei* which only was apparent in the median, was the only nonnative species of immediate concern with respect to turf quality and highway operation.
- *Hydrocotyle* in the median was a secondary concern. Based on its substantial extent, soil disturbance in the vicinity of *Hydrocotyle* could result in substantial spread of *Hydrocotyle*, which would reduce turf quality and could affect highway operation.
- *Salvia lyrata*, a showy native wildflower, was widespread on the south side of I-10. The modified mowing regime would facilitate its sustainability and should result in a showy display of this native species in early spring.

This reduced mowing area and frequency pilot project was continued in 2010 (PR4516611) and through the cleanup mowing in fall 2011 to determine longer-term effects of the modified mowing regime.

METHODS

Vegetation management in the pilot study area is detailed below.

<u>2009</u>

- 10-ft safety strip (starting at edge of shoulder) mowing started early April
- Cleanup mowing (fence to fence) – 8 October

<u>2010</u>

- Entire clear zone mowed in early May 2010
- 10-ft safety strip mowed until early June (see also top of p. 2, “entire clear zone mowed”), and then until early November

- Herbicide* applied to safety strip via wet blade (*2,4-D, formulated as Hi-Dep® IVM; PBI Gordon, Kansas City, Missouri) – 15 July and 4 October
- Entire clear zone mowed – In early June, the median as well as much of the north and south side right-of-ways (ROWs) were mowed due to a miscommunication between the contractor and their new mower operators. Future accidental mowing was prevented when FDOT installed delineators across the area at Mile Post 1.000
- Cleanup mowing – first week of November

2011

- 10-ft safety strip mowing – started second week of April; only two cycles instead of six cycles, due to contractual issues (Craft, 2011b)
- Herbicide applied to safety strip via wet blade (*2,4-D: Hi-Dep® IVM) – 19 April and 7 October
- Cleanup mowing – 18 November

On 19 March 2010, 19 October 2010, 18 March 2011, and 13 October 2011, vegetation in the clear zone in the median and along the north and south sides of the I-10 pilot study area was surveyed by walking forays and documented as described below.

1. Presence and approximate extent* of desirable and showy native wildflower and grass species that are flowering, or are not flowering but are obvious.

   * For species that exist in numbers that are deemed sufficient enough for the following FDOT offices to be aware of: Maintenance District 2, State Maintenance Office, and Environmental Management Office. For such populations of native wildflowers and grasses, it was noted:

   a. Whether the population has (or has the potential to have) substantial, aesthetically-pleasing impact.

   b. If managed appropriately, the likelihood that the population is sustainable and will expand.

2. Presence and approximate extent of undesirable nonnative, invasive species, or other species that are incompatible with highway operation, including any Category I nonnative, invasive species immediately adjacent to the clear zone and that could infest the clear zone; suggest management practices for the predominantly-occurring species in the clear zone.

All above determinations were based on the experience and knowledge of the Principal Investigator (PI).

For each species, an image was recorded as was at least one location using a Global Positioning Device (GPS) device (PhotoTrackr Model CD110mBT; GiSTEQ, Brea, California). Latitude and longitude points for new species recorded on 13 October 2011 were not available due to a GPS malfunction; however, since the pilot study has been extended, GPS points for these species will be recorded in fall 2012. Identities of the following species were based on images provided to the following botanists:

- David Hall, PhD; Consultant, Gainesville, Florida
  - *Eragrostis hirsuta* (Hall, 2011a)
  - *Paspalum urvillei* (Hall, 2011b)
- Bruce Hansen, PhD; Herbarium Curator, University of South Florida, Tampa, Florida
  - *Cyperus croceus* (Hansen, 2011a)
  - *Cyperus esculentus* (Hansen, 2011a)
  - *Erigeron quercifolius* (Hansen, 2011b)
  - *Pseudognaphalium obtusifolium* (Hansen, 2011a)
  - *Symphyotrichum pilosum* (Hansen, 2011c)
- Gil Nelson, PhD; Gil Nelson Associates, Thomasville, Georgia
  - *Carex* sp. (Nelson, 2011a)
  - *Ipomoea lacunosa* (Nelson, 2011b)
  - *Sida ulmifolia* (Nelson, 2010b)
  - *Symphyotrichum pilosum* (Nelson, 2010a)
- Richard Wunderlin, PhD; Institute for Systematic Botany, University of South Florida, Tampa, Florida
  - *Valerianella radiata* (Wunderlin, 2010)

To determine whether the modified mowing regime affected normal highway operation for this one-mile segment of I-10 (classified as “rural limited access”), Tim Allen (Florida Department of Transportation, Central Maintenance Office) used Maintenance Rating Program (MRP) standards (Florida Department of Transportation, Office of Maintenance, 2011) to conduct an informal MRP evaluation of the pilot study on 24 November 2010 (accompanied by the PI), and a formal MRP evaluation on 9 December 2011(Allen, 2011a).

FDOT’s MRP is designed to evaluate whether a highway is providing the level of service intended for that type of highway; in this study the type is ‘rural limited access’. MRP evaluations are conducted three times per year on randomly selected sections of highway, and upon request, as was the case for this study. The overall MRP score is the average score of all the elements: roadway, roadside, traffic services, drainage, facility, and **vegetation/aesthetics (see below)**. An element score is the average value of the characteristics evaluated for that particular element; within a particular element, some characteristics may not be applicable or rated. The minimum passing scores for the overall MRP, element, and characteristic are 80, 75, and 70, respectively.

> **Vegetation/aesthetics and turf quality** The 2011 MRP manual (Florida Department of Transportation, Office of Maintenance, 2011) defines turf as “…grass or other vegetation considered desirable for the particular roadside location. Properly maintained and desired vegetation provides…primarily…less chance of shoulder and slope defects (ruts, washouts, wash boarding), thereby, providing a safe recovery area for motoring traffic” (Florida Department of Transportation, Office of Maintenance, 2011, p. 125). So, while no mention is made in the MRP manual that roadside turf is mainly comprised of turfgrasses

(bahiagrass [*Paspalum notatum*] and bermudagrass [*Cynodon dactylon*]), management of FDOT's roadsides is clearly centered on factors, equipment, and practices to maintain bahiagrass and bermudagrass in a healthy state. Hence, comments in this final report about turf quality refer mainly to bahiagrass and bermudagrass quality, with quality being defined as density and vigor.

For some of the predominant species that occurred in the clear zone, opinions were sought from two weed specialist faculty in the Agronomy Department at the University of Florida, Institute of Food and Agricultural Sciences (IFAS), Gainesville, Florida: Jason Ferrell and Greg Macdonald.

RESULTS

Details about predominant species begin on page 9, including images of each species (Figures 2-30). Images of other native and nonnative species observed in the clear zones up to the woodland edges are shown in Table 1 (March, p. 38) and Table 2 (October, p. 40). Common and scientific names of all species are listed in Table 3 (p. 45); however, only scientific names are used throughout the body of the report, with the two exceptions at the top of this page. Desirability of all species is noted in Table 4 (p. 53).

19 March 2010

1. Growth of *Paspalum notatum* has not started therefore turf quality could not be accurately assessed. However, the modified mowing regimes implemented in 2009 did not appear to have any detrimental effects on turf quality or erosion in the clear zones of the north or south side ROWs.

2. Median – The substantial extent of the nonnative *Paspalum urvillei* continues to be of concern with respect to turf quality; however, its extent is limited to the moist depression in the median. Co-existing with the *P. urvillei*, and appearing to be equally abundant, was at least one *Cyperus* sp. Both species could be detrimental to turf quality in the moist depression.

3. Populations of *Viola*, especially *V. sororia* on the south side, were very impressive. *Viola* seems to be compatible with the existing turf species and should have no detrimental effect on turf quality. The modified mowing regime should help to sustain and facilitate spread of *Viola* species.

19 October 2010

1. North side clear zone beyond the 10-ft safety strip – Other than turfgrass, native herbaceous broadleaf and grass species predominated and were abundant, with exception of the locally abundant woody species *Diospyros virginica* and *Rhus copallinum*. No erosion was noted. The cleanup mowing in the fall will preclude development of woody species to the point where their stem diameter would be hazardous to vehicles that leave the road.

2. Median – *Paspalum urvillei* predominated, and secondarily *Cyperus* spp., in the westernmost portion and became progressively less dominant as elevation increased eastward. *Paspalum urvillei* and *Cyperus* are not compatible with *Paspalum notatum* (bahiagrass) turf and they have outcompeted it in much of the depressed, moist middle portion of the median. However, no erosion was noted anywhere in the median. *Paspalum urvillei* poses no hazard as a physical obstacle; it might even help to slow down an out-of-control vehicle that could cross the median into oncoming traffic. *Hydrocotyle* and especially *Ipomoea cordatotriloba* were not as widespread as in October 2009; this might simply be a normal fluctuation in species density.

3. Numerous seedlings of *Geranium carolinianum* in the south side 10-ft safety strip; also widely occurring in the 10-ft safety strip were *Salvia lyrata* and *Stachys floridana*.

4. For a roadside habitat, diversity was much greater than expected especially on the north and south side ROWs. The adjacent woodlands and nonturf areas beyond the clear zone probably served as a major seed source for species in the clear zone.

5. While it's possible that turf quality may decline over time beyond the 10-ft safety strip, there was no evidence to indicate that reduced mowing will lead to erosion. Hence, while turf quality may not be high the abundant herbaceous species growing in the clear zone serve the same function as turf – preventing erosion.

<u>18 March 2011</u>

1. Growth of *Paspalum notatum* has not started therefore turf quality could not be accurately assessed. However, the modified mowing regimes implemented in 2009 did not appear to have any detrimental effects on turf quality or erosion in the clear zones of the north or south side ROWs, or in the median.

2. On both the north and south side ROWs, it is becoming apparent that the modified mowing regime has enhanced the density and extent of native wildflowers. Showy spring wildflowers are increasing in density beyond the 10-ft safety strip – mainly *Tradescantia ohiensis* (Figure 1), *Salvia lyrata*, and *Erigeron quercifolius.*

Figure 1. The showy spring wildflower, *Tradescantia ohiensis*, in the clear zone just beyond the 10-ft safety strip on I-10 in Madison County, Florida (18 March 2011). The yellow dashed line delineates the safety strip from the remainder of the clear zone.

3. A showy population of *Lobelia feayana* was discovered near the western end of the median; Madison County is the northern and western most limit of this endemic species. Because *L. feayana* is low growing, the population is bordered by taller vegetation, and it is located in the depression in the middle of the median, this showy population is not visible to motorists.

4. Ten new species were observed, eight of which were native (underlined) – *Carex* sp., *Lobelia feayana*, *Linaria canadensis*, *Oxalis corniculata*, *Passiflora incarnata*, *Pyrrhopappus carolinianus*, *Sphenopholis obtusata*, *Trifolium repens*, *Youngia japonica*, and *Zephyranthes atamasca*. These species might have been present previously. That most were flowering aided in their detection.

13 October 2011

1. North side

   Clear zone beyond the 10-ft safety strip

   a. As in October 2010, native herbaceous broadleaf and grass species predominated and were abundant. The following woody species were also observed: locally abundant *Diospyros virginica* and *Rhus copallinum*, and infrequently occurring *Liquidambar styraciflua* and *Prunus serotina*. The cleanup mowing in the fall will preclude development of woody species to the point where their stem diameter would be hazardous to vehicles that leave the road.

   b. *Paspalum urvillei* was more abundant than previously thought.

   c. *Eustachys petraea* seemed to be more abundant in 2011 than previously observed.

   d. *Bidens alba* and *Cyperus* spp. occurred mainly in the western portion where elevation was lower and soil moister. In this same area, *Cyperus croceus* occurred frequently in the 10-ft safety strip. With rare exception, *Bidens alba* occurred in the clear zone beyond the 10-ft safety strip and along the woodland edge. *Bidens alba* often predominated along the woodland edge.

   e. Despite the widespread occurrence of *Bidens alba* and *Paspalum urvillei* no erosion has been observed due to their presence.

   Safety strip

   a. The main broadleaf species in the 10-ft safety strip were low growing *Desmodium* spp. They occurred infrequently and primarily along the edge of the paved shoulder; no erosion was noted where they occurred.

2. Median

   Clear zone beyond the 10-ft safety strip

   a. Clearly apparent were the locally abundant *Eupatorium capillifolium*, reduced growth of *Paspalum urvillei*, and the occurrence of woody species (*Baccharis halimifolia* and *Salix* sp.). While the occurrence of woody species was infrequent, this was the first time they have been observed in the median. The drought would

at least partially explain the abundance of *Eupatorium* and reduced growth of *P. urvillei.*

b. Other broadleaf species occurred infrequently.

Safety strip

a. The main broadleaf species in the 10-ft safety strip was a large population of *Sida* (see p. 30) that occurs along the edge of the shoulder; *Sida* has nearly eliminated the turfgrass.

b. Other broadleaf species occurred infrequently; *Cyperus croceus* occurred frequently.

c. No erosion was apparent.

3. South side

Clear zone beyond the 10-ft safety strip

a. *Ambrosia artemisiifolia and A. trifida* seemed more abundant than in 2010. These species dominated several areas, mainly where the soil seemed to be drier. *Eupatorium capillifolium* was also dominant, especially in the eastern half.

b. In the eastern half of the ROW, most non-turfgrass species occurred from the edge of the swale to the fence line. The exceptions were the widespread and locally abundant basal rosettes of *Erigeron quercifolius* and *Saliva lyrata*, which occurred beneath the turfgrass canopy starting at about the edge of the safety strip and proceeding towards the swale.

c. Although not dominant, numerous native broadleaf and grass species occurred in the moist, shady areas, which were mainly at the lower elevation in the western half of the south side ROW. *Setaria parviflora*, which has ornamental attributes in large stands, was locally abundant.

d. Moister areas in the western most ~700-1000 ft were dominated by a mixture of mainly *Bidens* spp., *Hyptis mutabilis*, and *Paspalum urvillei*, with infrequent occurrence of other native broadleaf species like *Acalypha gracilens* and *Conoclinium coelestinum*. As the soil seemed to be become drier and light level greater proceeding west, *Ambrosia artemisiifolia and A. trifida* became more dominant.

e. No erosion was observed.

Safety strip

a. The main broadleaf species in the 10-ft safety strip were the low growing *Desmodium incanum* (locally abundant) and *Richardia* sp. (infrequent). They occurred primarily along the edge of the paved shoulder; no erosion was noted where they occurred. *Cyperus croceus* occurred occasionally in moister areas.

4. Eighteen new species were observed, 13 of which were native (underlined) – *Acalypha gracilens*, *Baccharis* halimifolia, *Conyza canadensis*, *Cyperus croceus*, *Cyperus esculentus*, *Desmodium triflorum*, *Eragrostis hirsuta*, *Heteropogon melanocarpus*, *Ipomoea lacunosa*, *Liquidambar styraciflua*, *Mimosa strigillosa*, *Phyla nodiflora*, *Pseudognaphalium obtusifolium*, *Prunus serotina*, *Salix* sp., *Senna*

obtusifolia, *Sida rhombifolia*, *Verbena brasiliensis*, and *Vitis* sp. These species might have been present previously. That several were flowering aided in their detection.

The total number of species observed from 2009 to 2011 was 92, 76% of which were native.

Cost Savings

Sherry Craft (Contracts/Permits Manager, FDOT Maintenance District 2, Perry, FL) provided information about how the modified mowing regime reduced vegetation management costs (Craft, 2011a):

2009 Mowing/Litter Contract was reduced by $1,090.56 (11.36 acres per cycle for six cycles)

2010 Mowing/Litter Contract was reduced by $1,090.56 (11.36 acres per cycle for six cycles)

2011 Mowing/Litter Contract was reduced by $618.21 (11.36 acres per cycle for three cycles)

2011 was rebid at a lower price per acre. (See also top of p. 2, “entire clear zone mowed”)

NOTE: The mowing regime goal outside of the pilot study is for six cycles in the clear zone plus the fence-to-fence cleanup mowing in the fall. In addition, Hi-Dep® IVM (2,4-D) is applied in spring and fall to a ~15-ft swath along the pavement. In the pilot study area, herbicide was applied to the 10-ft safety strip; herbicide cost savings were negligible.

Predominant Clear Zone Species (Excluding planted turfgrass species)
NOTE: *GPS points for new species recorded on 13 October 2011 are not available due to a GPS device malfunction; however, since the pilot study has been extended, GPS points for these species will be recorded in fall 2012. Such occurrences are noted by* ****.

Allium canadense

Type	Grass-like foliage; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably*
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.445360 -83.710999

Figure 2. *Allium canadense*, I-10, Madison County, Florida; image recorded 19 March 2010.

Extent: Widespread and locally abundant on north side; locally abundant on south side

Management Recommendation

*No evidence to indicate that it is incompatible with bahiagrass turf in clear zone, so no need to take any action at this point.

Notes

Either *Allium canadense* var. *canadense* (nonshowy), or *A. canadense* var. *mobilense* (showy); not able to identify without inflorescence. If species is var. mobilense, modified mowing regime will facilitate its spread and aesthetic impact.

Ambrosia artemisiifolia

Type	Broadleaf; native
Life cycle/ bloom	Annual / fall
Compatible with bahiagrass turf	See below
Location	North and south side
Soil moisture	Moist to dry
Lat./long. (image)	+30.445430 -83.709447
Extent	Frequent

Figure 3. *Ambrosia artemisiifolia*, I-10, Madison County, Florida; images recorded 19 October 2010.

Management Recommendation

While it is quite tolerant to mowing (Ferrell, 2010b), the management regime, which includes two growing season broadleaf herbicide applications, has prevented its occurrence in the 10-ft safety strip (and hence alleviates erosion concerns).

Notes

First report of its occurrence in Madison County.

Erosion concern (Ferrell, 2010b).

See Table 4, p. 53 for information about species that are an erosion concern.

Ambrosia trifida

Type	Broadleaf; native
Life cycle/ bloom	Annual / fall
Compatible with bahiagrass turf	See below
Location	North and south side
Soil moisture	Moist to dry
Lat./long. (image)	+30.445430 -83.709447

Figure 4. *Ambrosia trifida*, I-10, Madison County, Florida; image recorded 19 October 2010.

Extent	Fall 2011: north side – occasional; south side – locally abundant, and noticeably more prevalent in 2011 than in 2010

Management Recommendation

While it is quite tolerant to mowing (Ferrell, 2011b), the management regime, which includes two growing season broadleaf herbicide applications, has prevented its occurrence in the 10-ft safety strip (and hence alleviates erosion concerns).

Notes

First report of its occurrence in Madison County.

Erosion concern (Ferrell, 2010b, 2011b).

See Table 4, p. 53 for information about species that are an erosion concern.

Andropogon glomeratus var. *pumilus* (prev. tentatively ID'd as a *Schizachyrium* sp.)

Type	Grass; native
Life cycle / bloom	Perennial / fall
Compatible with bahiagrass turf	See below
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445498 -83.708955

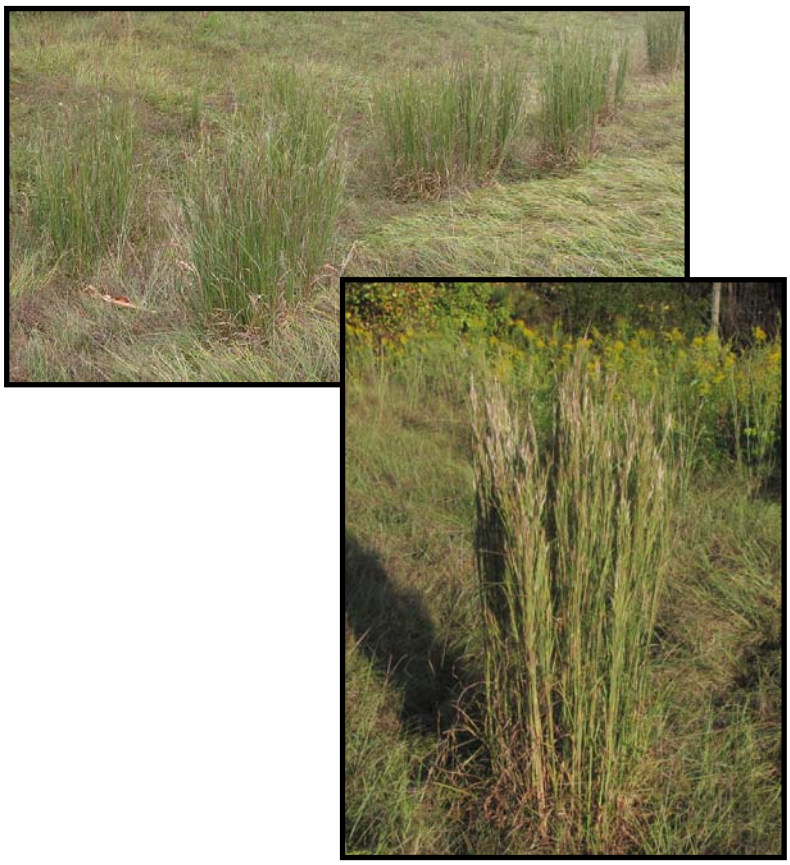

Figure 5. *Andropogon glomeratus* var. *pumilus*, I-10, Madison County, Florida; images recorded 19 October 2010 (UL) and 13 October 2011 (LR).

Extent: Most abundant in non-mowed portion of clear zone in western part of pilot study area on north side. Very sporadic in the median.

Management Recommendation

No evidence to indicate that it is incompatible with bahiagrass turf in clear zone. Mow in fall because the tall, persistent dead foliage in late fall and winter could be a fire risk.

Notes

Inflorescence confirms that this is an *Andropogon*, and most likely *A. glomeratus* var. *pumilus*. While this species has aesthetic appeal in fall and winter, it needs to be mowed back each fall because of fire risk.

Bidens alba

Type	Broadleaf; native
Life cycle / bloom	Annual / fall
Compatible with bahiagrass turf	Reported as being incompatible
Location	Mainly north and south side; sporadic in median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445442 -83.709765

Figure 6. *Bidens alba*, I-10, Madison County, Florida; images recorded 19 October 2010 (UL) and 13 October 2011 (LR).

Extent Widespread and locally abundant

Management Recommendation

The management regime, which includes two growing season broadleaf herbicide applications, has nearly prevented its occurrence in the 10-ft safety strip (and hence alleviates erosion concerns). In 2011, it only occurred very sporadically in the 10-ft safety strip.

Notes

A preferred native wildflower of the Monarch butterfly; showy in mass. The current management regime will facilitate its spread and aesthetic appeal beyond the 10-ft safety strip.

Erosion concern. Very tolerant to mowing. *Bidens* chokes out the turf, and when *Bidens* dies after frost the bare soil is susceptible to erosion (Ferrell, 2010c).

Chaerophyllum tainturieri

Type	Broadleaf; native
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445250 -83.709221

Figure 7. *Chaerophyllum tainturieri*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent Widespread, and locally abundant.

Management Recommendation

No evidence to indicate that it is incompatible with bahiagrass turf in clear zone, so no need to take any action at this point.

Notes

Not a showy native wildflower, even in mass.

Cyperus sp.

Type	Sedge; nativity unknown w/o identity
Life cycle / bloom	Prob. perennial / Prob. late spring to fall
Compatible with bahiagrass turf	Prob. incompatible in moist areas
Location	Median

Figure 8. *Cyperus* sp., I-10, Madison County, Florida; image recorded 19 March 2010.

Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445438 -83.720778
Extent	Widespread in moist areas in median

Management Recommendation

Likely to spread vegetatively regardless of mowing; in moist areas, where it is thriving, appears to have good soil stabilization properties so no need to control at this point; control will require herbicide program, but must identify in order to select appropriate herbicide(s)

Notes

Image of sedge in Figure 8, which is abundant, does not seem to be *C. croceus*, which occurred frequently in the median 10-ft safety strip.

Cyperus croceus

Type	Sedge; native
Life cycle / bloom	Perennial; summer to fall
Compatible with bahiagrass turf	See below

Figure 9. *Cyperus croceus*, I-10, Madison County, Florida; image recorded 13 October 2011.

Location	North side; south side; median
Soil moisture	Moist to slightly moist
Lat./long.	****
Extent	Mainly occurs in 10-ft safety strip: north side – locally abundant; median – frequent; south side – occasional

Management Recommendation

"…not concerned with sedges unless they are monoculture…herbicide options are expensive" (Ferrell, 2011a).

Notes

First report of this species in Madison County.

Desmodium incanum

Type	Broadleaf; nonnative
Life cycle / bloom	Perennial / spring, summer
Compatible with bahiagrass turf	Probably (see Notes)
Location	Mainly south side; very sporadic elsewhere
Soil moisture	Dry to slightly moist
Lat./long. (image)	+30.444993 -83.715968

Figure 10. *Desmodium incanum*, I-10, Madison County, Florida; images recorded 19 October 2010.

Extent — Locally abundant on south side in safety strip near pavement; infrequent on north side and median in safety strip near pavement.

Management Recommendation

No action required as it does not appear to be interfering with turf, or causing any erosion issues.

Notes

"…never seen this to be a problem on roadsides." (Ferrell, 2010b)

Diospyros virginiana

Type	Tree; native
Life cycle / bloom	Perennial / N/A
Compatible with bahiagrass turf	Prob. incompatible if not mowed back each fall
Location	Mainly north side; sporadic on south side
Soil moisture	Slightly moist to dry
Lat./long. (image)	+30.445400 -83.710030

Figure 11. *Diospyros virginiana*, I-10, Madison County, Florida; images recorded 19 October 2010 (UL) and 13 October 2011 (LR).

Extent — Widespread beyond 10-ft safety strip on the north side in the eastern part of pilot study.

Management Recommendation

Mow annually each fall.

Erigeron quercifolius

Type	Broadleaf; native
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Yes
Location	North side, south side
Soil moisture	Slightly moist
Lat./long.	+30.445472 -83.716139

Figure 12. *Erigeron quercifolius*, I-10, Madison County, Florida; images recorded 19 March 2010 (UL) and 13 October 2011 (LR).

Extent — Locally abundant in 2011, on north and south side ROW, starting about 10 ft from pavement and continuing into reduced mowing regime area; appeared to be more abundant on south side.

Management Recommendation

Most of this *Erigeron* occurs beyond the 10-ft safety strip, so the modified management regime will facilitate its sustainability and spread.

Notes

Appeared to be much more abundant in spring 2010 than in spring 2011. In fall 2011, many basal rosettes were noted in turf just beyond the 10-ft safety strip on south side ROW (Figure 12); one plant was in full bloom on north side.

Eupatorium capillifolium

Type	Broadleaf; native
Life cycle / bloom	Perennial / fall
Compatible with bahiagrass turf	Potentially incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445455 -83.712525

Figure 13. *Eupatorium capillifolium*, I-10, Madison County, Florida; images recorded 13 October 2011.

Extent

In 2010, locally abundant, mainly in moister areas beyond the10-ft safety strip on north and south side. In fall 2011, it was locally abundant mainly in the median and on the south side.

Management Recommendation

Mow annually in the fall. The management regime, which includes two growing season broadleaf herbicide applications, has prevented its occurrence in the 10-ft safety strip.

Notes

While listed by FDOT as being an undesirable species (Florida Department of Transportation, Office of Maintenance, 2011, p. 125), it does not occur in the 10-ft safety strip. In the median, it is limited to the central part of the median and has not caused any apparent detrimental effects.

Eustachys petraea

Type	Grass; native
Life cycle / bloom	Perennial / summer, fall
Compatible with bahiagrass turf	Prob. compatible (see Notes)
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.445433 -83.712077

Figure 14. *Eustachys petraea*, I-10, Madison County, Florida; images recorded 19 October 2010 (UL) and 13 October 2011 (LR).

Extent	Locally abundant, mainly in moister areas beyond the10-ft safety strip on north and south side

Management Recommendation

Mow annually in the fall.

Notes

No concern about potential negative effects in roadside ROW turf (Ferrell, 2011b).

Geranium carolinianum

Type	Broadleaf; native
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Potentially incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445389 -83.711777

Figure 15. *Geranium carolinianum*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent	Widespread

Management Recommendation

"…[it] will often persist well after bahia greenup, it can weaken turf and provide an environment for summer annuals to exploit…[may] never give bahia a chance to close in open space." (Ferrell, 2010a)

Consider spring mowing to reduce competitiveness with bahiagrass.

(See Table 4, p. 53 for information about species that are an erosion concern.)

Notes

Minimal aesthetic appeal, even in mass. Numerous small seedlings noted in 10-ft safety strip on south side ROW in October 2010.

Hydrocotyle sp.

Type	Broadleaf; native
Life cycle / bloom	Perennial / prob. spring, summer
Compatible with bahiagrass turf	Potentially incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (Top image)	+30.44527 -83.714796 to +30.44525 -83.71479

Figure 16. *Hydrocotyle* sp., I-10, Madison County, Florida; images recorded 19 March 2010 (U) and 19 October 2010 (L).

Extent: Median (spring 2010): 1000-1500sq. ft, mainly in swale but also extending up slope, and much of it contiguous; median (fall 2010) – did not seem as extensive as in spring 2010; south side – occurred at a number of locations in fall 2010. Sporadic on north side in March 2011.

Management Recommendation

"… not a big issue unless it excludes the bahiagrass. …some work with this weed a few years ago … found it was most sensitive to clopyralid. But, I rarely recommend clopyralid and think that aminopyralid (Milestone VM*) would probably be a better choice ". (Ferrell, 2009)

"…dollarweed will not be that big of a problem…its [sic] low growing and will transition out during warmer weather when the bahiagrass is beginning regrowth." (Macdonald, 2009)

No action needed; extent seems to be declining, especially near pavement.

* Milestone VM – DowAgroSciences, Indianapolis, Indiana

Notes

Not able to identify species without inflorescence. Not a showy wildflower.

Lolium perenne

Type	Grass; nonnative
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Potentially incompatible
Location	North side, south side, median
Soil moisture	Slightly moist
Lat./long.	+30.445389 -83.713753

Figure 17. *Lolium perenne*, I-10, Madison County, Florida; image recorded 19 March 2010.

Extent Widespread and locally abundant on north side and median.

Management Recommendation

"…can get really tall…and persist well into summer. This delays bahiagrass growth and will cause the bahia to thin." (Ferrell, 2010a)

Consider spring mowing to reduce competitiveness with bahiagrass.

Paspalum urvillei

Type	Grass; nonnative
Life cycle / bloom	Perennial / late summer, fall
Compatible with bahiagrass turf	No
Location	North side, south side, median
Soil moisture	Moist to very moist
Lat./long.	+30.445438 -83.720778 (west end of where *P. urvillei* was abundant in median in 2009-2010); See Notes

Figure 18. *Paspalum urvillei*, I-10, Madison County, Florida; images recorded 8 October 2009 (UR), 19 October 2010 (UL), and 13 October 2011 (LL, LR).

Extent	Median: >1100 ft; mainly in swale; abundance gradually declines to none proceeding east, with increase in elevation and decrease in moisture. North side – in 2011, much more prevalent than previously thought. South side – locally abundant.

Management Recommendation – see next page

Management Recommendation

"… vasey grass can be a big issue. It will exclude bahiagrass, with time…. Fortunately, it is quite sensitive to Plateau." (Ferrell, 2009)

Plateau herbicide (imazapic; BASF, Research Triangle Park, North Carolina) will also affect bahiagrass so if Plateau is used apply it as a directed spray, including use of wet blade technology. Plateau also is very effective against sedges, which occur in same area as *P. urvillei*.

Notes

Fall 2011 – While its extent in the median did not decline, *Eupatorium capillifolium* was much more prominent, possibly due to the drought. In addition, there were many fewer *Paspalum urvillei* flowering culms. Despite its substantial occurrence and ability to outcompete roadside turfgrass, there is no apparent evidence that *P. urvillei* has caused any erosion or is a safety concern.

Rhus copallinum

Type	Small tree; native
Life cycle / bloom	Perennial / N/A
Compatible with bahiagrass turf	Prob. incompatible if not mowed back each fall
Location	North side; sporadic on south side
Soil moisture	Slightly moist to dry
Lat./long.	+30.445600 -83.709998

Figure 19. *Rhus copallinum*, I-10, Madison County, Florida; images recorded 19 October 2010 (U) and 13 October 2011 (L).

Extent — Locally abundant on north side ROW beyond 10-ft safety strip, especially in eastern half of north side.

Management Recommendation

Small tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf if mowed back.

Salvia lyrata

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Yes
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.444778 -83.705948

Figure 20. *Salvia lyrata*, I-10, Madison County, Florida; images recorded 19 March 2010 (UL) and 8 October 2009 (LR). LL image recorded 13 April 2010, I-10, Suwannee County, Florida.

Extent — Mainly occurred in two populations on south side ROW, and locally abundant on north side in western end. Overall abundance appears to have increased since March 2010.

Management Recommendation

To facilitate sustainability and spread of *S. lyrata* avoid mowing until the last week of April under normal winter conditions late April, or until mid-May when winters are colder than normal. Such timing will enhance density and showiness of *S. lyrata*, and based on anecdotal evidence, such practices should be compatible with normal highway operations. However, the timing of mowing should be weighed against the need to mow for controlling growth of species potentially detrimental to turf quality.

Setaria parviflora

Type	Grass; native
Life cycle / bloom	Perennial / summer, fall
Compatible with bahiagrass turf	Prob. compatible
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445458 -83.717442

Figure 21. *Setaria parviflora*, I-10, Madison County, Florida; images recorded 13 October 2011.

Extent Locally abundant, mainly in moister areas.

Management Recommendation

Likely to spread vegetatively regardless of mowing; in moist areas, where it is thriving, it appears to have good soil stabilization properties due to its rhizomatous nature.

Notes

Large populations are aesthetically appealing.

Sida spp. (See Notes)

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring to early fall
Compatible with bahiagrass turf	Incompatible, based on observations (see Notes)
Location	Median (west bound); north side
Soil moisture	Dry
Lat./long. (image)	+30.445190 -83.711590 to +30.445190 -83.711920

Figure 22. *Sida* spp., I-10, Madison County, Florida; images recorded 19 October 2010 (UL, LL) and 13 October 2011 (MR).

Extent: Mainly median, ~ 210 ft long x 7 wide; infrequent on north side ROW.

Management Recommendation

Species occurs in 10-ft safety strip and appears to be very tolerant of mowing; no need to alter mowing regime.

Notes

Appears to be a mixture of *Sida ulmifolia* (formerly known as *S. acuta*; image UL) and *S. rhombifolia* (Figure 22, MR) based on flowering characteristics (length of flower stem) and location. No evidence indicating that either of these *Sida* species is of concern with respect to erosion. Monitor this area after significant freeze for potential erosion issue. Completely outcompetes roadside turfgrass.

Stachys floridana

Type	Broadleaf; native
Life cycle / bloom	Perennial; spring to fall
Compatible with bahiagrass turf	Reported as being incompatible
Location	South side
Soil moisture	Moist to slightly moist
Lat./long.	+30.444944 -83.712860

Figure 23. *Stachys floridana*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent — One south side population (500-600 ft^2); locally abundant along woodland edge.

Management Recommendation

While *Stachys floridana* is considered showy by some people, *S. floridana* is very competitive and can be locally dominant.

Since this species "…can cause large open areas in the turf" (Ferrell, 2010a), monitor this area for signs of erosion. Consider use of wet blade herbicide application in 10-ft safety strip during the first mowing in spring.

Tradescantia ohiensis

Type	Grass-like foliage; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Yes, if not dense
Location	North side, south side, median
Lat./long.	+30.445084 -83.721169

Figure 24. *Tradescantia ohiensis*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent — Westbound; median – sporadic; eastbound – more widespread, with one small population; appears to be more individuals in March 2011 than March 2010.

Management Recommendation

Avoiding mowing thru mid-May will enhance the aesthetic impact of *Tradescantia*; based on anecdotal evidence, such practices should be compatible with normal highway operations.

Figure 25. *Tradescantia ohiensis*, I-10, Madison County, Florida; image recorded 22 March 2003.

Trifolium campestre

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Yes
Location	North side, south side, median
Soil moisture	Slightly moist to dry
Lat./long.	+30.445110 -83.722946

Figure 26. *Trifolium campestre*, I-10, Madison County, Florida; image recorded 19 March 2010.

Extent Widespread and locally abundant in all areas in March 2011.

Management Recommendation

No action required.

Notes

Much more apparent in March 2011 than in March 2010.

Trifolium incarnatum

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Yes
Location	North side, south side, median
Soil moisture	Slightly moist to dry
Lat./long.	+30.445389 -83.716309

Figure 27. *Trifolium incarnatum*, I-10, Madison County, Florida; image recorded 19 March 2010.

Extent March 2011 – Locally abundant on north side; occasional in median; sporadic on south side.

Management Recommendation

No action required.

Notes

Much more apparent in March 2011 than in March 2010.

Valerianella radiata

Type	Broadleaf; native
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.444805 -83.706253

Figure 28. *Valerianella radiata*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent Widespread and locally abundant but more so north and south side.

Management Recommendation

No evidence to indicate that it is incompatible with bahiagrass turf in clear zone, so no need to take any action at this point.

Notes

Not a showy native wildflower, even in mass.

Viola bicolor

Type	Broadleaf; native
Life cycle / bloom	Annual / Spring
Compatible with bahiagrass turf	Yes
Location	North side, south side
Soil moisture	Slightly moist to moist
Lat./long.	+30.445278 -83.707031

Figure 29. *Viola bicolor*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent Locally abundant in a few locations.

Management Recommendation

No action required as height of *V. bicolor* probably will not exceed mower height. Current mowing practices will facilitate spread and aesthetic impact.

Notes

Showy roadside wildflower in mass on road-facing slopes, or in absence of taller species.

Viola sororia

Type	Broadleaf; native
Life cycle / bloom	Annual to perennial / spring
Compatible with bahiagrass turf	Yes
Location	North side, south side
Soil moisture	Slightly moist to moist
Lat./long.	+30.444973 -83.717667

Figure 30. *Viola sororia*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent Widespread and locally abundant, especially on south side.

Management Recommendation

No action required as *Viola* spp. are below mowing height. Current mowing practices will facilitate spread and aesthetic impact.

Notes

Showy roadside wildflower in mass on road-facing slopes, or in absence of taller species.

Table 1. Species observed in mid-March 2010/2011 that occurred sporadically in the clear zone, or were sporadic to locally abundant beyond the clear zone up to the woodland edge. Environmental conditions and management practices could increase the occurrence of any one of these species in the future.

		
Carex sp.	*Gelsemium sempervirens*	*Lamium amplexicaule*
		
Lepidium virginicum	*Linaria canadensis*	*Lobelia feayana*
		
Oxalis corniculata	*Passiflora incarnata*	*Piptochaetium avenaceum*

		
Pyrrhopappus carolinianus	*Rumex hastatulus*	*Sisyrinchium angustifolium*
		
Sphenopholis obtusata	*Trifolium repens*	*Youngia japonica*
		
Zephyranthes atamasca	Unknown broadleaf species	Unknown monocot species

Table 2. Species observed in mid-October 2010/2011 that occurred sporadically in the clear zone, or were sporadic to locally abundant beyond the clear zone up to the woodland edge. While these species were not the predominant ones in October, environmental conditions and management practices could increase the occurrence of any one of these species in the future. Images of all observed species were not recorded as some species were in a state of decline.*

		
Acalypha gracilens	*Acmella oppositifolia*	*Agalinis* sp.
		
Andropogon sp.	*Baccharis halimifolia*	*Bidens bipinnata*
		
Campsis radicans	*Chamaecrista fasciculata*	*Chamaesyce hyssopifolia*

		
Conoclinium coelestinum	*Conyza canadensis*	*Crotalaria spectabilis*
		
Cyperus esculentus	*Desmodium triflorum*	*Eragrostis hirsuta*
		
Eupatorium perfoliatum	*Heteropogon melanocarpus*	*Ipomoea cordatotriloba*

		
Ipomoea hederifolia	*Ipomoea lacunosa*	*Liquidambar styraciflua*
		
Mimosa strigillosa	*Oenothera biennis*	*Phyla nodiflora*
		
Phyllanthus urinaria	*Pityopsis graminifolia*	*Polygonum* sp.

		
Prunus serotina	*Pseudognaphalium obtusifolium*	*Rubus cunefolius*
		
Richardia sp.	*Salix* sp.	*Senna obtusifolium*
		
Symphyotrichum carolinianum	*Symphyotrichum dumosum*	*Symphyotrichum pilosum*

		
Solidago canadensis	*Sporobolus indicus*	*Trichostema dichotomum*
		
Verbena brasiliensis	*Vitis rotundifolia*	*Vitis* sp.

* No images recorded for *Euthamia* sp., *Gaura angustifolia*, *Hyptis mutabilis*, and *Monarda punctata* – acceptable examples not available.

Table 3**.** Scientific and common names of species observed in March or October 2010 or 2011. The common names are those listed by the Atlas of Florida Vascular Plants (http://florida.plantatlas.usf.edu/; accessed 1 November 2011.) BL = Broadleaf; GR = Grass; MN=Monocot; SG=Sedge; SH=Shrub; TR=Tree; VN=Vine.

Species			Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Scientific name	Common name	Type		
Native				
Acmella oppositifolia	Oppositeleaf Spotflower	BL	W (N)	+30.445472 -83.717639
Agalinis sp.	False Foxglove	BL	N, S	+30.445518 -83.708930
Acalypha gracilens	Slender Threeseed Mercury	BL	S	*
Allium canadense	Meadow Garlic	MN	N, S	+30.445360 -83.710999
Ambrosia artemisiifolia	Common Ragweed	BL	N, S	+30.445430 -83.709447
Ambrosia trifida	Giant Ragweed	BL	S	+30.444857 -83.712368
Andropogon glomeratus var. *pumilus*	Bushy Bluestem	GR	N, S	+30.445498 -83.708955
Baccharis halimifolia	Groundsel Tree	GR	M	*
Andropogon sp.	Bluestem	GR	N, S	+30.445370 -83.711813

Bidens alba	Beggarticks	BL	N, S, M	+30.445442 -83.709695
Bidens bipinnata	Spanish Needles	BL	S	+30.445000 -83.717383
Campsis radicans	Trumpet Creeper	VN	S	*
Chaerophyllum tainturieri	Hairyfruit Chervil	BL	N, S, M	+30.445250 -83.709221
Carex sp.	Sedge	SG	S	+30.444944 -83.715444
Chamaecrista fasciculata	Partridge Pea	BL	S	+30.444750 -83.709512
Chamaesyce hyssopifolia	Hyssopleaf Sandmat	BL	M	+30.445040 -83.715750
Conoclinium coelestinum	Blue Mistflower	BL	W (N, S)	+30.444928 -83.713437
Conyza canadensis	Canadian Horseweed	BL	N	*
Cyperus croceus	Baldwin's Flatsedge	SG	N,S,M	*
Diospyros virginiana	Common Persimmon	TR	N, S	+30.445400 -83.710030
Eragrostis hirsuta	Bigtop Lovegrass	GR	N	*
Erigeron quercifolius	Oakleaf Fleabane	BL	N, S	+30.445473 -83.716141

Eupatorium capillifolium	Dogfennel	BL	N, S, M	+30.445455 -83.712525
Eupatorium perfoliatum	Common Boneset	BL	W (N, S)	+30.445556 -83.714110
Eustachys petraea	Fingergrass	GR	N, S	+30.445433 -83.712077
Euthamia sp.	Flattop Goldenrod	BL	S	+30.444825 -83.710375
Gaura angustifolia	Southern Beeblossom	BL	N	+30.445472 -83.712583)
Gelsemium sempervirens	Carolina Jessamine	VN	W (S)	+30.444778 -83.708252
Geranium carolinianum	Carolina Cranesbill	BL	N, S, M	+30.445389 -83.711777
Hydrocotyle sp.	Dollarweed, Pennywort	BL	N,S, **M**	**+30.44527 -83.714796 to +30.44525 -83.71479**
Ipomoea cordatotriloba	Tievine	BL	S, M	+30.445155 -83.713460
Ipomoea hederifolia	Scarletcreeper	BL	N	+30.445472 -83.713611
Ipomoea lacunosa	Whitestar	BL	S	*
Lepidium virginicum	Virginia Pepperweed	BL	N	+30.445417 -83.708557

Linaria canadensis	Canadian Toadflax	BL	N	+30.445417 -83.709083
Liquidambar styraciflua	Sweetgum	TR	M	*
Lobelia feayana	Bay Lobelia	BL	M	+30.445306 -83.721444
Mimosa strigillosa	Powderpuff	BL	M	*
Monarda punctata	Spotted Beebalm	BL	N	*
Oenothera biennis	Common Eveningprimrose	BL	N	+30.445535 -83.708372
Oxalis corniculata	Woodsorrel	BL	S	+30.444972 -83.717611
Passiflora incarnata	Passionflower	BL	N	+30.445444 -83.709528
Phyla nodiflora	Frogfruit	BL	N	*
Pseudognaphlium obtusifolium	Sweet Everlasting	BL	N	*
Pyrrhopappus carolinianus	Carolina Desertchicory	BL	S	+30.444889 -83.708639
Piptochaetium avenaceum	Blackseed Needlegrass	GR	W(N, S), N, S	+30.445417 -83.708359
Pityopsis graminifolia	Narrowleaf Silkgrass	BL	S	+30.444667 -83.708675

Polygonum sp.	Knotweed	BL	S, M	+30.445250 -83.718737
Rhus copallinum	Winged Sumac	TR	N, S	+30.445600 -83.709998
Rubus cunefolius	Sand Blackberry	SH	N, S	+30.445437 -83.710670
Rumex hastatulus	Hearting Dock	BL	N	+30.445417 -83.710114
Salix sp.	Willow	TR	M	*
Salvia lyrata	Lyreleaf Sage	BL	N, S	+30.444778 -83.705948
Setaria parviflora	Knotroot Foxtail	GR	N, S	+30.445458 -83.717442
Sida ulmifolia/ rhombifolia	Fanpetals	BL	M	+30.445190 -83.711590 to +30.445190 -83.711920
Sisyrinchium angustifolium	Blue-eyed Grass	MN	N, S	+30.445417 -83.714584
Solidago canadensis	Canada Goldenrod	BL	W (N), S	+30.445225 -83.708222
Stachys floridana	Florida Betony	BL	S	+30.444944 -83.712860
Symphyotrichum carolinianum	Climbing Aster	BL	W (N)	+30.445583 -83.721642

Symphyotrichum dumosum	Rice Button Aster	BL	S, M	+30.445522 -83.715738
Symphyotrichum pilosum	White Oldfield Aster	BL	N, S	+30.445505 -83.710500
Tradescantia ohiensis	Ohio Spiderwort	BL	N, S, M	+30.445084 -83.721169
Trichostema dichotomum	Forked Bluecurls	BL	N	+30.445498 -83.708977
Valerianella radiata	Beaked Cornsalad	BL	N, S	+30.444805 -83.706253
Viola bicolor	Field Pansy	BL	N, S	+30.445278 -83.707031
Viola sororia (also recognized as *Viola affinis*)	Common Blue Violet	BL	N, S	+30.444973 -83.717667
Vitis rotundifolia	Grape	VN	N	+30.445470 -83.709312
Vitis sp. (*V. aestivalis* or *V. vulpina*)	Grape	VN	W (S)	*
Zephyranthes atamasca	Atamasco Lily	BL	N	+30.445361 -83.711167
Nonnative				
Crotalaria spectabilis	Showy Rattlebox	BL	N	+30.445337 -83.709707
Cyperus esculentus	Yellow Nutsedge	SG	N, S	*

Desmodium incanum	Zarzabacoa Comun	BL	N, S, M	+30.444993 -83.715968
Desmodium triflorum	Threeflower Ticktrefoil	BL	N	*
Heteropogon melanocarpus	Sweet Tanglehead	GR	N	*
Hyptis mutabilis	Tropical Bushmint	BL	N, S	+30.445372 -83.708365
Lamium amplexicaule	Henbit Deadnettle	BL	N, M	+30.445360 -83.71025
Lolium perenne	Italian Ryegrass	GR	N, S, M	+30.445389 -83.713753
Paspalum urvillei	Vaseygrass	GR	N, S, **M**	**+30.445438 -83.720778 (west end of median population)**
Phyllanthus urinaria	Chamberbitter	BL	S, M	*
Senna obtusifolia	Sicklepod	BL	M	*
Sphenopholis obtusata	Prairie Wedgescale	GR	S, M	+30.445333 -83.721500
Sporobolus indicus	Smutgrass	GR	N	+30.445523 -83.717377
Trifolium campestre	Field Clover	BL	N, S, M	+30.445110 -83.722946

Trifolium incarnatum	Crimson Clover	BL	N, S, M	+30.445389 -83.716309
Trifolium repens	White Clover	BL	S	+30.445028 -83.717278
Verbena brasiliensis	Brazilian Vervain	BL	M	+30.445500 -83.710595
Vicia sativa	Common Vetch	BL	N, S, M	+30.444805 -83.711052
Youngia japonica	Oriental False Hawksbeard	BL	S	+30.445056 -83.720111
Unable to Determine Nativity				
Cyperus sp.	Sedge	SG	M	+30.445438 -83.720778 (west end of population)
Unknown broadleaf	?	BL	N, S	+30.445389 -83.708168
Unknown monocot	?	MN	S	+30.444750 -83.712306

* Data not available due to GPS / GIS failure.

Table 4. Desirability of species observed in March or October 2010 or 2011 in the clear zone (up to the woodland edge) of the reduced mowing regime pilot study along I-10 in Madison County; the pilot study was initiated in spring 2009. To be deemed desirable, a species must be considered compatible with traditional turf species (based on best available evidence) as well as have at least two attributes. Underlined species in bold type are listed in the 2011 MRP manual as being undesirable.

When reading this table, consider that research is extremely limited in regard to the compatibility of non-turfgrass species and traditional turfgrass species under roadside conditions. In addition, no evidence exists in the pilot study to indicate that those species classified as undesirable or potentially undesirable species are a safety concern, or that their presence has led to erosion or sites that are likely to erode. Compatibility among species is a very complex issue that is related to soil type, soil moisture, light, slope, climate, etc. For example, a non-turfgrass species that leads to erosion on sandy soils might not have that same effect on clayey soils.

Species	Native to Florida	Showy	Desirable	Comments
		Widespread in clear zone, locally abundant		
Allium canadense	Yes	Yes[1]	Yes	[1] Only var. *mobilense* is showy
Ambrosia artemisiifolia	Yes	No	No	Prob. incompatible with traditional turf
Ambrosia trifida	Yes	No	No	Prob. incompatible with traditional turf; not clear from MRP if it's undesirable
Andropogon glomeratus var. *pumilus*	Yes	No	Yes	See page 12
Bidens alba	Yes	*Yes*	?	Incompatible with traditional turf
Chaerophyllum tainturieri	Yes	No	No	See page 14
Cyperus croceus	Yes	No	No	See page 16
Cyperus sp.	?	No	No	Probably incompatible with traditional turf based on observations in median
Desmodium incanum	No	No	No	Probably compatible with traditional turf

Diospyros virginiana	Yes	N/A	No	Tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Erigeron quercifolius	Yes	Yes	Yes	Apparently compatible with traditional turf based on other roadside observations
Eupatorium capillifolium	Yes	No	No	Potentially incompatible with traditional turf
Eustachys petraea	Yes	No	Yes (?)	Apparently compatible with traditional turf (Ferrell, 2011b)
Geranium carolinianum	Yes	No	No	Potentially incompatible with traditional turf
Hydrocotyle sp.	Yes	No	No	See page 23
Lolium perenne	No	No	No	Potentially incompatible with traditional turf
Paspalum urvillei	No	No	No	Incompatible with traditional turf
Rhus copallinum	Yes	No	No	Small tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Salvia lyrata	Yes	Yes	Yes	See page 28
Setaria parviflora	Yes	Yes (in mass)	Yes (?)	See page 29
Sida spp.	Yes	No	?	See page 30
Stachys floridana	Yes	Yes	No	Incompatible with traditional turf
Tradescantia ohiensis	Yes	Yes	Yes[2]	[2] In low densities
Trifolium campestre	No	Yes (in mass)	Maybe[4]	Probably adds nitrogen to soil; [4] compatibility with turf not known

Trifolium incarnatum	No	Yes	Yes	Adds nitrogen to soil
Valerianella radiata	Yes	No	No	See page 35
Viola bicolor	Yes	Yes	Yes	Seems to be compatible with traditional turf
Viola sororia	Yes	Yes	Yes	Seems to be compatible with traditional turf

Sporadic in clear zone, or occurs beyond clear zone to woodland edge

Comments about compatibility with traditional turf if species were to become locally abundant in the clear zone.

Acalypha gracilens	Yes	No	Yes (?)	Seems to be compatible with traditional turf
Acmella oppositifolia	Yes	Yes	Yes	On woodland edges where traditional turf is relatively sparse
Agalinis sp.	Yes	Yes	Yes	Compatibility with traditional turf unknown
Andropogon sp.	Yes	No	Yes	See Mgt. Recomm. on page 12
Baccharis halimifolia	Yes	No	No	Shrub species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Bidens bipinnata	Yes	No	?	On woodland edge where traditional turf is more sparse
Campsis radicans	Yes	Yes	Yes	On woodland edge where traditional turf is more sparse; climbing vine; no effect on turf
Carex sp.	Yes	No	Yes	Only occurs in shady moist areas; should be no effect on turf in that environment

Chamaecrista fasciculata	Yes	Yes	Yes	Mainly on woodland edges and in tree islands where traditional turf normally is relatively sparse; adds nitrogen to soil
Chamaesyce hyssopifolia	Yes	No	No	Potentially incompatible with traditional turf
Conoclinium coelestinum	Yes	Yes	Yes	On woodland edge where traditional turf is normally sparse
Crotalaria spectabilis	No	Yes	No	Potentially incompatible with traditional turf
Conyza canadensis	Yes	No	?	Too sparse to determine
Cyperus esculentus	No	No	No	See Mgt. Recomm. on page 15
Desmodium triflorum	No	No	No	Probably compatible with traditional turf
Eupatorium perfoliatum	Yes	Yes	Yes	On woodland edge where traditional turf is normally sparse
Eragrostis hirsuta	Yes	Yes	Yes (?)	Mainly occurs in open areas beyond clear zone
Euthamia sp.	Yes	Yes	Yes (?)	Mainly occurs in open areas beyond clear zone; very sporadic in clear zone
Gaura angustifolia	Yes	No	?	
Gelsemium sempervirens	Yes	Yes	Yes[3]	[3] If on fence or in trees, shrubs
Heteropogon melanocarpus	No	No	No	Occurs only at woodland edge; too sparse to determine compatibility with turf
Hyptis mutabilis	No	No	No	
Ipomoea cordatotriloba	Yes	Yes	?	Creeping nature is compatible with mowing; expected to compatible with traditional turf

Ipomoea hederifolia	Yes	Yes	Yes	Climbing vine that will only occur on woodland edge or in reduced mowing area where it has other plant or structure to climb; not expected to compete with traditional turf
Ipomoea lacunosa	Yes	Yes	?	Creeping nature is compatible with mowing; expected to compatible with traditional turf
Lamium amplexicaule	No	Yes, in mass	No	
Lepidium virginicum	Yes	No	No	Potentially incompatible with traditional turf
Linaria canadensis	Yes	Yes	Yes	Seems to be compatible with traditional turf
Liquidambar styraciflua	Yes	N/A	No	Tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Lobelia feayana	Yes	Yes	Yes	In the wet area where it occurs, no indication that it is incompatible with turf
Mimosa strigillosa	Yes	Yes	Yes	Compatible with turf based on experience
Monarda punctata	Yes	Yes	?	Potentially incompatible with traditional turf
Oenothera biennis	Yes	Yes	?	Potentially incompatible with traditional turf
Oxalis corniculata	Yes	Yes	?	Potentially incompatible with traditional turf
Passiflora incarnata	Yes	Yes	?	Probably incompatible with traditional turf if it creeps into clear zone

Phyla nodiflora	Yes	Yes	?	Incompatible with traditional turf; HOWEVER, seems to fulfill turf function
Phyllanthus urinaria	No	No	No	Probably incompatible with traditional turf
Piptochaetium avenaceum	Yes	No	Yes[4]	[4] If on woodland edge
Pityopsis graminifolia	Yes	Yes	?	Only seems to be competitive with traditional turf in dry sites where turf is relatively sparse, like tree islands
Polygonum sp.	Yes	Yes (in mass)	Probably	Only occurred in wet areas where traditional turf density was sparse to nil, so not expected to compete with traditional turf
Prunus serotina	Yes	No	No	Tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Pseudognaphalium obtusifolium	Yes	Yes	?	Probably compatible, but too spare to determine
Pyrrhopappus carolinianus	Yes	Yes	Probably not	
Richardia sp.	No	No	No	Probably incompatible
Rubus cunefolius	Yes	No	No	Small shrub species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Rumex hastatulus	Yes	Yes	No	Incompatible with traditional turf
Salix sp.	Yes	No	No	Tree species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf

Senna obtusifolia	No	Yes	No	Probably incompatible but too sparse to determine
Sisyrinchium angustifolium	Yes	Yes (in mass)	Probably	
Solidago canadensis	Yes	Yes	?	Mainly occurs beyond clear zone; its perennial nature might make it incompatible with traditional turf
Sphenopholis obtusata	Yes	No	No	No evidence to indicate otherwise that this species is incompatible with traditional turf
Sporobolus indicus	No	No	No	Potentially incompatible with traditional turf; must be mowed back in fall like *Andropogon*
Symphyotrichum carolinianum	Yes	Yes	Yes	Only occurs on woodland edge; does not compete with turf
Symphyotrichum dumosum	Yes	Yes	Yes (?)	Mainly occurs where traditional turf is relatively sparse
Symphyotrichum pilosum	Yes	Yes	Yes (?)	Mainly occurs where traditional turf is relatively sparse
Trichostema dichotomum	Yes	Yes	Yes	Annual species that seems to be compatible with traditional turf
Trifolium repens	No	Yes	Maybe[4]	Probably adds nitrogen to soil; [4] compatibility with turf not known
Verbena brasiliensis	No	No	No	
Vicia sativa	No	Yes (in mass)	Maybe[5]	[5] Probably adds nitrogen to soil; compatibility with traditional turf unknown

Vitis rotundifolia	Yes	No	No	Vine that only occurs in reduced mowing area, and does not seem to be interfere with traditional turf if mowed back in fall
Vitis sp. (*V. aestivalis* or *V. vulpina*)	Yes	No	No	Vine that mainly occurs along woodland edge
Youngia japonica	No	Yes (in mass)	No	Probably incompatible with turf
Zephyranthes atamasca	Yes	Yes	Yes	No evidence to indicate that it's incompatible with turf
Unknown broadleaf species	?	?	?	?
Unknown monocot species	?	?	?	?

CONCLUSIONS

Based on the observations from October 2009 to October 2011, plus the informal MRP evaluation conducted by Tim Allen on 24 November 2010, and the formal MRP evaluation conducted on 9 December 2011 (Allen, 2011a):

1. The modified mowing regime has not and is not expected to interfere with normal highway operation in the near future.
2. The modified mowing regime has not caused any erosion, or sites likely to erode. Species reported as being probably or potentially incompatible with traditional roadside turf species, including undesirable species listed in the MRP manual – *Ambrosia artemisiifolia*, *Bidens alba*, *Eupatorium capillifolium*, and *Paspalum urvillei* – have not caused or seem likely to cause any erosion in the near future. Moreover, in locations where non-turfgrass species may be outcompeting traditional turfgrass species, the non-turfgrass species appear to have provided the same soil stabilization functions of traditional turfgrass species. However, all sites where undesirable species and non-turfgrass species predominate need to be monitored over the next few years, especially after a few heavy rain events or a tropical storm.
3. The annual management regime implemented since 2010 has resulted in acceptable turf quality in all 10-ft safety strips expect in one area of the median where *Sida* spp. occurs; while no erosion has been noted where *Sida* occurs, this area needs to be monitored (see p. 30).
4. Safety to motorists has been improved because of the reduced presence of mowers and string trimmer operators.
5. The modified mowing regime will enhance overall roadside aesthetics as the density and extent of showy native wildflowers is now increasing.
6. The number of species observed was 90. Most of the species are native (76%); inflorescences of many of these species will benefit native pollinators.
7. In the 2011 MRP manual (Florida Department of Transportation, Office of Maintenance, 2011, p. 131), the scientific name of Spanish Needles is listed incorrectly; the correct name is *Bidens alba*. In addition, the PI suggests that FDOT consider revising the "Undesirable Vegetation" section of the MRP manual to facilitate correct identification of undesirable species under field conditions. For example, based on the images in the MRP manual it would be difficult to distinguish the undesirable sandspur *Cenchrus incertus* (which is now named *C. spinifex*) and *Cenchrus echinatus*, which is not undesirable. In addition, they both occur throughout most of Florida.
8. The only issues of minor concern were as follows:
    a. Some areas of the median did not meet MRP standards after the fall 2011 cleanup cycle because some vegetation did not get mowed properly, which appeared to be because vegetation was tall and might have been flattened by mowers before it could be cut. An additional mowing of the entire median in late June or early July probably would reduce vegetation height in the fall thereby resolving this issue.

b. Tree trimming did not meet MRP standards in most sections of the pilot study after the fall 2011 cleanup cycle. It was not clear if this was a direct result of the reduced mowing regime – tall vegetation in the vicinity of these trees may have impeded or discouraged access to tree trimmers. An additional mowing of the east and westbound clear zone only (not fence to fence) in late June or early July will help determine whether the lack of tree trimming resulted from the reduced mowing regime.

c. Litter removal did not meet MRP standards in most sections of the pilot study after the fall 2011 cleanup mowing (Allen, 2011b). Based on the PI's discussion with Tim Allen, failure to meet MRP standards in all areas of the pilot study did not appear to be solely due to the reduced regime. An additional mowing of the east and westbound clear zone only (not fence to fence) in late June or early July will help determine the effect of the reduced mowing regime on litter. The PI suggests that litter be evaluated.

9. This pilot study clearly provides preliminary evidence that:

   a. Presence of incompatible, potentially incompatible, or MRP-listed undesirable species within the clear zone does not necessarily interfere with normal highway operation. Moreover, the potential negative effects of such species appear to be context sensitive.

   b. The current modified mowing regime reduces mowing costs by over $1,000 per mile; cost savings would be less if an additional clear zone mowing cycle were added as noted above.

10. When selecting potential sites for implementing reduced mowing regimes, pre-scout sites at least three times: spring, shortly before the first mowing cycle; summer, between mowing cycles; fall, just before the fall cleanup mowing cycle. Good candidate sites for reduced mowing regimes will be in rural areas that have:

    a. No significant presence of MRP-listed undesirable species within the clear zone, or immediately adjacent to the clear zone. However,

       1) Avoid sites in which any Category I invasive species occurs within or immediately adjacent to the clear zone.

       2) Not all species classified as undesirable by MRP standards may pose a significant risk to normal highway operation under all circumstances. For example, in the current pilot study, there has been no evidence that Spanish Needles (*Bidens alba*) negatively impacts normal highway operation despite its significant presence. This example suggests that the undesirability of a species may be a context sensitive issue.

    b. Significant presence of showy, native herbaceous species, especially in late winter and early spring before bahiagrass is actively growing.

    These criteria are based on the short-term outcomes of the current study. Criteria should be considered context sensitive and will vary by local environmental conditions (soils, vegetation, climate, etc.) and public perceptions. Negative public perception may be alleviated by publicizing the cost-saving and ecological benefits.

11. Since the 2011 MRP manual defines turf as "…grass or other vegetation considered desirable for the particular roadside location" (Florida Department of Transportation, Office of Maintenance, 2011, p. 125), the PI suggests that a subject worthy of investigation by FDOT in the near future is context sensitive composition of roadside species that meet MRP standards. While traditional turfgrasses may be desirable in some situations, naturally occurring roadside species may successfully fulfill MRP standards but with less inputs.

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