Madison County Energy Conservation Study
2012-2013 Survey of Roadside Vegetation

PR6365252

February 2014

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

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16. Abstract

The current clear zone mowing frequency for I-10 in Madison County (FDOT Maintenance District 2) is 7 times per year. To conserve energy and reduce expenses associated with mowing, a pilot study was implemented in 2009, and continued in 2010-11 (Contract No. PR4170440) and 2012-13 (current contract). In cooperation with District 2 maintenance personnel, mowing of the westernmost mile of I-10 in Madison County was limited to a 10- to 15-ft safety strip along the edge of pavement until the time of the fall cleanup mowing. As was done from 2009 to 2011, vegetation surveys of the clear zone were conducted by walking forays twice per year – spring (March) before the first safety strip mowing and fall (October) just before the cleanup mowing. The main objectives were 1. 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, and 2. Suggest management practices for the predominant species in the clear zone. In addition, soil characteristics were recorded in fall 2012 and 2013 where *Bidens alba* (Spanish Needles) was abundant. This species is of special concern because FDOT anecdotal evidence suggests that it causes erosion. However, no erosion has been noted in the pilot study, even where *Bidens alba* was dense. The relationship between this species and erosion may be due to soil characteristics. 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, 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 turfgrass species, the non-turfgrass species appeared to have provided the same soil stabilization functions of traditional turfgrass species. It was also clear that under the environmental conditions of this study bahiagrass and *Bidens alba* can co-exist, and at least to the degree that erosion does not occur even in an alkaline, sandy type soil. Further research is needed to determine if the degree of sandiness and/or other factors are resulting in erosion observed on FDOT roadsides in other parts of the state. Other significant outcomes of the 4-year modified mowing regime were: 1. Improved safety to motorists because of the reduced presence of mowers and string trimmer operators, 2. Reduced mowing costs, 3. Increased diversity – the number of species in the safety strip clearly was less than in the remainder of the clear zone; and 4. Improved aesthetics – the apparent density of spring wildflowers increased, especially the showy *Tradescantia ohiensis* (Spiderwort) and *Salvia lyrata* (Lyreleaf Sage). In conclusion, this pilot study clearly provides evidence that mowing costs can be reduced and energy conserved without negatively impacting normal highway operation. The best locations to implement reduced mowing strategies are rural areas where motorists appear to accept a less manicured turf.

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PREFACE

Contract PR6365252 essentially is a continuation of Contract No. PR4170440 (2009) and Contract PR4516611/ PR4516611-V2 (2010-2011).

EXECUTIVE SUMMARY

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 westernmost mile of Madison County from the Aucilla River and eastward 1 mile. The study was continued in 2010 and 2011 as Contract No. PR4516611/PR4516611-V2. Since reducing the area and frequency of mowing conserved energy without negatively affecting turf quality or normal highway operation from 2009 through 2011, the pilot study was continued in 2012 and 2013.

Mowing was limited to a 10- to15-ft safety strip along the edge of pavement until the time of the fall cleanup mowing, As was done from 2009 to 2011, vegetation surveys of the clear zone were conducted by walking forays twice per year, spring (March) before the first safety strip mowing and fall (October) just before the cleanup mowing. The main objectives were:

- 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 predominant species in the clear zone.

In addition, soil characteristics were recorded in fall 2012 and 2013 where *Bidens alba* (Spanish Needles) was abundant. This species is of special concern because FDOT anecdotal evidence suggests that it causes erosion. However, no erosion has been noted in the pilot study, even where *Bidens alba* was dense. The relationship between this species and erosion may be due to soil characteristics.

The modified mowing regime did not affect apparent turf quality or interfere with normal highway operation after 4 years. Moreover, the widespread occurrence of the MRP undesirable species *Ambrosia artemisiifolia* (Common Ragweed), *Bidens alba, Eupatorium capillifolium* (Dogfennel), and *Paspalum urvillei* (Vaseygrass) did not result in any erosion, or sites likely to erode in the near future. Hence, MRP-listed undesirable species within the clear zone do not necessarily interfere with normal highway operation. And in locations where non-turfgrass species may have been outcompeting traditional turf species, the non-turfgrass species appeared to have provided the same soil stabilization functions of traditional turfgrass species. Hence, while traditional turfgrasses may be desirable in some situations, naturally occurring roadside species may successfully fulfill turfgrass functions but with less inputs.

Other significant outcomes of the 4-year modified mowing regime:

- Improved safety to motorists because of the reduced presence of mowers and string trimmer operators.
- Reduced mowing costs.
- Increased diversity – the number of species in the safety strip clearly was less than in the remainder of the clear zone.
- Improved aesthetics – The apparent density of spring wildflowers increased, especially the showy *Tradescantia ohiensis* (Spiderwort) and *Salvia lyrata* (Lyreleaf Sage).

- Under the environmental conditions of this study, it was clear that bahiagrass and *Bidens alba* can co-exist, and at least to the degree that erosion does not occur even in an alkaline, sandy type soil. Further research is needed to determine if the degree of sandiness and/or other factors are resulting in erosion observed on FDOT roadsides in other parts of the state.

In conclusion, this pilot study clearly provides 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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INTRODUCTION

The current mowing frequency goal for the clear zone on I-10 in Madison County (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) and continued from 2010 through 2011 (PR4516611/PR4516611-V2).

The location of the study was the westernmost mile of Madison County (from the Aucilla River and eastward 1 mile). This 1-mile segment consists of three sections (Figure 1): a lower portion starting at the west end, a sloped section, and an upper portion that ends at the eastern terminus; the elevation of the upper section is about 66 feet higher than the lower section. The lower portion, which is the longest of the three sections (~0.6 miles), has the moistest soil, especially on the south side (eastbound) where the wooded area is along the back edge of the clear zone and precludes any direct sun.

Figure 1. Pilot study area: upper section (UL; looking west, 13 March 2013), lower section (UR; at west end terminus, looking east, 13 March 2013), and slope (LR; image is at top of slope looking west, 17 March 2012).

Starting in 2009, mowing was limited to a 10 to 15-ft safety strip along the edge of pavement until the time of the fall cleanup mowing. In 2010 and 2011, herbicide was applied twice per year via wet-blade mowing to a swath about 15-ft wide along the edge of pavement. The modified mowing regime from 2009 through 2011 did not interfere normal highway operation, nor was it expected to. The widespread occurrence of the MRP undesirable species *Ambrosia artemisiifolia* (Common Ragweed), *Bidens alba* (Spanish Needles), *Eupatorium capillifolium*

(Dogfennel), and *Paspalum urvillei* (Vaseygrass) did not result in any erosion, or sites likely to erode in the near future. Moreover, in locations where non-turfgrass species possibly were outcompeting traditional turfgrass species, the non-turfgrass species appeared to have provided the same soil stabilization functions of traditional turfgrass species.

The purpose of extending the study through 2013 was to provide longer term evidence about the effects of a reduced mowing regime, including any detrimental effects associated with the occurrence of undesirable species and non-turfgrass species.

METHODS

As was done in the previous work, the following types of vegetation were surveyed during early climatological spring (March) and fall (October) in 2012 and 2013; fall surveys were conducted prior to the cleanup mowing.

In the entire median and the clear zone of the north and south sides of the pilot study area, the following were documented by walking forays:

1. Presence and approximate extent* of desirable and showy native wildflower and grass species that are flowering.

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

3. Presence and approximate extent* of undesirable nonnative, invasive species, or other species that are incompatible with highway operation. Presence of any Category I nonnative, invasive species immediately adjacent to the clear zone and that could infest the clear zone.

*For species that exist in numbers that are deemed sufficient enough for District 2, Office of Maintenance, and Environmental Management Office personnel to be aware of. For such populations of showy native wildflowers and grasses, it will be noted:

- Whether the population has (or has the potential to have) substantial, aesthetically-pleasing impact.
- If managed appropriately, the likelihood that the population is sustainable and will expand.

All above determinations were based on the experience and knowledge of the PI, with input as needed from University of Florida/IFAS right-of-way (ROW) weed experts. Assistance with identification of some species was provided by Bruce Hansen (Herbarium Curator, Institute for Systematic Botany, University of South Florida) and Gil Nelson (Gil Nelson Associates).

Images and GPS coordinates were recorded for the three categories of species that occurred to a noteworthy extent in the median or clear zone on the north and south sides. As the habitat of the entire pilot study area is ruderal, only the apparent soil moisture type (dry or moist) was noted.

In addition, soil characteristics were recorded where *Bidens alba* (Spanish Needles) was abundant. This species is of special concern because FDOT anecdotal evidence suggests that it causes erosion. A follow-up FDOT research study suggested that *Bidens alba* (and other species) caused erosion (Sellers and Ferrell, 2012), although that study only showed an association between non-turfgrass species and erosion, not that non-turfgrass species caused erosion; no observational data was recorded in the panhandle. No erosion has been noted in the pilot study, even where *Bidens alba* is dense. The relationship between this species and erosion may be due to soil characteristics; erosion thought to be due to *Bidens alba* only has been noted in sandy soils. On the north side ROW where *Bidens alba* is dense, five soil samples were extracted at random in October 2012 and 2013 (prior to cleanup mowing) and submitted to

Waters Agricultural Laboratories, Inc. (Camilla, GA) to evaluate soil texture, bulk density, percent organic matter, and pH; see Table 1 (page 13) for sample locations.

Finally, it was suggested by the PI that District 2 Maintenance add an additional mowing cycle of the clear zone (but not fence-to-fence) in late June or early July to help determine whether the additional mowing cycle will resolve three minor issues that became apparent after the fall 2011 cleanup cycle:

- Some areas of the median did not meet MRP standards 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.
- Tree trimming did not meet MRP standards in most sections. Tall vegetation in the vicinity of these trees may have impeded or discouraged access to tree trimmers.
- Litter removal did not meet MRP standards in most sections.

Spring 2012

The spring vegetation survey was conducted on 17 March 2012, which was prior to the first mowing of the 10- to 15-ft safety strips immediately adjacent to the paved shoulder. For the three categories of species that occurred to a noteworthy extent in the median or clear zone, images and GPS coordinates were recorded for species not previously observed during spring surveys in 2010 and 2011. Images and GPS coordinates from previous reports were used for the other species observed during the spring 2012 survey.

Fall 2012

The fall vegetation survey was conducted on 17 October 2012. The maintenance activities that occurred after the spring 2012 survey but prior to the fall survey were as follows (Craft, 2012b, 2012c):

- "15-ft safety strip only" mowed – April, May, July, August, and September
  *September mowing was a wet-blade herbicide mowing
- Median and clear zone mowed – 19, 20 June

For the three categories of species that occurred to a noteworthy extent in the median or clear zones, images and GPS coordinates were recorded for species not previously observed during surveys in 2009 to 2011. Images and GPS coordinates from previous reports were used for many of the other species.

On 23 October (prior to the fall cleanup mowing), five soil samples were extracted at random on the westbound ROW where *Bidens alba* predominated. Soil samples were extracted from the top 4 to 6 inches, the portion of the soil profile that would be most susceptible to erosion if the soil were to become non-vegetated. Dried soil samples were submitted to Waters Agricultural Laboratories, Inc. for analysis as previously described.

The fence-to-fence fall cleanup mowing was conducted during the last week of October.

Spring 2013

The spring vegetation survey was conducted on 13 March 2013, which was prior to the first mowing of the 10- to 15-ft safety strips immediately adjacent to the paved shoulders.

For the three categories of species that occurred to a noteworthy extent in the median and clear zones, images and GPS coordinates were recorded for species not previously observed during spring surveys in 2010, 2011, and 2012. Images and GPS coordinates from previous reports often were used for the other species observed during the spring 2013 survey.

Fall 2013

The fall vegetation survey was conducted on 6 October 2013. This was 1 to 2 weeks earlier than planned, and at FDOT's request. An earlier than usual mowing of the median was requested because it had not been mowed in early summer as in 2012. The maintenance activities that occurred after the spring 2013 survey but prior to the fall survey were as follows (Craft, 2014a, 2014b):

- "15-ft safety strip only" mowed – April, May, and June

  *The median and clear zone were not mowed in early summer as was done in 2012

For the three categories of species that occurred to a noteworthy extent in the median or clear zones, images and GPS coordinates were recorded for species not previously observed during surveys in 2009 to 2012. Images and GPS coordinates from previous reports were used for many of the other species.

On 6 October (prior to the fall cleanup mowing), five soil samples were extracted at random on the westbound ROW where *Bidens alba* predominated. Soil samples were extracted from the top 4 to 6 inches, the portion of the soil profile that would be most susceptible to erosion if the soil were to become non-vegetated. Dried soil samples were submitted to Waters Agricultural Laboratories, Inc. for analysis as previously described.

The fence-to-fence fall cleanup mowing was conducted in late October (Craft, 2014b).

RESULTS

Details about species that predominated in the clear zone start on page 15. Species that occurred sporadically in the clear zone, or were sporadic to locally abundant just beyond the clear zone, often including the woodland edge, are shown in Table 2 (spring, page 70) and Table 3 (fall, page 72). The scientific and common names of species observed are listed in Table 4 (spring, page 76) and Table 5 (fall, page 81). The desirability of species observed in in 2012 and 2013 in the clear zone (up to the woodland edge) is noted in Table 6 (page 89). To be deemed desirable in this segment of I-10, a species must be native (exception made for legumes that add nitrogen to soil), not associated with erosion in this study, and appeared to be compatible with bahiagrass where bahiagrass was observed to be thriving. This latter criterion would not be applicable in wet and/or shady conditions where turf would not perform well.

Spring 2012

Notable Observations

1. Given the warm weather and frequent rain, turfgrass growth has started.

2. Seedlings of what appeared to be *Ambrosia trifida* and *Bidens alba* were widespread and locally abundant in the clear zone on the south side ROW.

3. Forty-one species (29 native; 10 nonnative; 2 undetermined) were observed, 8 of which were not observed in March 2010 or 2011, and 6 of those were native (underlined): *Carex fissa* var. *aristata*, *Eleocharis* sp., *Dichanthelium* sp., *Galium aparine*, *Glandularia pulchella*, *Nothoscordum bivalve*, *Sonchus* sp., and *Rubus* sp. These species might have been present previously. That most were flowering aided likely in their detection.

4. The weather-induced early flowering of many species probably was the reason for the observed increase in extent of *Piptochaetium*, *Sphenopholis*, and *Sisyrinchium*.

5. Noticeably absent was *Lepidium virginicum*. Even without flowers, it is easy to detect with fruit.

6. There was a clearly evident disparity in apparent species diversity between the safety strip and the clear zone that's mowed only once per year in fall. The safety strip was dominated by a handful of species, with a low number of sporadically occurring species that mainly occurred close to the reduced mowing zone.

7. 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 mowed safety strip – mainly *Tradescantia ohiensis*, *Salvia lyrata*, and *Erigeron quercifolius*. (See Figure 2, next page.)

8. No detrimental effects have been observed related to erosion or safety.

9. Sherry Craft, FDOT, Perry Maintenance was "…not aware of any negative safety consequences in the Pilot Project area. I have not received any calls or complaints from the public nor have I received any negative comments from my inhouse personnel." (Craft, 2012a).

Figure 2. 18 March 2011 (left) – The showy spring wildflower, *Tradescantia ohiensis*, in the clear zone just beyond the 10-ft safety strip on I-10 in Madison County, Florida. The yellow dashed line delineates the safety strip from the remainder of the clear zone. 17 March 2012 (right) – The same area; however, showiness was due to both *Tradescantia ohiensis* and *Salvia lyrata.* The warm weather may have accelerated *Salvia lyrata* flowering in 2012; *Salvia* was present in 2011.

Fall 2012

Notable Observations

1. As noted in 2011, clearly evident was the disparity in species diversity between the safety strip, which was mowed seven times in 2012, and the clear zone that was mowed only twice (mid-June and fall cleanup). The safety strip was dominated by bahiagrass, usually with a low number of sporadically occurring species that mainly occurred close to the reduced mowing zone. The main exception was in moister areas where showy, spring blooming wildflowers were widespread and locally abundant: basal rosettes of *Saliva lyrata* and *Erigeron quercifolius*, and seedlings of one or more *Viola* species; the *Viola* seedlings were observed only on the eastbound ROW.

2. The additional clear zone mowing in June:
   a. Reduced the height of woody species like *Diospyros*.
   b. Seems to have been a factor in the reduced prevalence of *Ambrosia* species.
   c. Appeared to resolve the MRP issue in the median as described on page 4.

3. Sixty-five species (53 native; 12 nonnative) were observed; that most were flowering likely aided in their detection. In addition, two Category I invasive species, *Ligustrum sinense* and *Lygodium japonicum*, were observed on the south side ROW growing on the edge of the woodland; neither was in the clear zone.

4. No detrimental effects have been observed related to erosion or safety.

5. North side

   Clear zone beyond the safety strip

   a. As observed in previous fall surveys, native herbaceous broadleaf and grass species predominated and were abundant. The following woody species also were observed, and mainly occurred from the sloped portion of I-10 and east: *Diospyros virginica*, *Liquidambar styraciflua*, *Rubus cuneifolius* and *Rhus copallinum*. The summer clear zone mowing and fall cleanup mowing precludes development of any of these woody species to the point where their stem diameter would be hazardous to vehicles that leave the road.
   b. *Eustachys petraea* was dominant in much of the western half but its dominance eventually gave way to *Bidens alba*. *Bidens alba* has been a dominant species in approximately the western third of the north side since 2010.
   c. *Bidens bipinnata* was much more abundant and widespread than in previous years, and occurred mainly in the eastern half.
   d. Despite the widespread occurrence of *Bidens alba*, no erosion has been observed where it occurs.

   Safety strip

   a. The main broadleaf species in the safety strip occurred along the edge of the paved shoulder and were locally abundant but not necessarily widespread: *Desmodium incanum*, *Hydrocotyle* sp., and *Sida* spp. No erosion was noted anywhere in the safety strip.
   b. Seedlings of *Erigeron quercifolius* were locally abundant near the eastern end.

6. Median

   Clear zone beyond the safety strip

   a. The prevalence of *Eupatorium capillifolium* clearly decreased from 2011 to 2012, with a concomitant increase in prevalence of *Paspalum urvillei*, similar to 2009 and 2010.
   b. Broadleaf species, including three woody species (*Baccharis halimifolia, Salix caroliniana, and Ulmus americana*), occurred infrequently. The most widespread broadleaf species was *Solidago canadensis*.
   c. No erosion was apparent.

   Safety strip

   a. Broadleaf species only occurred sporadically.
   b. Turfgrass was thin in the area adjacent to the pavement of the westbound traffic in the approx. 200-ft strip where *Sida* spp. were previously noted. This area is now predominated by *Sida* spp. and some *Bidens alba*.
   c. No erosion was apparent.

7. South side

   Clear zone beyond the safety strip

   a. 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.

b. *Ambrosia artemisiifolia* and *A. trifida* appeared to be smaller and less prevalent than in 2011. This may have been a result of the clear zone mowing in mid-June. However, *A. trifida* seemed more widespread in the eastern portion than in 2011.

c. *Eupatorium capillifolium* seemed much less prevalent than in 2011, which also may have been due to the mid-June clear zone mowing.

d. *Bidens bipinnata* was much more abundant and widespread than in previous years.

e. *Bidens alba* and *Conoclinium coelestinum* were increasingly more prevalent proceeding westward in the western most 200-300 yards.

f. The large monoculture of *Stachys floridana* noted in 2010 did not outcompete the bahiagrass; the monoculture is much less prevalent and the bahiagrass has become re-established.

g. The bahiagrass turf was thin in the western most 50-100 ft.

h. If not mowed too early in the spring, the potential is high for a good to excellent displays of *Salvia lyrata, Erigeron quercifolius,* and *Viola* spp. based on the locally abundant seedlings observed. The *Viola* spp. were in the western portion of the ROW.

i. No erosion was observed.

Safety strip

a. The main broadleaf species in the safety strip were:

- The low growing *Desmodium incanum* (locally abundant), which occurred primarily along the edge of the paved shoulder; no erosion was noted where it occurred.
- Seedlings of *Salvia lyrata* and *Erigeron quercifolius* became increasingly abundant proceeding westward.

Soil Test results – see Table 1, page 13.

Spring 2013

Notable Observations

1. The modified mowing regime has clearly increased the number of widely occurring to locally abundant species in the clear zone beyond the mowed safety strip. In March 2013, there were 28 such species, and in 2012 there were 22 such species. In both years, the proportion of native species was slightly more than 70%. Moreover, in 2011 the number of such March-observed species was less than half that observed in March 2013.

2. There is no evidence that non-turfgrass species in the clear zone are negatively impacting bahiagrass over the long term, or causing erosion. Even where *Stachys floridana* was dominant in 2011, bahiagrass has become much denser. And where *Sida* was thick along edge of pavement in the median and had nearly excluded turfgrass, bahiagrass appears to have recovered this March, at least temporarily.

3. Despite the unseasonably warm early winter weather, the wet cool weather from mid-February to mid-March slowed growth and development of several herbaceous species compared to 2011 and 2012.

4. Shade and consistently moist soil are major factors affecting bahiagrass. Under these conditions, bahiagrass quality is fair to poor. However, no erosion has ever been observed under these conditions as other species appear to have stabilized the soil in these areas.

5. Thirty-nine species (27 native; 10 nonnative; 2 undetermined) were observed, 2 of which were not observed in March 2010, 2011, or 2012; one was native (*Ranunculus pusillus*) and one nonnative (*Buglossoides arvensis*). These new species might have been present previously but their flowering likely aided in their detection this year. Likewise, some species like *Carex fissa* var. *aristata* and *Nothoscordum bivalve* probably were present but lack of inflorescences made them difficult to detect. Noticeably absent again was *Lepidium virginicum*, which is relatively easy to detect even without flowers.

6. The extent of *Valerianella radiata* was substantially reduced compared to 2012.

7. As in 2012, there was a clearly evident disparity in apparent species diversity between the safety strip and the clear zone that's mowed only once per year in fall. The safety strip was dominated by a handful of species, with a low number of sporadically occurring species that mainly occurred close to the reduced mowing zone.

8. No detrimental effects have been observed related to erosion or safety

   In 2013 Sherry Craft stated "My response for this past year (since April 2012) would be as follows: I am not aware of any negative safety consequences in the Pilot Project area. I have not received any calls or complaints from the public nor have I received any negative comments from my inhouse [sic] personnel."(Craft, 2013)

Fall 2013

Notable Observations

1. As noted previously, clearly evident was the disparity in species diversity between the safety strip, which was under the normal mowing regime, and the clear zone that was mowed only once since fall 2012. The safety strip was dominated by bahiagrass, usually with a low number of sporadically occurring species that mainly occurred close to the reduced mowing zone. The main exception was in moister areas were showy, spring blooming wildflowers were widespread and locally abundant: basal rosettes of *Saliva lyrata* and *Erigeron quercifolius*, and seedlings of one or more *Viola* species; the *Viola* seedlings were observed only on the eastbound ROW.

2. Sixty-seven species (55 native; 12 nonnative) were observed; that most were flowering likely aided in their detection. Eight new native species were observed in the clear zone: *Dichondra caroliniensis, Elephantopus* sp., *Euthamia caroliniana, Melothria pendula, Parthenocissus quinquefolia, Sacciolepis striata, Smilax auriculata,* and *Toxicodendron radicans.* The nonnative species included three Category I invasive species, *Ligustrum sinense* and *Lygodium japonicum*, growing on the edge of the woodland on the south side ROW (neither was in the clear zone), and *Sapium sebiferum* in the median.

3. The unknown *Andropogon* species was identified as *A. virginicus* (Hansen, 2013b), and the unknown monocot identified as the nonnative *Gladiolus dalenii* based on flowers seen in the summer. Also apparent in the summer was *Lilium longiflorum* (Easter Lily); one or two were observed flowering on the north and south sides.

4. North side

   Clear zone beyond the safety strip

   a. *Ambrosia artemisiifolia* and *A. trifida* dominated the clear zone in the eastern part proceeding east to the first Rest Area sign. Both species are much more prevalent on the north side than in previous years.
   b. As observed in previous fall surveys, native herbaceous broadleaf and grass species predominated and were abundant. The following woody species also were observed: *Diospyros virginica* was more prevalent at the higher and drier eastern portion, while *Liquidambar styraciflua, Rubus cuneifolius* and *Rhus copallinum* were scattered throughout.
   b. *Bidens alba* has been a dominant species in approximately the western third of the north side since 2010.
   c. Despite the widespread occurrence of *Bidens alba*, no erosion has been observed where it occurs.

   Safety strip

   a. Vines sporadically crept into the safety strip: *Ampelopsis, Passiflora* and *Ipomoea cordatotriloba. Bidens alba, Hydrocotyle* sp. and *Salvia* occurred sporadically as well, except in the western portion where *B. alba* was locally abundant.
   b. Along the edge of pavement, *Desmodium incanum* was locally abundant, mostly in the western half; *Sida* spp. also occurred. No erosion was noted anywhere in the safety strip.

5. Median

   Clear zone beyond the safety strip

   a. Woody species are becoming more common – *Baccharis halimifolia, Liquidambar styraciflua, Salix caroliniana, Ulmus americana,* and for the first time *Sapium sebiferum.*
   b. *Eupatorium capillifolium, Paspalum urvillei, Solidago,* and *Cyperus* spp. were the predominant species except from the top of the slope and eastward, which was dominated by both *Ambrosia* species. *Paspalum urvillei* decreased proceeding east as elevation increased and apparent soil moisture decreased.
   c. *Hydrocotyle* was much more abundant than in any previous year.
   d. Erosion was noted at the inlet; according to Tim Allen this has been a problem in the past and is not associated with the mowing regime.
   e. No other erosion was apparent.

   Safety strip

   a. The main species were *Bidens alba* and *Sida* spp. Both were widespread and locally abundant, especially as apparent soil moisture decreased with increasing elevation.
   b. *Desmodium incanum* was the most prevalent species along the edge of pavement.
   c. No erosion was apparent, even where *Sida* spp. occurred.

6. South side

Clear zone beyond the safety strip

a. *Ambrosia artemisiifolia, A. trifida,* and *Bidens alba* were dominant in the eastern half, including the slope and the far eastern part of the shadier segment at the lower elevation.
b. Broadleaf species in the portion of the clear zone under reduced mowing are much more prevalent at the safety strip interface (and even into the back half of the safety strip) than occurs on the north side clear zone. This seems to be related to the shadier conditions and moister soil in the eastern and western portions. This phenomenon is much less substantial on the slope where the entire ROW is sunny.
c. In the western third (shady; moist soils), non-turfgrass species are predominant and apparently provide adequate soil stabilization. And while *Phyla nodiflora* is locally abundant, no erosion has been observed where it occurs. This section also has the showy displays of spring native wildflowers (see 6e); *Setaria parviflora,* which has ornamental attributes in large stands, is locally abundant.
d. The large monoculture of *Stachys floridana* noted in 2010 did not outcompete the bahiagrass; the bahiagrass continues to become re-established.
e. If not mowed too early in the spring, the potential is high for good to excellent displays of *Salvia lyrata*, *Erigeron quercifolius*, *Tradescantia ohiensis*, and *Viola* spp.
f. No erosion was observed.

Safety strip

a. At least 13 broadleaf species occurred, with the greatest occurrence in the two shady areas, although they most frequently occurred in the western shady area where the soil was moister.
b. The three locally abundant species were *Bidens alba*, *Desmodium incanum* (mainly in western shady area), and *Salvia lyrata*.
c. No erosion was observed.

Soil Test results – see Table 1, page 13.

Soil Properties Where *Bidens alba* Predominates

Bahiagrass does not grow well above pH 6.5 (Newman et al., 2011) so the area where *Bidens alba* is growing would seem not to support vigorous growth of bahiagrass as the soil was alkaline (Table 1, page 13). However, in this study area, erosion may not have occurred because (1) there was a sufficient density of bahiagrass underneath the *B. alba* canopy, and (2) the soil drained fast enough to prevent runoff and erosion: soil physical properties were consistent with a porous, well-drained mineral soil, and the roots of *B. alba*, even if the top growth is dead, provide channels that would aid water penetration into the soil.

Under the environmental conditions of this study, it was clear that bahiagrass and *Bidens alba* can co-exist, and at least to the degree that erosion does not occur even in a slightly alkaline, sandy type soil, conditions under which bahiagrass would not be expected to perform well.

Table 1. Physical properties and pH of the soil where *Bidens alba* is predominant in the clear zone of the westbound ROW in the 1-mile pilot study area of I-10 in Madison County, Florida.

Sample[1]	Bulk density[2] lb/ft^3 (g/cm^3)	Organic matter %	pH	Buffer pH[3]	Soil type	Sand %	Silt %	Clay %
			October 2012[4]					
1	82.85 (1.33)	2.6	7.5	7.8	Sand	87.2	4.4	8.4
2	73.88 (1.18)	2.8	7.7	7.8	Sand	91.2	2.4	6.4
3	75.03 (1.20)	3.1	6.7	7.7	Loamy sand	84.4	8.8	6.8
4	80.36 (1.29)	2.8	7.1	7.8	Loamy sand	84.4	6.8	8.8
5	79.19 (1.27)	3.0	7.2	7.8	Sand	88.0	4.8	7.2
			October 2013[4]					
1	59.90 (0.96)	4.1	7.0	7.8	Sandy loam	81.2	6.8	12.0
2	56.56 (0.91)	3.0	7.2	7.8	Sandy loam	83.6	4.4	12.0
3	64.43 (1.03)	3.1	7.2	7.8	Sandy loam	81.2	6.8	12.0
4	64.55 (1.03)	3.7	7.3	7.8	Sandy loam	79.2	6.8	14.0
5	79.19 (1.27)	3.4	6.2	7.7	Sandy loam	80.8	6.8	12.4

[1]Samples lat./long.: **2012**: 1 – 30.44553, -83.71807; 2 – 30.445528, -83.717892; 3 – 30.445407, -83.71928; 4 – 30.445505, -83.719128; 5 – 30.445533; -83.72002
2013: 1 – 30.44549, -83.718872; 2 – 30.445488, -83.718367; 3 – 30.445438, -83.719055; 4 – 30.445518, -83.718565; 5 – 30.445477, -83.718677

[2]Bulk density – "As a general rule, a normal bulk density for a coarse textured soil would be 1.2-1.8 g/cm^3"…. Above that you run into root penetration, nutrient cycling and water movement problems" (Shober, 2009).

[3]Buffer pH: the lower the value, the more resistant the soil is to change in pH.

[4] Mean bulk density, percent sand, and percent clay were statistically different for 2012 and 2013. (95% confidence that means were different since they differed by more than two times the standard error – results not shown).

Predominant or Locally Abundant Clear Zone Species in Spring or Fall

Except where noted, these species were observed in spring or fall in 2012 or 2013 in the clear zone outside of the mowed safety strip. Planted turfgrasses are excluded.

Acalypha gracilens

Type	Broadleaf; native
Life cycle / bloom	Annual / fall
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.445443 -83.713486

Figure 3. *Acalypha gracilens*, I-10, Madison County, Florida; image recorded 13 October 2011.

Extent Sporadic on north side and locally abundant on south side.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. The modified mowing regime will facilitate its spread.

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.	+30.445553 -83.717233

Figure 4. *Allium canadense*, I-10, Madison County, Florida; images recorded 17 March 2012.

Extent — Widespread and locally abundant on north side, and beyond clear zone to the woodland edge; locally abundant on south side.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. The modified mowing regime will facilitate its spread and showiness.

Ambrosia artemisiifolia

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

Figure 5. *Ambrosia artemisiifolia*, I-10, Madison County, Florida; images recorded 19 October 2010.

Extent — Widespread and locally abundant on both sides in clear zone and beyond clear zone; sporadic in median.

Management Recommendation

While it is quite tolerant to mowing (Ferrell, 2010b), the management regime, which includes growing season broadleaf herbicide applications (two in 2011; one in 2012), has prevented its occurrence in the safety strip (and hence alleviates erosion concerns).

Note

Erosion concern (Ferrell, 2010b).

Ambrosia trifida

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

Figure 6. *Ambrosia trifida*, I-10, Madison County, Florida; image recorded 19 October 2010.

Extent: Widespread and locally abundant on both sides in clear zone and beyond clear zone; sporadic in median.

Management Recommendation

While it is quite tolerant to mowing (Ferrell, 2010d), the management regime, which includes growing season broadleaf herbicide applications (two in 2011; one in 2012), has prevented its occurrence in the safety strip (and hence alleviates erosion concerns).

Note

Erosion concern (Ferrell, 2010d).

Ampelopsis arborea

Type	Broadleaf vine; native
Life cycle / bloom	Perennial / summer
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445383 -83.709992

Figure 7. *Ampelopsis arborea*, I-10, Madison County, Florida; images recorded 13 October 2011 (UL) and 10 October 2010 (LR).

Extent: Widespread and locally abundant.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Notes

Misidentified as *Campsis radicans* in previous years. Identified by Bruce Hansen (Hansen, 2012d).

Andropogon glomeratus var. pumilus

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 8. *Andropogon glomeratus* var. *pumilus*, I-10, Madison County, Florida; images recorded 13 October 2011 (top) and 17 October 2012 (bottom).

Extent: Widespread; most abundant in western part of pilot study area on north side, but locally abundant in the median and on south side.

Management Recommendation

No evidence to indicate that it is incompatible with bahiagrass turf in the clear zone. Mow in fall because the tall, persistent dead foliage in late fall and winter could be a fire risk. (Ferrell, 2011b)

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. Should help to stabilize soil.

Bidens alba

Type	Broadleaf; native
Life cycle / bloom	Annual / fall
Compatible with bahiagrass turf	Reported as being incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445447 -83.721713

Figure 9. *Bidens alba*, I-10, Madison County, Florida; images recorded 17 October 2013 (UL) and 13 October 2011 (LR).

Extent: Widespread and locally abundant on north and south sides; sporadic in safety strip on north side; median – sporadic in safety strips, mainly near edge of pavement.

Management Recommendation

The management regime, which includes growing season broadleaf herbicide applications (2 in 2011; 1 in 2012), has minimized its occurrence in the 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.
Bidens chokes out the turf, and when *Bidens* dies after frost the bare soil is susceptible to erosion (Ferrell, 2010c). See also page 12, **Soil Properties Where Bidens alba Predominates**.

Bidens bipinnata

Type	Broadleaf; native
Life cycle / bloom	Annual / fall
Compatible with bahiagrass turf	May be incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445392 -83.710287

Figure 10. *Bidens bipinnata*, I-10, Madison County, Florida; images recorded 6 October 2013 (UL) and 17 October 2012 (UR and LR).

Extent: North and south side – widespread and locally abundant, and beyond clear zone; much more prevalent than in 2010 and 2011; south side – sporadic in safety strip; median – sporadic

Management Recommendation

No evidence that it is an erosion concern like *Bidens alba*. Wet-blade application of broadleaf herbicide should prevent its occurrence in the safety strip.

Notes

Foliage of many plants infected with downy mildew in 2012; “pretty likely….this is what is now classified as *Podosphaera xanthii*, which [is] considered a species complex, common around the world on many host genera in the Asteraceae.”(Schubert, 2012).

Boehmeria cylindrica

Type	Broadleaf; native
Life cycle / bloom	Perennial / fall
Compatible with bahiagrass turf	Probably (see Mgt.)
Location	South side
Soil moisture	Moist to slightly moist
Lat./long.	+30.444972 -83.714472
Extent	Locally abundant

Figure 11. *Boehmeria cylindrica* I-10, Madison County, Florida; images recorded 6 October 2013.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Identified by Bruce Hansen, Institute for Systematic Botany, University of South Florida (Hansen, 2013b).

Buglossoides arvensis

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Probably (see Mgt.)
Location	Median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445389 -83.722194
Extent	Locally abundant

Figure 12. *Buglossoides arvensis*, I-10, Madison County, Florida; images recorded 13 March 2013.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. "…like all other annual species… not a problem until the population gets so high that it out competes the Bahia." (Ferrell, 2013).

Note

Identified by Bruce Hansen, Institute for Systematic Botany, University of South Florida (Hansen, 2013a).

Carex dasycarpa

Type	Sedge; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	See below
Location	South side
Soil moisture	Moist
Lat./long.	+30.444967 -83.714972

Figure 13. *Carex dasycarpa*, I-10, Madison County, Florida; images recorded 18 March 2011 (UR) and 17 March 2012 (LL).

Extent Locally abundant in lower elevation.

Management Recommendation

No control action needed as there is no evidence to indicate that it causes erosion in the clear zone. *C. dasycarpa* only occurs in shady conditions where soil is consistently moist and bahiagrass performs poorly.

Note

Not a showy native wildflower, even in mass. Tentatively identified as *C. louisianica* (or *C. lupulina*) in 2011 (Nelson, 2011a). Based on additional images, "…definitely not *Carex louisianica*. Looks more like *C. dasycarpa* to me" (Hansen, 2012b).

Chaerophyllum tainturieri

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

Figure 14. *Chaerophyllum tainturieri*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent — North side, median – widespread and locally abundant; south side – much less frequent but locally abundant.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Since an annual, presumably like many other annuals "…not a problem until the population gets so high that it out competes the Bahia" (Ferrell, 2013).

Note

Not a showy native wildflower, even in mass.

Conoclinium coelestinum

Type	Broadleaf; 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.	+30.444928 -83.713437

Figure 15. *Conoclinium coelestinum* I-10, Madison County, Florida; images recorded 19 October 2010.

Extent — Locally abundant on north and south side, especially close to and along woodland edge. More abundant on south side. Very sporadic in median.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Showy native wildflower, especially in mass. Reduced mowing regime will increase its spread and aesthetic appeal.

Cyperus esculentus

Type	Sedge; nonnative
Life cycle / bloom	Perennial / Summer, fall
Compatible with bahiagrass turf	Probably not in moister areas
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.445437 -83.714323

Figure 16. *Cyperus esculentus*, I-10, Madison County, Florida; images recorded 17 October 2012.

Extent Widespread and locally abundant

Management Recommendation

Sedges, including *Cyperus esculentus,* are thriving in the moist, central part of the median. Jay Ferrell is "…not concerned with sedges unless they are monoculture…herbicide options are expensive" (Ferrell, 2011a). However the sedges appear to have good soil stabilization properties as no signs of erosion have been observed since 2009. Likely to spread vegetatively regardless of mowing.

Desmodium incanum

Type	Broadleaf; nonnative
Life cycle / bloom	Perennial / spring to fall
Compatible with bahiagrass turf	Probably (see Notes)
Location	North side, south side, median
Soil moisture	Dry to slightly moist
Lat./long. (image)	+30.445522 -83.721642

Figure 17. *Desmodium incanum*, I-10, Madison County, Florida; images recorded 19 October 2010.

Extent — Widespread and Locally abundant in safety strip close to and along edge of pavement;

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

"…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	Probably compatible if mowed back each fall
Location	North side, south side
Soil moisture	Slightly moist to dry
Lat./long. (image)	+30.445361 -83.709500

Figure 18. *Diospyros virginiana*, I-10, Madison County, Florida; images recorded 17 October 2012 (top) and 13 October 2011 (bottom).

Extent — Widespread and locally abundant on the north side in the eastern part of pilot study; sporadic on the south side.

Management Recommendation

Mow annually each fall.

Note

Summer clear zone mowing noticeably reduces the size of these trees in 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.	+30.445375 -83.709000

Figure 19. *Erigeron quercifolius*, I-10, Madison County, Florida; images recorded 19 March 2010 top) and 17 October 2012 (LL, LR).

Extent — Widespread and locally abundant in clear zone, including safety strip, where it is increasingly abundant proceeding from east to west, similar to what was observed in October 2011.

Management Recommendation

The date of the first spring mowing of the safety strip will affect the showiness and subsequent spread into the clear zone beyond the safety strip. The later the mowing, the showier the display and the greater the amount of seed that will spread into areas beyond the safety strip, with a concomitant increase in showiness in subsequent years.

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 20. *Eupatorium capillifolium*, I-10, Madison County, Florida; images recorded 13 October 2011 (UR) and 17 October 2012 (LL).

Extent — Widespread and locally abundant in the median. North side – sporadic. South side – locally abundant.

Management Recommendation

Mowing will reduce its presence. Include a summer mowing of median.

Note

This species is listed by FDOT as being an undesirable species in MRP Handbook. However, it does not occur in the safety strip. In the median, it is limited to the central part of the median and has not caused any apparent detrimental effects, including erosion.

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.	+30.445472 -83.716417

Figure 21. *Eustachys petraea*, I-10, Madison County, Florida; images recorded 17 October 1 2012 (UL) and 19 October 2010 (LR).

Extent — North side – widespread and locally abundant, mainly in moister areas; south side – sporadic in moister areas

Management Recommendation

Mow annually in the fall.

Note

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

Galium aparine

Type	Broadleaf; native
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	See below
Location	South side, median
Soil moisture	Slightly moist to moist
Lat./long.	+30.445389 -83.722083

Figure 22. *Galium aparine*, I-10, Madison County, Florida; images recorded 13 March 2013 (UL) and 17 March 2012 (LR).

Extent: Widespread and locally abundant; south side – mainly in upper portion and sloped section.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. "…like all other annual species… not a problem until the population gets so high that it out competes the Bahia" (Ferrell, 2013).

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

Extent — Widespread and locally abundant; some in safety strip.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Minimal aesthetic appeal, even in mass. No evidence of erosion where it is abundant. Thin turf areas where it occurs on south side appear to be result of shade.

"…[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).

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.	+30.445298 -83.708465

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

Extent — Widespread and locally abundant. Occasionally extends into safety strip.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone even where it occurs in safety strip (see Note).

Note

Not able to identify species without inflorescence. Not a showy wildflower.
"… 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).
* Milestone VM – DowAgro Sciences, Indianapolis, Indiana

Hyptis mutabilis

Type	Broadleaf; nonnative
Life cycle / bloom	Perennial / summer
Compatible with bahiagrass turf	Potentially incompatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445056 -83.709778

Figure 25. *Hyptis mutabilis*, I-10, Madison County, Florida; images recorded 6 October 2013 (UL) and 10 October 2009 (LR).

Extent South side – locally abundant; north side and median – sporadic.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Consider monitoring as it is becoming more widespread.

Note

Foliage and stems have aromatic scent when rubbed or crushed, which will help to identify this tall perennial

Ipomoea cordatotriloba

Type	Broadleaf; native
Life cycle / bloom	Perennial/ summer-fall
Compatible with bahiagrass turf	Probably compatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445537 -83.718530

Figure 26. *Ipomoea cordatotriloba*, I-10, Madison County, Florida; images recorded 13 October 2011.

Extent — Median – locally abundant; north and south sides – sporadic but some in safety strip on north side.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Minimal aesthetic appeal, even in mass, because purple flowers in turf do not contrast well with green turf.

Ipomoea lacunosa

Type	Broadleaf; native
Life cycle / bloom	Annual, fall
Compatible with bahiagrass turf	Probably compatible
Location	South side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445310 -83.715213

Figure 27. *Ipomoea lacunosa* I-10, Madison County, Florida; images recorded 17 October 2012.

Extent Locally abundant

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Some aesthetic appeal in mass as white flowers contrast with turf, although flowers only open mainly in morning. Identification based partly on input of Gil Nelson (Nelson, 2011b).

Lamium amplexicaule

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	See below
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445222 -83.716861

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

Extent — Most frequent on north side (locally abundant; also occurred beyond clear zone) and median (widespread in safety strip to edge of wettest part of swale in middle); south side – much less frequent (sporadic in mowed safety strip on slope, and locally abundant in sunny areas in lower portion).

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Since an annual, presumably like many other annuals "…not a problem until the population gets so high that it out competes the Bahia" (Ferrell, 2013).

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

Extent Widespread and locally abundant

Management Recommendation

Under the conditions of this study, no control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

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

Melothria pendula

Type	Broadleaf; native
Life cycle / bloom	Perennial / summer, early fall
Compatible with bahiagrass turf	Potentially incompatible
Location	South side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445306 -83.716917

Figure 30. *Melothria pendula*, I-10, Madison County, Florida; images recorded 6 October 2013.

Extent Locally abundant; some in safety strip in median.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Oxalis corniculata

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring-fall
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445390 -83.715110

Figure 31. *Oxalis corniculata*, I-10, Madison County, Florida; image recorded 18 March 2011.

Extent Locally abundant; occasionally in safety strip

Management Recommendation

No action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Becoming more widespread than in previous years.

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.	+30.445168 -83.711938

Figure 32. *Paspalum urvillei*, I-10, Madison County, Florida; images recorded 19 October 2010 (UR), 13 October 2011 (ML, LL, LR), and 17 October 2012 (MR).

Extent Widespread and locally abundant, but is most frequent in median.

Management Recommendation

Mow in early summer. In the wet part of the median, it and sedges have outcompeted bahia but there is no reason to eradicate *P. urvillei* as there is no evidence that it (or the sedges) causes erosion. See **Note**, next page.

Note

"… 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 vaseygrass.

Phyla nodiflora

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring- early fall
Compatible with bahiagrass turf	Probably (See Mgt.)
Location	North side, south side
Soil moisture	Moist
Lat./long.	+30.445002 -83.715415

Figure 33. *Phyla nodiflora*. I-10, Madison County, Florida; images recorded 13 October 2011 (UL) and 6 October 2013 (MR, LL); the butterfly is a Phaon Crescent.

Extent South side – locally abundant in moist, shady area. North side – sporadic.

Management Recommendation

While it reportedly is associated with erosion, **no control action needed** as there is no evidence to indicate that it causes erosion in the clear zone. May help to stabilize soil.

Polygonum sp.

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring-fall (see Notes)
Compatible with bahiagrass turf	Probably (see Mgt.)
Location	North side, south side, median
Soil moisture	Moist
Lat./long.	+30.445413 -83.714282

Figure 34. *Polygonum* sp., I-10, Madison County, Florida; images recorded 17 October 2012 (UL) and 19 October 2010 (LR).

Extent — Locally abundant. North side – mainly towards back of clear zone to woodland edge; south side – in moist, shady areas. Median – center, moist areas in western half.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Only occurs in moist and/or shady areas where traditional turf density was sparse to nil, so not expected to compete with traditional turf. Reduced mowing regime will help increase its spread.

Note

Probably *P. hydropiperoides* (perennial) but could be *P. punctatum* (annual) (Hansen, 2012c). Showy in mass. May help to stabilize soil in moist areas where bahiagrass does not thrive.

Piptochaetium avenaceum

Type	Grass; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.445417 -83.708359

Figure 35. *Piptochaetium avenaceum*, I-10, Madison County, Florida; images recorded 17 March 2012 (UL) and 13 March 2013 (LR).

Extent — Widespread, and locally abundant. Most abundant along woodland edge but substantial occurrence mainly in back half of clear zone.

Management Recommendation

This species seems to be a desirable turfgrass species where it has been observed to occur. Reduced mowing regime will help to increase its spread.

Note

Showiness directly related to population size and density. May help to stabilize soil.

Pyrrhopappus carolinianus

Type	Broadleaf; native
Life cycle / bloom	Annual, biennial/ spring
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Slightly dry to slightly moist
Lat./long.	+30.445000 -83.714278

Figure 36. *Pyrrhopappus carolinianus*, I-10, Madison County, Florida; image recorded 13 March 2013.

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

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Showy; flower strongly resembles a large, lemon yellow dandelion flower. Provides groundcover in winter and may help to reduce erosion.

Rhus copallinum

Type	Small tree; native
Life cycle / bloom	Perennial / N/A
Compatible with bahiagrass turf	Probably compatible if mowed back each fall
Location	North side, south side
Soil moisture	Slightly moist to dry
Lat./long.	+30.445405 -83.708625

Figure 37. *Rhus copallinum*, I-10, Madison County, Florida; images recorded 19 October 2010 (ML) and 13 October 2011 (UR, LR).

Extent — North side – widespread and locally abundant especially in eastern half of north side. South side – sporadic.

Management Recommendation

Mow down during fall cleanup mowing; no evidence of being incompatible with traditional turf if mowed back.

Rubus cuneifolius

Type	Shrub; native
Life cycle / bloom	Perennial / N/A
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Slightly moist to dry
Lat./long.	+30.445437 -83.710670

Figure 38. *Rubus cuneifolius*, I-10, Madison County, Florida; images recorded 19 October 2010.

Extent — North side – widespread and locally abundant especially in eastern half of north side, including beyond clear zone. South side – sporadic, and mainly beyond clear zone in western half.

Management Recommendation

Mow down during fall cleanup mowing; no evidence of being incompatible with traditional turf if mowed back.

Salix caroliniana

Type	Tree; native
Life cycle / bloom	Perennial / N/A
Compatible with bahiagrass turf	See Mgt.
Location	Median
Soil moisture	Slightly moist to dry
Lat./long.	+30.445410 -83.720472

Figure 39. *Salix caroliniana*, I-10, Madison County, Florida; images recorded 17 October 2012.

Extent Locally abundant.

Management Recommendation

Mow down during fall cleanup mowing. Only occurs in wet area of median where bahiagrass performs poorly. No evidence of erosion where it occurs.

Salvia lyrata

Type	Broadleaf; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.444833 -83.708667

Figure 40. *Salvia lyrata*, I-10, Madison County, Florida; images recorded 17 March 2012 (UL, UR) and 13 March 2013 (ML, LR). Western-most end of north side beyond the safety strip is dominated by *S. lyrata* and *Tradescantia ohiensis*.

Extent — Widespread and locally abundant. North side – mostly in western half, extent from sporadic to locally abundant, east to west, respectively; south side – widespread and locally abundant. The reduced mowing regime seems to have increased its extent on both sides. Median – very sporadic.

Management Recommendation – see next page

Management Recommendation

To facilitate sustainability and spread of this showy wildflower, avoid mowing until the last week of April under normal winter conditions, 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. No evidence to indicate that it causes erosion in the clear zone.

Note

Given the high density of *Salvia* and *Tradescantia* at the western end of the north side (Figure 40, LR), consideration should be given to developing this area into a wildflower site using a management regime that will result in a showy, sustainable stand of wildflowers.

No evidence of erosion where *Salvia* occurs.

Setaria parviflora

Type	Grass; native
Life cycle / bloom	Perennial / summer, fall
Compatible with bahiagrass turf	Probably compatible
Location	North side, south side, median
Soil moisture	Moist to slightly moist
Lat./long. (image)	+30.444889 -83.710806

Figure 41. *Setaria parviflora*, I-10, Madison County, Florida; images recorded 17 October 2012.

Extent: North and south sides – locally abundant, mainly in moister areas. Median – sporadic.

Management Recommendation

No control action needed. It appears to have good soil stabilization properties due to its rhizomatous nature. Likely to spread vegetatively regardless of mowing; in moist areas, where it is thriving,

Note

Large populations are aesthetically appealing.

Sida spp.*

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

Figure 42. *Sida* spp., I-10, Madison County, Florida; images recorded 19 October 2010 (UL, ML) 13 October 2011 (UR), and 17 October 2012 (LR).

Extent: Locally abundant in median and north side; sporadic on south side.. Median – population ~ 210 ft long x 7 wide near edge of pavement. North side – near edge of pavement.

Management Recommendation

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

Note

*Appears to be a mixture of *Sida ulmifolia* (UL) and *S. rhombifolia* (UR) based on observations in previous years. No evidence indicating that either of these *Sida* species is of concern with respect to erosion based on observations in 2012 and 2013. Continue to monitor this area.

Sisyrinchium angustifolium

Type	Monocot; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side
Soil moisture	Moist to slightly moist
Lat./long.	+30.445417 -83.714584

Figure 43. *Sisyrinchium angustifolium*, I-10, Madison County, Florida; images recorded 17 March 2012.

Extent — North side – locally abundant, mainly in back half of clear zone to woodland edge; south side –sporadic.

Management Recommendation

To facilitate sustainability and spread of this showy wildflower, avoid mowing until the last week of April. *S. angustifolium* seems to be compatible with turf in the clear zone based on observations in this study and its widespread occurrence in the clear zone on many roadside ROWS with no apparent detrimental effects.

Note

Very showy, especially in mass. May help to stabilize soil in moister areas where bahiagrass does not thrive.

Solidago canadensis

Type	Broadleaf; native
Life cycle / bloom	Perennial / fall
Compatible with bahiagrass turf	See Notes
Location	North side, south side, median
Soil moisture	Dry
Lat./long. (image)	+30.445200 -83.712196

Figure 44. *Solidago canadensis*, I-10, Madison County, Florida; images recorded 17 October 2012 (UL, ML) 13 October 2011 (LL).

Extent — North side – widespread and locally abundant from woodland edge to beyond clear zone. Median – widespread and locally abundant. South side – locally abundant in and beyond clear zone. .

Management Recommendation

Fall cleanup should facilitate seed dispersal and increase showiness in subsequent years

Note

Showy wildflower; no evidence to indicate that it's incompatible with turf; no erosion observed.

Sonchus sp.

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Probably
Location	North side, South side
Soil moisture	Slightly dry to slightly moist
Lat./long.	+30.444917 -83.711361

Figure 45. *Sonchus* sp., I-10, Madison County, Florida; images recorded 17 March 2012.

Extent South side – locally abundant. North side – very sporadic.

Management Recommendation

No control action needed as there is no evidence to indicate that it currently is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Since an annual, presumably like many other annuals "…not a problem until the population gets so high that it out competes the Bahia" (Ferrell, 2013).

Note

Either *S. asper* or *S. oleraceus*; however, very difficult to distinguish the two species (Hansen, 2012a).

Sphenopholis obtusata

Type	Grass; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Slightly dry to slightly moist
Lat./long.	+30.445333 -83.721500

Figure 46. *Sphenopholis obtusata*, I-10, Madison County, Florida; images recorded 17 March 2012

Extent Widespread and locally abundant.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Mistakenly classified as nonnative in previous reports. Probably present to a similar extent in 2009-11 but flowering in 2012 and 2013 made it very obvious. Identified verified by Bruce Hansen (Hansen, 2013a). May help to stabilize soil.

Sporobolus indicus

Type	Grass; nonnative
Life cycle / bloom	Perennial / summer, fall
Compatible with bahiagrass turf	See Notes
Location	North side, median
Soil moisture	Moist to slightly moist
Lat./long.	+30.445387 -83.722531

Figure 47. *Sporobolus indicus*, I-10, Madison County, Florida; images recorded 10 October 2010.

Extent	Widespread and locally abundant, mainly in western half of median. North side - sporadic

Management Recommendation

Mow annually in the fall.

Note

No evidence to indicate that it is incompatible with bahiagrass turf in clear zone. Mow in fall because the persistent dead foliage in late fall and winter could be a fire risk (Ferrell, 2011b).

Stachys floridana

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

Figure 48. *Stachys floridana*, I-10, Madison County, Florida; images recorded 19 March 2010 (UL, LL) and 13 March 2013 (MR).

Extent — Widespread and locally abundant, especially south side. South side – population (500-600 ft^2, see image), and appears to be spreading into safety strip; also locally abundant in lower portion of pilot study area. A notably large population on north side (~300 ft^2).

Management Recommendation

While *Stachys floridana* is considered showy by some people, *S. floridana* is very competitive and can be locally dominant.
While Ferrell (2010a) cautioned that this species "…can cause large open areas in the turf…and to monitor this area for signs of erosion", the large population on the south side is clearly in decline and bahiagrass is filling back in**; <u>no action needed at this time</u>**. This population is beyond the mowed safety strip so the decline is not due to herbicide applied via wet blade. No evidence of erosion any place it occurs.

Symphyotrichum dumosum

Type	Broadleaf; native
Life cycle / bloom	Perennial / mid-summer to fall
Compatible with bahiagrass turf	See Notes
Location	North side, south side, median
Soil moisture	Slightly dry to slightly moist
Lat./long. (image)	+30.444833 -83.710806

Figure 49. *Symphyotrichum dumosum*, I-10, Madison County, Florida; images recorded 6 October 2013.

Extent — Locally abundant in median and south side. North side – sporadic.

Management Recommendation

No control action needed as there is no evidence to indicate that it currently is incompatible with bahiagrass turf and/or causes erosion in the clear zone.

Note

Showy native wildflower. Mainly occurs where traditional turf is relatively sparse. Reduced mowing will increase its spread and aesthetic appeal.

Tradescantia ohiensis

Type	Monocot; native
Life cycle / bloom	Perennial / mainly spring
Compatible with bahiagrass turf	See below
Location	North side, south side, median
Lat./long.	+30.445528 -83.721528

Figure 50. *Tradescantia ohiensis*, I-10, Madison County, Florida; images recorded 17 March 2012 (UL), 13 March 2013 (MR), 19 March 2010 (ML), and 27 October 2011 (LR).

Extent North and south sides – widespread and locally abundant, especially in the western, lower portion of the pilot study area (see Fig. 1). Its extent seems about the same as in 2012; however, the reduced mowing regime seems to have increased the extent of *T. ohiensis* from 2009 to 2012/13. Median – sporadic.

Management Recommendation

A reduced mowing regime should continue to increase its extent beyond the safety strip. To facilitate sustainability and spread of this showy wildflower on other roadsides, avoiding mowing until mid-May will enhance the aesthetic impact of *Tradescantia*. Based on observations on other roadsides, such practices seem to be compatible with normal highway operations. No erosion observed where it occurs. This perennial may help to stabilize soil.

Trifolium campestre

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

Figure 51. *Trifolium campestre,* I-10, Madison County, Florida; images recorded 19 March 2010 (UL) and 18 March 2011 (LR).

Extent — Widespread and locally abundant, especially on north side; one of the predominant species. South side and median – sporadic; less abundant in 2013 than in previous years.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone, even at high density.

Note

Probably adds nitrogen to soil via nitrogen fixation.

Trifolium incarnatum

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

Figure 52. *Trifolium incarnatum*, I-10, Madison County, Florida; image recorded 19 March 2010.

Extent — Widespread and locally abundant especially on north side. Locally abundant only in sunny area in western-most end of pilot study area. Median – sporadic.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone, even at high density.

Note

Probably adds nitrogen to soil via nitrogen fixation.

Valerianella radiata

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

Figure 53. *Valerianella radiata*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent South side – locally abundant. North side – sporadic;

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone. Since an annual, presumably like many other annuals "…not a problem until the population gets so high that it out competes the Bahia" (Ferrell, 2013).

Note

Noticeably less prevalent in all areas in 2012 -2013 compared to 2009-2011.

Vicia sativa

Type	Broadleaf; nonnative
Life cycle / bloom	Annual / spring
Compatible with bahiagrass turf	Probably
Location	North side, south side, median
Soil moisture	Slightly dry to slightly moist
Lat./long.	+30.444805 -83.711052

Figure 54. *Vicia sativa* I-10, Madison County, Florida; images recorded 19 March 2010.

Extent Widespread and locally abundant.

Management Recommendation

No control action needed as there is no evidence to indicate that it is incompatible with bahiagrass turf and/or causes erosion in the clear zone, even at high density.

Note

Probably adds nitrogen to soil via nitrogen fixation.

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.	+30.444944 -83.714083

Figure 55. *Viola sororia*, I-10, Madison County, Florida; images recorded 19 March 2010.

Extent: South side – widespread and locally abundant in western shady portion. North side – one small population

Management Recommendation

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

Note

Showy roadside wildflower in mass on road-facing slopes, or in absence of taller species. No *Viola biocolor* observed in 2012 or 2013 but was observed in previous years.

Vitis rotundifolia

Type	Woody vine; native
Life cycle / bloom	Perennial / spring
Compatible with bahiagrass turf	Probably, provided that portion growing out into turf gets mowed each fall
Location	North side, south side
Soil moisture	Slightly moist to dry
Lat./long.	+30.445470 -83.709312

Figure 56. *Vitis rotundifolia* I-10, Madison County, Florida; image recorded 13 October 2011.

Extent — North and south side – widespread and locally abundant especially in eastern half; grows out from woodland edge. Locally abundant on both sides beyond clear zone.

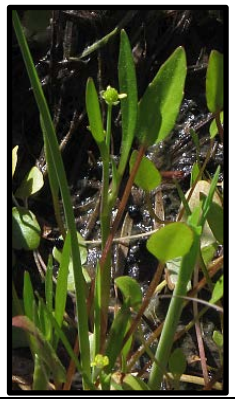
Management Recommendation

Mow in mid to late fall; no evidence of being incompatible with traditional turf when mowed back.

Table 2. Species observed on 17 March 2012 or 13 March 2013 that occurred sporadically in the clear zone, or were sporadic to locally abundant just beyond the clear zone, often including the woodland edge. Environmental conditions and management practices could increase the occurrence of any one of these species in the future.

		
Baccharis halimifolia	Carex fissa var. aristata[1]	Dichanthelium sp.
		
Eleocharis sp.[1]	Gelsemium sempervirens	Gladiolus dalenii
		
Glandularia pulchella	Linaria canadensis	Lobelia feayana

Table 2 - continued

		
Nothoscordum bivalve	Ranunculus pusillus[2]	Rubus sp.
		
Rumex hastatulus	Trifolium repens	Youngia japonica
		
Zephyranthes atamasca		

[1] Identified by Bruce Hansen (Hansen, 2012b).

[2] Identified by Bruce Hansen (Hansen, 2013a).

Table 3. Species observed on 17 October 2012 or 6 October 2013 that occurred sporadically in the clear zone, or were sporadic to locally abundant just beyond the clear zone, often including the woodland edge. Environmental conditions and management practices could increase the occurrence of any one of these species in the future. [1, 2]

		
Amaranthus sp.	Acmella oppositifolia	Agalinis sp.
		
Andropogon virginicus	Chamaecrista fasciculata	Chamaesyce hyssopifolia
		
Conyza canadensis	Crotalaria spectabilis	Desmodium triflorum

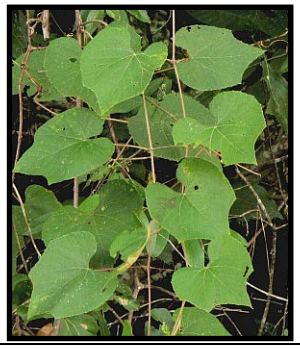
Table 3 - continued

		
Dichondra caroliniensis	Elephantopus sp.	Eragrostis sp.[3]
		
Eupatorium perfoliatum	Euthamia caroliniana	Ipomoea hederifolia
		
Liquidambar styraciflua	Mimosa strigillosa	Monarda punctata
		
Oenothera biennis	Parthenocissus quinquefolia	Passiflora incarnata

Table 3 - continued

		
Phyllanthus urinaria	Pityopsis graminifolia	Pseudognaphalium obtusifolium
		
Sacciolepis striata	Smilax auriculata	Symphyotrichum carolinianum[4]
		
Symphyotrichum pilosum	Toxicodendron radicans	Trichostema dichotomum
		
Tridens flavus	Ulmus americana	Verbena brasiliensis

Table 3 - continued

 Vitis sp.[5]		
Category I Invasive species; these only occur on the woodland edge.	 Ligustrum sinense	 Lygodium japonicum
Category I Invasive species	 Sapium sebiferum	

[1] Images not included of *Baccharis* (see Table 2) or *Viola* (see page 68).

[2] No image recorded for *Ipomoea quamoclit* – acceptable example not available.

[3] *Eragrostis spectabilis* or *E. hirsuta* (both native).

[4] *Symphyotrichum carolinianum* is a very showy native wildflower that only occurs on the woodland edge.

[5] *Vitis aestivalis* or *V. vulpina* (both native).

Table 4. Scientific and common names of species observed on 12 March 2012 or 13 March 2013. The common names are those listed by the Atlas of Florida Vascular Plants (http://florida.plantatlas.usf.edu/; accessed 25 March 2013.) BL = Broadleaf; GR = Grass; MN=Monocot; SG=Sedge; SH=Shrub; TR=Tree; VN=Vine. See Table 5 for Category I invasive species.

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
		Native		
Allium canadense	Meadow Garlic	MN	N, S	+30.445553 -83.717233
Ambrosia trifida (seedlings)	Giant Ragweed	BL	S	+30.444861 -83.708417
Baccharis halimifolia	Groundsel Tree	SH	S	+30.444870 -83.710047
Carex dasycarpa	Sandywoods Sedge	SG	S	+30.444967 -83.714972
Carex fissa var. aristata	Hammock Sedge	SG	S	+30.445250 -83.721750
Chaerophyllum tainturieri	Hairyfruit Chervil	BL	N, S, M	+30.445250 -83.709221
Dichanthelium sp.	Witchgrass	GR	W (N), N, S	+30.44558 -83.719675
Eleocharis sp.	Spikerush	SG	M	+30.445333 -83.721833
Erigeron quercifolius	Oakleaf Fleabane	BL	N, S	+30.445473 -83.716141

Table 4 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Galium aparine	Stickwilly, Bedstraw	BL	S, M	+30.445389 -83.722083
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	+30.445222 -83.714917
Linaria canadensis	Canadian Toadflax	BL	N	+30.445417 -83.709083
Lobelia feayana	Bay Lobelia	BL	M	+30.445306 -83.721444
Nothoscordum bivalve	False Garlic	MN	N	+30.445517 -83.721682
Oxalis corniculata	Woodsorrel	BL	N, S	+30.445390 -83.715110
Piptochaetium avenaceum	Blackseed Needlegrass	GR	W (N, S), N, S	+30.445417 -83.708359
Pyrrhopappus carolinianus	Carolina Desert Chicory	BL	N, S	+30.445000 -83.714278
Ranunculus pusillus	Low Spearwort	BL	M	+30.445333 -83.723083

Table 4 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Rubus cuneifolius	Sand Blackberry	SH	N, S	+30.445437 -83.710670
Rubus sp.	Dewberry	VN	N	+30.445458 -83.710507
Rumex hastatulus	Heartwing Dock	BL	W (N)	+30.445389 -83.710139
Salvia lyrata	Lyreleaf Sage	BL	N, S	+30.444833 -83.708667
Sisyrinchium angustifolium	Blue-eyed Grass	MN	N, S	+30.445417 -83.714584
Sphenopholis obtusata	Prairie Wedgescale	GR	N, S, M	+30.445333 -83.721500
Stachys floridana	Florida Betony	BL	N, S	+30.444944 -83.712860
Tradescantia ohiensis	Ohio Spiderwort	BL	N, S, M	+30.445528 -83.721528
Valerianella radiata	Beaked Cornsalad	BL	N, S	+30.444805 -83.706253
Viola sororia (also recognized as *Viola affinis*)	Common Blue Violet	BL	N, S	+30.444944 -83.714083

Table 4 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Zephyranthes atamasca	Atamasco Lily	BL	N	+30.445361 -83.711167
		Nonnative		
Buglossoides arvensis	Corn Gromwell	BL	M	+30.445389 -83.722194
Gladiolus dalenii	Florida Gladiolus	MN	N, S	+30.445611 -83.721389
Glandularia pulchella	Moss Verbena	BL	M	+30.445194 -83.710667
Lamium amplexicaule	Henbit Deadnettle	BL	N, S, M	+30.445222 -83.716861
Lolium perenne	Italian Ryegrass	GR	N, S, M	+30.445389 -83.713753
Paspalum urvillei	Vaseygrass	GR	N, S, M	+30.445168 -83.711938
Sonchus sp.	Sowthistle	BL	N, S	+30.444917 -83.711361
Trifolium campestre	Field Clover	BL	N, S, M	+30.445110 -83.722946
Trifolium incarnatum	Crimson Clover	BL	N, S, M	+30.445389 -83.716309

Table 4 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Trifolium repens	White Clover	BL	S	+30.445028 -83.717278
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)

Table 5. Scientific and common names of species observed on 17 October 2012 or 6 October 2013. The common names are those listed by the Atlas of Florida Vascular Plants (http://florida.plantatlas.usf.edu/; accessed 30 October 2012.) BL = Broadleaf; GR = Grass; MN=Monocot; SG=Sedge; SH=Shrub; TR=Tree; VN=Vine.

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
		Native		
Acalypha gracilens	Slender Threeseed Mercury	BL	N, S	+30.445443 -83.713486
Acmella oppositifolia	Oppositeleaf Spotflower	BL	N, W (N)	+30.445380 -83.717510
Agalinis sp.	False Foxglove	BL	N, S	+30.445518 -83.708930
Ambrosia artemisiifolia	Common Ragweed	BL	N, S, M	+30.445430 -83.709447
Ambrosia trifida	Giant Ragweed	BL	N, S, M	+30.444857 -83.712368
Ampelopsis arborea	Peppervine	VN	N, S	+30.445383 -83.712368
Andropogon glomeratus var. pumilus	Bushy Bluestem	GR	N, S, M	+30.445498 -83.708955
Andropogon virginicus	Bluestem	GR	S	+30.445370 -83.711813
Baccharis halimifolia	Groundsel Tree	GR	M	+30.445343 -83.720762

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Bidens alba	Beggarticks	BL	N, S, M	+30.445442 -83.709695
Bidens bipinnata	Spanish Needles	BL	N, S, M	+30.445392 -83.710287
Boehmeria cylindrica	False Nettles	BL	S	+30.444972 -83.714472
Chamaecrista fasciculata	Partridge Pea	BL	S	+30.444750 -83.709512
Chamaesyce hyssopifolia	Hyssopleaf Spurge	BL	N, S	+30.445111 -83.723278
Conoclinium coelestinum	Blue Mistflower	BL	N, S, M, W (N, S)	+30.444928 -83.713437
Conyza canadensis	Canadian Horseweed	BL	N, S	+30.445437 -83.710908
Dichondra caroliniensis	Carolina Ponysfoot	BL	S	+30.445028 -83.714833
Diospyros virginiana	Common Persimmon	TR	N, S	+30.445362 -83.709505
Elephantopus sp.	Elephantsfoot	BL	S	+30.444972 -83.714056
Eragrostis sp. (E. spectabilis or E. hirsuta)	Lovegrass	GR	N	+30.445433 -83.711708

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Erigeron quercifolius	Oakleaf Fleabane	BL	N, S	+30.445375 -83.709000
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 caroliniana	Slender Flattop Goldenrod	BL	N, S	+30.444806 -83.710861
Hydrocotyle sp.	Dollarweed, Pennywort	BL	N, S, M	+30.445298 -83.708465
Ipomoea cordatotriloba	Tievine	BL	N, S, M	+30.445537 -83.718530
Ipomoea hederifolia	Scarletcreeper	BL	N, S	+30.445420 -83.712657
Ipomoea lacunosa	Whitestar	BL	S, M	+30.445310 -83.715213
Liquidambar styraciflua	Sweetgum	TR	N, S, M	+30.445467 -83.716058
Melothria pendula	Creeping Cucumber	VN	S, M	+30.445306 -83.716917

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Mimosa strigillosa	Powderpuff	VN	N, M	+30.445522 -83.721642
Monarda punctata	Spotted Beebalm	BL	N, M	+30.445440 -83.711702
Oenothera biennis	Common Evening Primrose	BL	N	+30.445443 -83.708670
Oxalis corniculata	Woodsorrel	BL	N, S, M	+30.445083 -83.708861
Parthenocissus quinquefolia	Virginia Creeper	VN	S	+30.445083 -83.720417
Passiflora incarnata	Passionflower	BL	N	+30.445444 -83.709528
Phyla nodiflora	Frogfruit	BL	N, S	+30.445002 -83.715415
Pityopsis graminifolia	Narrowleaf Silkgrass	BL	S (W)	+30.444763 -83.708838
Polygonum sp. (probably P. hydropiperoides)	Knotweed	BL	N, S, M	+30.445413 -83.714282
Pseudognaphalium obtusifolium	Sweet Everlasting	BL	N, S	+30.444835 -83.710803
Rhus copallinum	Winged Sumac	TR	N, S	+30.445405 -83.708625

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Rubus cuneifolius	Sand Blackberry	SH	N, S	+30.445437 -83.710670
Sacciolepis striata	American Cupscale	GR	N (W)	+30.445500 -83.714528
Salix caroliniana	Carolina Willow	TR	M	+30.445410 -83.720472
Salvia lyrata	Lyreleaf Sage	BL	N, S, M	+30.444778 -83.705948
Setaria parviflora	Knotroot Foxtail	GR	N, S, M	+30.444897 -83.710797
Sida ulmifolia/ rhombifolia	Fanpetals	BL	N, S, M	+30.445190 -83.711590 to +30.445190 -83.711920
Smilax auriculata	Earleaf Greenbrier	VN	N	+30.445569 -83.722277
Solidago canadensis	Canada Goldenrod	BL	W (N), S, M	+30.445200 -83.712196
Stachys floridana	Florida Betony	BL	N, S	+30.444944 -83.712860
Symphyotrichum carolinianum	Climbing Aster	BL	W (N)	+30.445583 -83.721642

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Symphyotrichum dumosum	Rice Button Aster	BL	N, S, M	+30.444833 -83.710806
Symphyotrichum pilosum	White Oldfield Aster	BL	S, W (S)	+30.445807 -83.710415
Toxicodendron radicans	Poison Ivy	VN	S	+30.445000 -83.714778
Tradescantia ohiensis	Ohio Spiderwort	BL	N, S, M	+30.445084 -83.721169
Trichostema dichotomum	Forked Bluecurls	BL	N, M	+30.445498 -83.708977
Tridens flavus	Purpletop	GR	N	+30.445455 -83.710605
Ulmus americana	American Elm	TR	M	+30.445432 -83.722278
Vitis rotundifolia	Muscadine	VN	N, S	+30.445470 -83.709312
Vitis sp. (V. aestivalis or V. vulpina)	Muscadine	VN	W (N, S)	+30.445435 -83.709920
Viola sp. (V. bicolor and/or V. sororia)	Common Blue Violet	BL	S	+30.444973 -83.717667

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
		Nonnative		
Amaranthus sp.	Pigweed	BL	M	+30.445250 -83.711639
Crotalaria spectabilis	Showy Rattlebox	BL	N	+30.445472 -83.711105
Cyperus esculentus	Yellow Nutsedge	SG	N, S, M	+30.445438 -83.714325
Desmodium incanum	Zarzabacoa Comun	BL	N, S	+30.445522 -83.721642
Desmodium triflorum	Threeflower Ticktrefoil	BL	N, M	+30.445328 -83.711557
Hyptis mutabilis	Tropical Bushmint	BL	N, S, M	+30.445056 -83.709778
Ipomoea quamoclit	Cypressvine Morning-glory	BL	N	+30.445420 -83.712657
Ligustrum sinense[1]	Chinese Privet	SH	W (S)	+30.444952 -83.714998
Lygodium japonicum[1]	Japanese Climbing Fern	----	W (S)	+30.444942 -83.716977
Paspalum urvillei	Vaseygrass	GR	N, S, M	+30.445168 -83.711938

Table 5 - continued

Scientific name	Common name	Type	Location: **M**edian, **N**orth side, **S**outh side, or **W**oodland edge	GPS coordinates of at least one location (latitude / longitude)
Phyllanthus urinaria	Chamberbitter	BL	S	+30.444983 -83.715550
Sapium sebiferum[1]	Popcorn Tree	TR	M	+30.445361 -83.720000
Sporobolus indicus	Smutgrass	GR	N, M	+30.445387 -83.722531
Verbena brasiliensis	Brazilian Vervain	BL	N, S	+30.444897 -83.712463

[1] Category I invasive species.

Table 6. Desirability of species in the clear zone observed in March and October of 2012 and 2013 of the reduced mowing regime pilot study along I-10 in Madison County; the clear zone was up to the woodland edge in some areas. To be deemed desirable in this segment of I-10, a species must be native (exception made for legumes that add nitrogen to soil), not associated with erosion in this study, and appeared to be compatible with bahiagrass where bahiagrass was observed to be thriving. This latter criterion would not be applicable in moist and/or shady conditions where turf would not perform well or survive. Underlined species in bold type are listed in the 2013 MRP Handbook as being undesirable.

NOTE: *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 in the 2013 MRP Handbook, or potentially undesirable species, are a safety concern, or that their presence has led to erosion or is likely to lead to erosion. Compatibility among species is a very complex issue that is related to soil type, soil moisture, light, pH, slope, climate, etc. For example, a non-turfgrass species that is associated with erosion under one set of environmental conditions might not be associated with erosion under different environmental conditions. Also, it is very important to be aware that an association between a particular species and erosion is not necessarily a cause and effect relationship, that is, a particular species causes erosion. An association between two observations is impetus to determine if there is a cause and effect relationship, which only can be determined by a research study that includes the appropriate control treatments.*

Species	Native to Florida	Showy	Desirable	Comments
		Species Widespread In Clear Zone		
Allium canadense	Yes	Yes (in mass)	Yes	Seems to be compatible with traditional turf
Ambrosia artemisiifolia	Yes	No	No	Prob. incompatible with traditional turf
Ambrosia trifida	Yes	No	No	Prob. incompatible with traditional turf
Ampelopsis arborea	Yes	No	No	Vine that does not seem to affect turf
Andropogon glomeratus var. pumilus	Yes	Yes	Yes	See page 19
Bidens alba	Yes	Yes	?	See page 20

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Bidens bipinnata	Yes	No	No	May be incompatible with traditional turf but no evidence of incompatibility
Chaerophyllum tainturieri	Yes	No	No	Might be incompatible with traditional turf at very high density
Cyperus esculentus	No	No	No	See page 27
Cyperus sp.	?	No	No	Probably incompatible with traditional turf based on observations in median; however mainly thrives in wet to consistently moist soil where turf performs poorly; no erosion where it occurs
Desmodium incanum	No	No	No	Probably compatible with traditional turf
Diospyros virginiana	Yes	No	No	Probably compatible with traditional turf if mowed back each fall
Erigeron quercifolius	Yes	Yes	Yes	Apparently compatible with traditional turf based on observations in this study and other roadside observations
Eupatorium capillifolium	Yes	No	No	Potentially incompatible with traditional turf

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Eustachys petraea	Yes	No	Yes	Apparently compatible with traditional turf
Galium aparine	Yes	No	No	Might be incompatible with traditional turf at very high density
Geranium carolinianum	Yes	No	No	Potentially incompatible with traditional turf
Hydrocotyle sp.	Yes	No	No	See page 35
Lamium amplexicaule	No	Yes (in mass)	No	Might be incompatible with traditional turf at very high density
Lolium perenne	No	No	No	Probably incompatible with traditional turf as density increases
Paspalum urvillei	No	No	No	Incompatible with traditional turf; see page 43
Piptochaetium avenaceum	Yes	Yes (in mass)	Yes	Seems to be compatible with traditional turf, and seems to be a desirable turf species in moist areas
Pyrrhopappus carolinianus	Yes	Yes	Yes	Seems to be compatible with traditional turf

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Rhus copallinum	Yes	No	No	No evidence that is incompatible with traditional turf or is associated with erosion; may help to stabilize soil if mowed back each fall
Rubus cuneifolius	Yes	No	No	Probably compatible with traditional turf if mowed back each fall
Salvia lyrata	Yes	Yes	Yes	See pages 52
Solidago canadensis	Yes	Yes	Yes (?)	See page 57
Sphenopholis obtusata	Yes	No	Yes	Seems to be compatible with traditional turf
Sporobolus indicus	No	No	No	See page 60
Stachys floridana	Yes	Yes	No	See page 61
Tradescantia ohiensis	Yes	Yes	Yes	See page 63
Trifolium campestre	No	Yes (in mass)	Probably	No evidence to indicate that it's incompatible with traditional turf, even at high density. Probably adds nitrogen to soil.
Trifolium incarnatum	No	Yes (in mass)	Probably	No evidence to indicate that it's incompatible with traditional turf, even at high density. Probably adds nitrogen to soil.

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Vicia sativa	No	Yes	Maybe	No evidence to indicate that it's incompatible with traditional turf, even at high density. Probably adds nitrogen to soil.
Viola sororia	Yes	Yes	Yes	Seems to be compatible with traditional turf
Vitis rotundifolia	Yes	No	No	Vine that only occurs in reduced mowing area, and does not seem to interfere with traditional turf if mowed back in fall
<u>Species Not Widespread But Locally Abundant Or Sporadic In Clear Zone, Or Occur Just Beyond Clear Zone To Woodland Edge</u>				
Acalypha gracilens	Yes	No	Yes (?)	Seems to be compatible with traditional turf
Acmella oppositifolia	Yes	Yes	Yes	Mainly on woodland edges where traditional turf is relatively sparse
Agalinis sp.	Yes	Yes	Yes	Mainly occurs where turf is sparse
Amaranthus sp.	No	No	No	Potentially incompatible with traditional turf
<u>Andropogon virginicus</u>	Yes	Yes	Yes	Same as for A. glomeratus var. pumilus; see page 19

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Baccharis halimifolia	Yes	No	No	Shrub species that gets mowed down during fall cleanup mowing; no evidence of being incompatible with traditional turf
Boehmeria cylindrica	Yes	No	No	No evidence to indicate that is incompatible with traditional turf
Buglossoides arvensis	No	No	No	Might be incompatible with traditional turf at very high density
Carex dasycarpa	Yes	No	Yes	Only occurs in moist, shady areas; helps to stabilize soil where turf performs poorly
Carex fissa var. aristata	Yes	No	Yes	Only occurs in moist, shady areas; helps to stabilize soil where turf performs poorly
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

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Conoclinium coelestinum	Yes	Yes	Yes	Mainly in shady areas and woodland edges where traditional turf is normally sparse
Crotalaria spectabilis	No	Yes	No	Potentially incompatible with traditional turf
Conyza canadensis	Yes	No	?	Too sparse to determine
Desmodium triflorum	No	No	No	Probably compatible with traditional turf
Dichanthelium sp.	Yes	No	Yes	On woodland edge where traditional turf is more sparse; no evidence to that it's incompatible with traditional turf
Dichondra caroliniensis	Yes	No	Yes	Groundcover that is compatible with turf; probably helps to prevent erosion
Eleocharis sp.	Yes	No	Yes	Only occurs in moist areas; should have no effect on turf in that environment; helps to stabilize soil where turf performs poorly
Elephantopus sp.	Yes	Yes (in mass)	?	No evidence to indicate that it's incompatible with turf

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Eragrostis sp.	Yes	Yes	Yes (?)	Mainly occurs beyond clear zone
Eupatorium perfoliatum	Yes	Yes	Yes	On woodland edge where traditional turf is normally sparse
Euthamia caroliniana	Yes	Yes	?	No evidence to indicate that it's incompatible with turf
Gelsemium sempervirens	Yes	Yes	Yes*	*Only desirable if on fence, or in trees or shrubs
Gladiolus dalenii	No	Yes	No	Too sparse to determine
Glandularia pulchella	No	Yes	?	Popular, showy groundcover that is compatible with turf
Hyptis mutabilis	No	No	No	Seems a bit more prevalent than in past years; may need to be monitored for erosion potential
Ipomoea cordatotriloba	Yes	Yes	?	Vine that creeps in turf but does not seem to have significant effect on turf
Ipomoea hederifolia	Yes	Yes	?	Vine that sporadically occurs near back of clear zone; does not seem to have significant effect on turf

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Ipomoea lacunosa	Yes	Yes	?	Vine that creeps into turf but does not seem to have significant effect on turf
Ipomoea quamoclit	No	Yes	No	Vine that sporadically occurs or near back of clear zone; does not seem to have significant effect on turf
Ligustrum sinense	No	No	No	Category I invasive species
Liquidambar styraciflua	Yes	No	No	Probably compatible if mowed back each fall
Lobelia feayana	Yes	Yes	Yes	Only occurs in moist/wet areas; should have no effect on turf in that environment
Lygodium japonicum	No	No	No	Category I invasive species
Melothria pendula	Yes	No	No	Vine that creeps in turf but does not seem to have significant effect on turf
Mimosa strigillosa	Yes	Yes	Yes	Compatible with turf based on experience
Monarda punctata	Yes	Yes	Yes*****	*****Only desirable if beyond clear zone, or towards back side of clear zone

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Nothoscordum bivalve	Yes	Yes (in mass)	Yes	No evidence to indicate that it's incompatible with traditional turf; probably helps to stabilize soil
Oenothera biennis	Yes	Yes	?	Potentially incompatible with traditional turf
Oxalis corniculata	Yes	Yes	?	No evidence to indicate that it's incompatible with traditional turf
Parthenocissus quinquefolia	Yes	No	?	Vine that creeps in turf but does not seem to have significant effect on turf
Passiflora incarnata	Yes	Yes	?	Potentially incompatible with traditional turf; desirable if beyond clear zone, or towards back side of clear zone
Phyla nodiflora	Yes	Yes	Yes	While it reportedly is associated with erosion, no evidence of erosion in this study.
Phyllanthus urinaria	No	No	No	Probably incompatible with traditional turf

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Pityopsis graminifolia	Yes	Yes	Yes*	*Only seems to be competitive with traditional turf in dry sites where turf is relatively sparse
Polygonum sp.	Yes	Yes (in mass)	Yes	Only occurred in moist and/or shady areas where traditional turf density was sparse to nil, so not expected to compete with traditional turf
Pseudognaphalium obtusifolium	Yes	Yes	?	Probably compatible, but too spare to determine
Ranunculus pusillus	Yes	No	Yes	Only occurs in moist/wet areas; should have no effect on turf in that environ.
Rubus cuneifolius	Yes	No	No	Probably compatible if mowed back each fall
Rubus sp.	Yes	No	No	Vine that creeps out from woodland edge; no evidence of being incompatible with traditional turf
Rumex hastatulus	Yes	Yes (in mass)	Yes	No evidence to indicate that it's incompatible with traditional turf, even at high density based on observations where it occurs on other roadsides

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Sacciolepis striata	Yes	No	Yes	Seems to be compatible with traditional turf, and seems to be a desirable turf species that will help to stabilize soil
Salix caroliniana	Yes	No	No	See page 51
Sapium sebiferum	No	No	No	Category I invasive species
Setaria parviflora	Yes	Yes (in mass)	Yes	See page 54
Sida spp.	Yes	No	?	See page 55
Sisyrinchium angustifolium	Yes	Yes (in mass)	Yes	See page 56
Sonchus sp.	No	No	No	Might be incompatible with traditional turf at very high density
Smilax auriculata	Yes	No	No	Vine that creeps into turf but does not seem to have significant effect on turf
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

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Symphyotrichum pilosum	Yes	Yes	Yes (?)	Mainly occurs where traditional turf is relatively sparse
Toxidendron radicans	Yes	No	No	Vine that creeps into turf but does not seem to have significant effect on turf
Trichostema dichotomum	Yes	Yes	Yes	No evidence that is incompatible with turf or is associated with erosion
Tridens flavus	Yes	Yes	Yes	No evidence that is incompatible or is associated with erosion; may help to stabilize soil
Trifolium repens	No	Yes	Maybe[1]	No evidence to indicate that it's incompatible with traditional turf, even at high density. [1]Probably adds nitrogen to soil.
Ulmus americana	Yes	No	No	Probably compatible if mowed back each fall
Valerianella radiata	Yes	No	No	Might be incompatible with traditional turf at very high density

Table 6 - continued

Species	Native to Florida	Showy	Desirable	Comments
Verbena brasiliensis	No	No	No	Will need to be monitored for erosion potential if it becomes locally abundant
Vitis sp.	Yes	No	No	Vine that occurs near back of clear zone or woodland edge and may creep into turf; does not seem to have significant effect on turf
Viola sp.	Yes	Yes	Yes	Seems to be compatible with traditional turf; only occurs in moist, shady areas where bahiagrass performs poorly
Zephyranthes atamasca	Yes	Yes	Yes	Compatible with turf based on observations at other roadside sites
Youngia japonica	No	Yes	No	Spring blooming annual that seems to be compatible with traditional turf

CONCLUSIONS

The modified mowing regime on the westernmost mile of I-10 in Madison County did not interfere with normal highway operation. From 2009 to 2013, limiting the number of clear zone mowing cycles to all but a 10- to 15-ft safety strip adjacent to the shoulder had no detrimental effects related to erosion or safety. Moreover, Sherry Craft of District 2 Perry Maintenance was "…not aware of any negative safety consequences in the Pilot Project area…not received any calls or complaints from the public nor have I received any negative comments from my inhouse personnel" (Craft, 2012a), or was "… aware of any safety or erosion concerns" in 2013 (Craft, 2014a). The only complaint was from the Central Office in early fall 2013 because of concerns about median clear zone aesthetics since it had not been mowed in early summer as it had in 2012 (Craft, 2014b).

The modified mowing regime reduced mowing costs. For example, mowing just the safety strip 6 times per year followed by a fence-to-fence fall cleanup mowing reduced mowing costs by over $1000 per mile in 2010 and 2011 (Norcini, 2012); however, cost savings were less in 2012 because of the clear zone mowing in June. Not only were mowing costs reduced but aesthetics were improved in the spring because reduced mowing beyond the safety strip allowed showier displays of wildflowers, especially the spring wildflowers *Tradescantia ohiensis* (Spiderwort) and *Salvia lyrata* (Lyreleaf Sage).

Mowing had a substantial effect on species diversity as the number of species in the safety strip clearly was less than in the remainder of the clear zone. Moreover, the reduced mowing facilitated the apparent sustainability and spread of desirable native wildflower species. One hundred and ten species were observed in the clear zone or along the woodland edge just beyond the clear zone, 84 (76%) of which were native. Thirty-six of those native species were deemed as clearly desirable native wildflowers, grasses, or sedges in this segment of I-10.

The 36 species included two species currently listed as undesirable in FDOT's 2013 MRP Handbook – *Andropogon virginicus* and *Bidens alba*[1]. In neither case were any detrimental effects associated with their occurrence, even though *Bidens alba* was widespread and locally abundant. *Bidens alba* apparently co-existed well with bahiagrass under the environmental conditions of the pilot study, even though bahiagrass would not have been be expected to perform well in the alkaline, sandy type soil where *Bidens alba* was dense. Erosion may not have occurred because 1) there was a sufficient density of bahiagrass underneath the *Bidens alba* canopy, and 2) the soil drained fast enough to prevent runoff and erosion. Further research is needed to determine if the degree of sandiness and/or other factors are resulting in erosion observed on FDOT roadsides in other parts of the state (Sellers and Ferrell, 2012).

Phyla nodiflora, a species suggested as being undesirable because it was observed where erosion occurred (Sellers and Ferrell, 2012), was locally abundant but no erosion was observed where it occurred. And other species listed as undesirable species in the MRP Handbook—*Ambrosia artemisiifolia*, *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

[1] In the 2013MRP Handbook, the scientific name of Spanish Needle is listed incorrectly as *Bidens pilosa*; the correct name is *Bidens alba*. In addition, the PI suggests that FDOT consider revising the "Undesirable Vegetation" section of the MRP Handbook to facilitate correct identification of undesirable species under field conditions.

be outcompeting traditional turfgrass species, the non-turfgrass species appear to have provided the same soil stabilization functions of traditional turfgrass species. Based on the evidence in this study, the issue of undesirable species should be re-examined. At the very least, a one size fits all policy does not appear warranted with regard to undesirable species. As District 1 Secretary Billy Hattaway noted at the January 2014 meeting of the District Landscape Architects and Managers, FDOT "…should not be a one size fits all agency".

Finally, when selecting potential sites for implementing reduced mowing regimes, the PI suggests pre-scouting 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:

- Significant presence of showy, native herbaceous species, especially in late winter and early spring before bahiagrass is actively growing.
- No significant presence of MRP-listed undesirable species within the clear zone, or immediately adjacent to the clear zone. However, consider that not all species classified as undesirable by MRP standards may pose a significant risk to normal highway operation under all circumstances (see the two preceding paragraphs).

These criteria are based on the outcomes of the 4-year study. Criteria should be considered context sensitive so they may 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. And consider too that the 2013 MRP Handbook defines turf as "…grass or other vegetation considered desirable for the particular roadside location". The PI suggests that a subject worthy of investigation by FDOT in the near future is the context sensitive composition of roadside species that meet MRP standards. While traditional turfgrasses often may be desirable, naturally occurring roadside species may successfully fulfill turfgrass functions but with less inputs.

REFERENCES

Craft, S. (2012a). Response to inquiry about being "…aware of any negative safety consequences as a result of the reduced mowing regime implemented in 2009 on I-10 in Madison County?" [email] Personal communication, 26 April 2012.

Craft, S. (2012b). Response to inquiry about the summer clear zone mowing. [email] Personal communication, 10 July 2012.

Craft, S. (2012c). Response to inquiry about herbicide mowing and fall cleanup mowing. [email] Personal communication, 9 November 2012.

Craft, S. (2013). Response to inquiry about being "…aware of any negative safety consequences as a result of the reduced mowing regime implemented in 2009 on I-10 in Madison County?" [email] Personal communication, 20 March 2013.

Craft, S. (2014a). Response to inquiry about herbicide mowing. [email] Personal communication, 24 January 2014.

Craft, S. (2014b). Response to inquiry about mowing. [email] Personal communication, 27 January 2014.

Ferrell, J. (2009). Response to inquiry about the effect of vaseygrass and dollarweed on roadside bahiagrass turf quality. [email] Personal communication, 10 October 2009.

Ferrell, J., 2010a. Response to inquiry about the compatibility of several species with roadside bahiagrass turf. [email] Personal communication, 30 March 2010.

Ferrell, J. (2010b). Response to inquiry about the effect of several native and nonnative species on roadside bahiagrass turf as well as erosion. [email] Personal communication, 15 November 2010).

Ferrell, J. (2010c). Response to inquiry about how *Bidens alba* causes erosion on roadsides. [email] Personal communication, 15 November 2010).

Ferrell, J. (2010d). Response to inquiry about how *Ambrosia trifida* on roadsides. [email] Personal communication, 17 November 2010).

Ferrell, J. (2011a). Response to inquiry about the erosion threat and compatibility with roadside bahiagrass turf for *Cyperus croceus* and *Cyperus esculentus*. [email] Personal communication, 17 November 2011.

Ferrell, J. (2011b). Response to inquiry about the erosion threat and compatibility with roadside bahiagrass turf for *Ambrosia trifida, Eustachys,* and other species. [email] Personal communication, 15 November 2011).

Ferrell, J. (2013). Response to inquiry about the roadside right-of-way concerns about the annual species *Galium aparine* and *Buglossoides arvensis*. [email] Personal communication, 27 March 2013.

Hansen, B. F. (2012a). Response to inquiry about distinguishing the two *Sonchus* species that occur in Florida. [email] (Personal communication, 19 March 2012.

Hansen, B. F. (2012b). Response to request confirmation of identity of *Carex* tentatively identified in 2011. [email] (Personal communication, 20 March 2012.

Hansen, B. F. (2012c). Response to inquiry about identification of a *Polygonum*, *Salix*, and *Ulmus* species. [email] (Personal communication, 31 October 2012.

Hansen, B. F. (2012d). Response to inquiry about identification of a vine. [email] (Personal communication, 2 November 2012.

Hansen, B. F. (2013a). Response to inquiry about identification of two species, and confirming the identity of *Sphenopholis obtusata*. [email] (Personal communication, 14 March 2013.

Hansen, B. F. (2013b). Response to inquiry about identification of several species observed on 6 October 2013, and confirming the identity of *Sphenopholis obtusata*. [email] (Personal communication, 8 October 2013.

MacDonald, G. (2009). Response to inquiry about the effect of vaseygrass and dollarweed on roadside bahiagrass turf quality. [email] Personal communication, 10 October 2009.

Nelson, G. (2011a). Response to inquiry about *Carex* identification. [email] Personal communication, 13 April 2011.

Nelson, G. (2011b). Response to inquiry about *Ipomoea lacunosa* identification. [email] Personal communication, 15 November 2011.

Newman, Y., Vendramini, J., & Blount, A. (2011). Bahiagrass (*Paspalum notatum*): overview and management. University of Florida Cooperative Extension Service EDIS Publication SS-AGR-332.

Norcini, J.G. (2012). Energy Conservation Study – Madison County: 201 Survey of Roadside Vegetation. Retrieved January 23, 2014. From Florida Department of Transportation Research Center http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_EMO/FDOT_PR4516611_rpt.pdf.

Schubert, T. (2012). Response to observation about mildew occurring on *Bidens bipinnata.* 31 October 2012.

Sellers, B. & Ferrell, J. (2012). Undesirable Roadside Vegetation (Final Report: Research Contract # BDK75 977-54). Retrieved June 26, 2013, from Florida Department of Transportation Research Center: http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_MNT/FDOT-BDK75-977-54-rpt.pdf

Shober, A. (2009). Response to inquiry about soil bulk density. [email] Personal communication, 14 December 2009.