SIGN RETROREFLECTIVITY MAINTENANCE
Seminole Tribe of Florida Pilot Program

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U.S. Department of Transportation
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Federal Lands Highway
Commitment to Excellence

Central Federal Lands Highway Division
12300 West Dakota Avenue
Lakewood, CO 80228

FOREWORD

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This FHWA report called *Sign Retroreflectivity Maintenance, Seminole Tribe of Florida Pilot Program* offers specific actions roadway managers may follow to meet the MUTCD sign retroreflectivity standard.

Michael Davies, P.E., Director of Project Delivery
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Central Federal Lands Highway Division

Notice

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16. Abstract

In response to a 1993 Congressional directive, the Federal Highway Administration (FHWA) added a table containing minimum sign retroreflectivity values to the 2009 MUTCD. In addition, several methods were identified that agencies can implement to maintain traffic signs at or above the minimum retroreflectivity requirements. The FHWA Federal Lands Highway Division partnered with the Bureau of Indian Affairs (BIA) to conduct a pilot assistance program program at the Big Cypress Reservation for the Seminole Tribe of Florida (STF). The program included a panel that reviewed the STF's traffic sign situation, provided information on the available retroreflectivity maintenance methods and helped the tribe identify a method that is most effective given their resources and constraints. The STF decided to wait till the BIA region develops a policy and then modify it accordingly if needed. The objective of this report was to document the pilot assistance program and the draft policy from the same. The objective of this report was to document the pilot assistance program.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

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
		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
		VOLUME		
fl oz	fluid ounces	29.57	Milliliters	mL
gal	gallons	3.785	Liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	Grams	g
lb	pounds	0.454	Kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	Lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	Newtons	N
lbf/in^2	poundforce per square inch	6.89	Kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	Inches	in
m	meters	3.28	Feet	ft
m	meters	1.09	Yards	yd
km	kilometers	0.621	Miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	Hectares	2.47	Acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	Milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	Gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	Ounces	oz
kg	kilograms	2.202	Pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	Poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380 (Revised March 2003)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BIA	Bureau of Indian Affairs
STF	Seminole Tribe of Florida
FHWA	Federal Highway Administration
FLH	Federal Lands Highway
FLHD	Federal Lands Highway Division
MUTCD	Manual on Uniform Traffic Control Devices
TTI	Texas A&M Transportation Institute

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The authors would like to thank and the following individuals who provided guidance and expertise in this pilot:

- Greg Schertz, FHWA-FLH, who served as COTR;
- Richard Pereira, STF;
- Sunshine Cayubit, STF;
- David Campbell, BIA;
- Robert Frazier, BIA

EXECUTIVE SUMMARY

In response to a 1993 Congressional directive, the Federal Highway Administration (FHWA) added a table containing minimum sign retroreflectivity values to the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD). In addition, several methods were identified that agencies can implement to maintain traffic signs at or above the minimum retroreflectivity requirements. The key element in the standards is the establishment of a method to maintain sign retroreflectivity at or above the minimums. FHWA/ Federal Lands Highway Division (FLHD) along with BIA conducted a two-day pilot program to assist tribes in choosing an appropriate retroreflectivity maintenance method to be compliant with the MUTCD requirements.

The objective of this report is to document the pilot assistance program conducted at the Big Cypress Reservation in April 2012 for the Seminole Tribe of Florida (STF).

The STF maintains about 16 miles of roadways within the reservation and is in the process of building a field sign inventory using a GIS system. The tribe replaces signs with new construction projects and on an as-needed basis. Common reason for replacing signs include knocked down signs, damaged signs with bullet shots or graffiti, change in orientation.

After field visit and discussions among the panel, it was agreed that having a sign inventory in place would help identify retroreflectivity maintenance method suitable for new signs (ie. those part of recent construction projects) and older signs (ie those not part of recent construction projects). The tribe and the Eastern BIA Region discussed various ways to track the number of signs that would need to be replaced. It was agreed that guesstimating the number of signs on each roadway using either the surface type or functional will be a good starting point for cost estimates and setting up a priority system for replacing signs that donot meet the minimum retroreflectivity requirements published in the 2009 MUTCD. To maintain a simple and straightforward policy, the tribe decided to wait till the BIA region develops a policy and then adopt it with maybe a subcomponent or modification to account for STF resources and constraints.

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CHAPTER 1 – INTRODUCTION

BACKGROUND

The *Manual on Uniform Traffic Control Devices* (MUTCD) provides the basic principles that govern the design and use of traffic control devices for all streets and highways open to public travel [(1)]. Traffic signs are classified into three main designations: regulatory, warning, and guide signs. Each classification serves a distinctive purpose and adheres to strict and uniform design standards. Regulatory signs provide information on traffic laws or regulations, warning signs give notice of a situation that might not be readily apparent, and guide signs provide destination information such as directions, distances, and points-of-interest. Information is conveyed through the legend, which can be compromised of words, symbols, and arrows. Roadway users can also extract information from a sign's unique appearance as size, color, and shape. For traffic signs to be effective, road users need to detect and comprehend the message content in a timely manner in both daytime and nighttime. At night, signs not internally illuminated must be fabricated with retroreflective materials. Light from a vehicle's headlamps is reflected from the sign's retroreflective surface back to the driver giving the sign an illuminated appearance.

In 1992, Congress required the Secretary of Transportation to revise the MUTCD to include "a standard for a minimum level of retroreflectivity for pavement markings and signs which apply to all roads open to public travel" [(2)]. The goal of the new minimum retroreflectivity requirements was to ensure that drivers, especially the aging population, could detect, comprehend, and react to traffic signs accordingly and help facilitate safe, uniform, and efficient travel on our nation's streets and highways. To satisfy the Congressional directive, the Federal Highway Administration (FHWA) added a table containing minimum sign retroreflectivity values to section 2A.08 of the 2009 MUTCD (shown in Table 1). In addition, several methods are identified that agencies can implement to maintain traffic signs at or above the minimum retroreflectivity requirements. The next section expands upon both the requirements and approved maintenance methods.

Table 1. MUTCD Minimum Maintained Retroreflectivity Levels[1].

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			[2]
	Y*; O*	Y ≥ 75; O ≥ 75			[3]
White on Red	W ≥ 35; R ≥ 7				[4]
Black on White	W ≥ 50				–

[1] The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m^2 measured at an observation angle of 0.2° and an entrance angle of -4.0°.
[2] For text and fine symbol signs measuring at least 48 inches and for all sizes of bold symbol signs
[3] For text and fine symbol signs measuring less than 48 inches
[4] Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)
* This sheeting type shall not be used for this color for this application.

Body Systems

• W1-1,2 – Turn and Curve • W1-3,4 – Reverse Turn and Curve • W1-5 – Winding Road • W1-6,7 – Large Arrow • W1-8 – Chevron • W1-10 – Intersection in Curve • W1-11 – Hairpin Curve • W1-15 – 270 Degree Loop • W2-1 – Cross Road • W2-2,3 – Side Road • W2-4,5 – T and Y Intersection • W2-6 – Circular Intersection • W2-7,8 – Double Side Roads	• W3-1 – Stop Ahead • W3-2 – Yield Ahead • W3-3 – Signal Ahead • W4-1 – Merge • W4-2 – Lane Ends • W4-3 – Added Lane • W4-5 – Entering Roadway Merge • W4-6 – Entering Roadway Added Lane • W6-1,2 – Divided Highway Begins and Ends • W6-3 – Two-Way Traffic • W10-1,2,3,4,11,12 – Grade Crossing Advance Warning	• W11-2 – Pedestrian Crossing • W11-3,4,16-22 – Large Animals • W11-5 – Farm Equipment • W11-6 – Snowmobile Crossing • W11-7 – Equestrian Crossing • W11-8 – Fire Station • W11-10 – Truck Crossing • W12-1 – Double Arrow • W16-5P,6P,7P – Pointing Arrow Plaques • W20-7 – Flagger • W21-1 – Worker

Fine Symbol Signs (symbol signs not listed as bold symbol signs)

Special Cases

- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs, such as W14-3 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,6,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level.

The key element in this standard is the establishment of a method to maintain sign retroreflectivity at or above the minimums. To establish a level of compliance, the FHWA had initially established three important compliance dates:

- January 2012: Implementation and continued use of an assessment or management method that is designed to maintain traffic sign retroreflectivity at or above the established minimum levels,
- January 2015: Replacement of regulatory, warning, and post-mounted guide (except street name) signs that are identified as failing,
- January 2018: Replacement of street name signs and overhead guide signs that are identified as failing.

With regard to the first compliance date, the 2009 MUTCD states "Public agencies or officials having jurisdiction shall use an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels" [(1)]. Traditionally, each agency manages and maintains their traffic signs in a manner that best accommodated their specific conditions, resources, and priorities. For this reason, the MUTCD allows the flexibility to select and modify one or more methods to best fit the needs of each entity. The second and third compliance dates deal with the replacement of existing signs that are below the minimum levels. Some proactive agencies may have a few signs to replace while others may have to replace a large portion of their sign population. Each agency will encounter different circumstances when addressing these two compliance dates.

These compliance dates have recently changed. On May 14, 2012, a final rule was published in the Federal Register, revising Table I-2 in the Introduction section of the 2009 MUTCD to modify the compliance dates for the minimum maintained sign retroreflectivity standard. That rulemaking extended the compliance date for implementation and continued use of an assessment or management method that is designed to maintain traffic sign retroreflectivity at or above the established minimum levels to June 13, 2014 and refined the compliance date to only apply to regulatory and warning signs, and not others. In addition, the final rule eliminated the target compliance dates for actual replacement of signs, which had previously been required by 2015 for post-mounted guide signs (except street name signs) and 2018 for street name signs and overhead guide signs[(3)]. These changes are shown in Table 2.

Table 2. Changes in Minimum Retroreflectivity Compliance Dates.

Provision	Compliance Date
Implementation and continued us of an assessment or management method that is designed to maintain ~~traffic~~ **regulatory and warning** sign retroreflectivity at or above the established minimum levels	~~January 22, 2012~~ June 13, 2014
~~Replace identified regulatory, warning, ground-mounted guide signs (except street name)~~	~~January 22, 2015~~
~~Replace identified street name & overhead guide signs~~	~~January 22, 2018~~

An agency will essentially be in compliance with the new MUTCD minimum sign retroreflectivity standard if they have a method in place and can demonstrate that they are acting

in good faith to implement that method. The FHWA acknowledges that an agency would be in compliance even if there are some individual signs that do not meet the minimum retroreflectivity levels at a particular point in time [(1)]. For the most part, the key element is selecting and implementing a suitable method to maintain traffic sign retroreflectivity.

FHWA Federal Lands Highway Division (FLH) and the Bureau of Indian Affairs (BIA) came together to conduct a pilot assistance program at the Big Cypress Reservation for the Seminole Tribe of Florida (STF). The program included a review of the STF's traffic sign situation, presentation of information on the available/accepted retroreflectivity maintenance methods, help in identifying a method that is most effective given the STF's resources and constraints and assistance in drafting a policy for the same.

OBJECTIVE

The objective of this report is to document the pilot assistance program at the Big Cypress Reservation in April 2012 to help the STF identify an appropriate sign retroreflectivity maintenance method and draft policy for the same.

APPROACH

The pilot was conducted at the Big Cypress Reservation and the Tribal Headquarters in Hollywood, Florida. Representatives from the STF tribal transportation department, BIA, FLH, FHWA and Texas A&M Transportation Institute (TTI) were in the panel. List of participants is provided in Appendix A.

The pilot was a two-day program, with the first day for training and field visit, and the second day for discussions and development of the most appropriate retroreflectivity maintenance method for the STF. Greg Schertz with FHWA provided training/review on the new minimum sign retroreflectivity standard, available/accepted methods for maintaining sign retroreflectivity and sign sheeting identification using the FHWA documents [(4)]. Vichika Iragavarapu with TTI provided training on using a hand-held retroreflectometer. The panel visited various roadways in the area, identified sign sheeting and measured sign retroreflectivity using a hand-held retroreflectometer. Discussions included an overview of the recent projects in the area, STF's resources and constraints and which available method would be appropriate for the STF's situation.

Figure 1. Photo. Team Members.
(Left to Right): David Campbell, Robert Frazier, Sunshine Cayubit, Vichika Iragavarapu, and Richard Pereira. (Not Shown: Greg Schertz.)

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CHAPTER 2 – RETROREFLECTIVITY MAINTENANCE METHODS REVIEW

RETROREFLECTIVITY MAINTENANCE METHODS

Compliance with the minimum retroreflectivity requirement is achieved by having a maintenance method in place and being able to document active implementation. Conformance does not require or guarantee that every individual sign will meet or exceed the minimum retroreflectivity levels at every point in time. Section 2A.8 in the MUTCD [(1)] offers five traffic sign maintenance methods and an "Other" method, which provides additional flexibility but must be supported by an engineering study to validate the tie to the minimum values in Table 1. The intent of the methods and guidance outlined in the MUTCD is to provide support to the agencies and offer them systematic procedures to maintain traffic sign retroreflectivity.

The five methods are categorized as either assessment or management methods. Assessment methods evaluate the retroreflectivity of individual signs and include Visual Nighttime Inspection and Measured Sign Retroreflectivity. Management methods are used by agencies that know the current retroreflectivity status of their signs and rely on a known retroreflectivity deterioration rate or monitoring a sample of signs. The retroreflective life of signs can originate from manufacturers' warranties, demonstrated performance, or control sign assessments. The management methods include Expected Sign Life, Blanket Replacement, and Control Signs. Assessment and management methods may be combined in many different ways to accommodate an agency's needs and objectives. The FHWA has a full report detailing each of the sign retroreflectivity methods listed in the MUTCD [(5)]. The report also includes a useful description of how to conduct the assessment methods, the advantages and disadvantages of each of the sign retroreflectivity methods listed in the MUTCD.

Visual Nighttime Inspection Method

Visual nighttime inspection is a fairly common method for maintaining traffic signs and guidelines for inspections have been documented for about 50 years [(6)]. However, visual inspections in the past have not had a tie to any specific level of retroreflectivity, were very subjective, and results depended on the judgment of individual inspectors. To be in compliance with the MUTCD, very specific procedures must be followed to tie the method to the values in Table 1.

To reduce the subjectivity and develop a tie to the minimum retroreflectivity requirements, the MUTCD requires the use of one of three different sign inspection procedures [(7)] –

- Calibration Signs Procedure: An inspector views calibration signs prior to conducting a nighttime field review. The calibration signs have known retroreflectivity levels at or above the specified minimums. The calibration signs are set up temporarily where the inspector can view the signs in a manner similar to nighttime field inspections. The inspector uses the visual appearance of the calibration signs to establish the evaluation threshold for that night's inspection activities.

- Comparison Panels Procedure: This procedure uses a set of comparison panels that have retroreflectivity levels at or above the specified minimums. Inspectors conduct a nighttime

field review and when a marginal sign is found, a comparison panel is attached and the sign/panel combination is viewed. The signs found to be less bright than the panel would then be scheduled for replacement.

- Consistent Parameters Procedure: The nighttime inspections are conducted under similar factors that were used in the research to develop the minimum retroreflectivity levels. These factors include:
    - Using a sport utility vehicle or pick-up truck to conduct the inspection. and
    - Using a model year 2000 or newer vehicle for the inspection. and
    - Using an inspector who is at least 60 the years old.

The visual nighttime inspection method is fairly simple but requires a trained inspector to view traffic signs from a moving vehicle during nighttime conditions. The inspector uses one of the three allowed procedures and subjectively concludes if the sign passes or fails. The visual nighttime inspection method is more effective with two individuals: a dedicated inspector monitoring and recording sign failures and a focused driver following a predetermined inspection route. The visual inspection needs to take place during typical nighttime conditions and viewing should not be affected by adverse or inclement weather such as fog, rain, or frost on signs. It is important to minimize interior vehicle lighting so the inspector's vision is not affected. The inspection should emulate how a normal driver would view a typical sign: at normal roadway speeds, from an appropriate travel lane, and at an adequate viewing distance. Sign failures and noteworthy comments should be documented in a standardized procedure. The inspector can document his or her evaluations by means of written notes on an agency form, audio recording, or laptop. The duration of a nighttime inspection session should not exceed a period where inspector fatigue becomes an issue or where roadway conditions change such as frost forming on a sign. Throughout the inspections, it is important to be consistent with agency procedures and to be able to document when the nighttime sign inspections have been completed.

Measured Retroreflectivity Method

The measured sign retroreflectivity method directly obtains retroreflectivity values with specialized equipment. Repeatable and adequate measurements require both a calibrated instrument and a knowledgeable operator. Similar to the visual nighttime inspection method, standard operating procedures must be established.

Sign retroreflectivity measurement procedures are relatively straightforward, but they need to be followed consistently. ASTM Standard Test Method E1709 outlines the procedures for operating and taking measurements with a retroreflectometer [8]. The standard instructs that a retroreflectometer operator should acquire a minimum of four retroreflectivity measurements per retroreflective sign color. The measurement locations should be in different parts of the sign and the readings should be averaged when compared to the MUTCD minimum levels.

The measured sign retroreflectivity method can be an expensive and time-consuming practice. Individual retroreflectometer units can cost between $10,000 and $12,000 to purchase. Also, some measurements can be difficult to obtain since the bottom of many signs is seven feet above the

roadway surface. Readings may require the use of a ladder or extension pole and overhead signs may call for a truck with a boom-lift. Taking readings manually from the side of the road may also expose sign technicians to more potential roadway hazards and place them in undesirable locations. Wide-spread implementation of this method at a large agency may not be practical because of the cost, time requirements, and roadway exposure.

Expected Sign Life Method

Expected sign life method is one of the three management methods listed in the MUTCD. The main aspect of the expected sign life method is that it documents and tracks individual signs to be replaced before the service life period expires. Sign service life represents the length of time that a certain sign sheeting material will be used in the field while remaining compliant with the minimum retroreflective requirements. Sign service life can be based on sign sheeting warranties, test deck or field measurements, or empirical data from other regional studies.

The key is being able to identify the age of individual signs. The level of complexity and sophistication depends on an agency's needs and available resources. Implementation of the expected sign life method can vary a great deal, but there are four main components to most successful systems. The four main components are establishing sign installation dates, selecting the service life for the sheeting being used, identifying signs for replacement, and organizing sign data. The majority of the agencies employing this method use installation date stickers on the signs to track sign age, sheeting type and other agency specific information. Barcode labels can also be used and serve a simple purpose of linking important information physically to the sign. Agencies can have sign inventory systems in place to query specific sign information or asset management features that allow for enhanced planning, work scheduling, and budgeting capabilities.

Blanket Replacement Method

The blanket replacement method uses service life periods and is similar to the expected sign life method, but the fundamental difference is targeting a large group of signs opposed to identifying individual signs. The replaced signs can be based upon either spatial or strategic data. The spatial approach replaces all signs in a certain geographic area. The scale of the spatial area can vary widely between agencies. The area could be limited to a single road/corridor or as large as replacing all signs in a county. The strategic approach replaces all signs of a common characteristic such as sheeting type, sign classification, and/or sign content. Upgrading signs with sheeting from Type I to Type III is an example of strategic replacement. The blanket replacement could incorporate both spatial and strategic characteristics by removing specific sign types in a certain area. Regardless of the approach, the goal is to replace signs in groups to keep all signs above the minimum retro values in the MUTCD.

The blanket replacement method documentation is simple and an agency can draft a short policy memo justifying the service life period, defining the area boundaries, and the yearly sign replacement procedures. Since all of the signs in a specific area are replaced on a regular cycle, then the chances of having signs that are below the MUTCD minimum requirements are low. An agency can easily show that it is implementing its method and working towards compliance through work-orders and sign replacement schedules. Overall, the blanket replacement method has simple procedures; it removes subjectivity, and can simplify sign replacement documentation.

However, the blanket replacement method can lead to the possibility of premature sign replacement and waste. For example, signs are sometimes replaced before the retroreflectivity falls below the minimum levels and reasons could be attributed to vandalism, vehicle knockdowns, road reconstruction, and changes in standards. When a group of signs is replaced with the blanket replacement method, even those individual signs that were recently replaced due to vandalism, etc. are included and therefore are being replaced before their service life expires.

Control Signs Method

The control signs method is the third sign management method and it may use both sign assessment and management techniques to maintain sign compliance. The MUTCD states that sign replacement in the field is based on the performance of a sample set of control signs [(1)]. Specific sheeting types in the controlled sample set represent the retroreflective values of a sign population in the field. The control signs may be a sample in a secure maintenance yard or selected signs on the roadway. The control signs are assessed and monitored to determine retroreflective performance. When the control signs approach the retroreflective minimums, then all the corresponding signs in the field are replaced. The control signs method requires means of establishing a creditable sample set, sign evaluation techniques, and a system to locate corresponding signs in the field.

Unlike the previous two management methods, this approach does require the periodic use of a retroreflectometer. Measuring control signs retroreflectivity should follow the procedures outlined in ASTM standard E1709-00e1 [(9)]. An average of four readings per retroreflective sign color should be recorded and compiled to document the retroreflectivity levels throughout the life of the sign. The time intervals between consecutive measurements depend on the agencies' objectives and the desired level of precision. The control signs method not only indicates when corresponding signs in the field require replacement, but it can also help to establish regional specific service life periods for different sheeting materials. The control signs method allows an agency to document and verify the extension of service life periods past the manufacturer's warranty.

CHAPTER 3 – SEMINOLE TRIBE OF FLORIDA PILOT

The Big Cypress Reservation is about 52,500 acres and is located in the southeastern Hendry County and northwestern Broward County in southern Florida. The STF's Tribal Transportation Department is responsible of the operations and maintenance of the roads under the tribe's jurisdiction.

PILOT COMPONENTS

Overview of Roads

About 168 miles of BIA roadway exists in the reservation, of which about 16 miles is maintained by the STF. Majority of the roads are on the reservation and the residential areas is BIA owned.

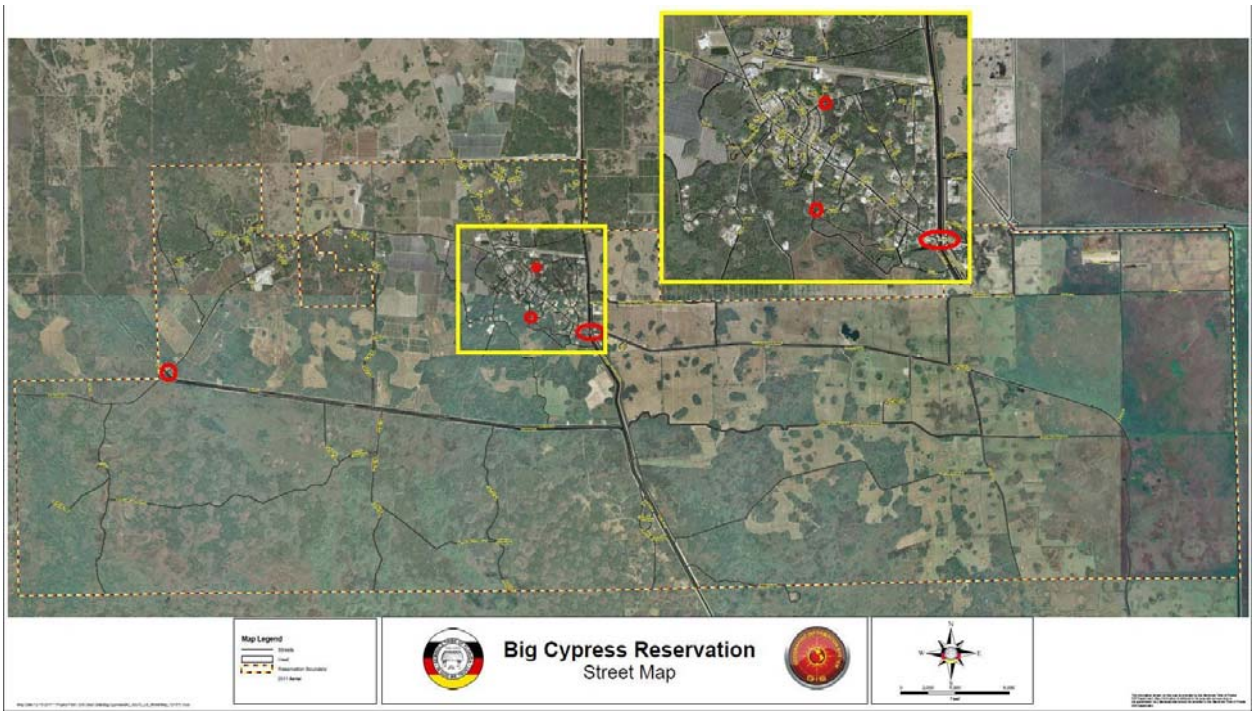

Figure 2. Map. The Big Cypress reservation.
(Red circles indicate the locations visited by the panel)

Sign Inventory

The tribe is beginning the process for building a field sign inventory using a GIS system to move towards performance based maintenance plans. In addition to the number and type of signs on their roadways, the completed inventory will have various other aspects of each sign such as installation date.

The tribe replaces signs with new construction projects and on an as-needed basis. Common reason for replacing signs include knocked down signs, damaged signs with bullet shots or graffiti, change in orientation.

Field Visit

Representatives from the tribe and the BIA region gave an overview of available resources and recent projects in the area. An overview on how to use a hand-held retroreflectometer, field procedures and calibration was provided to the panel. Introduction to field identification of sign sheeting type was also provided using FHWA documents [(4)].

Figure 3. Photos. Field visit.

Figure 4. Photos. Field sign sheeting identification.

After training on identification of sign sheeting and using a hand-held retroreflectometer, the panel visited various roadways within the reservation. The field visit provided a feel for the STF's current sign situation and also a chance for the panel to use the sign sheeting identification and retroreflectometer training.

Figure 5. Photos. Field measurements using a hand-held retroreflectometer.

Condition Assessment

The panel had a chance to visit various tribal roads and measure retroreflectivity of many signs. After the field visit, the panel concluded that the signs associated with new or recent construction projects were in good condition, whereas most of the older signs (i.e. those outside the recent construction project boundaries) were border line.

Figure 6. Photos. Field assessments of signs.

Discussion on Appropriate Retroreflectivity Maintenance Method

Since most older signs on the reservation were observed to have border line retroreflectivity, the discussion was focused on how to handle sign replacement. For the tribe, knocked down signs are an issue at the more populated locations, and bullet shots or graffiti, is a problem for rural signs. Currently the tribe replaces signs with new construction projects and on an as-needed basis. The tribe identified potential future construction projects, like the roadway upgrade of Snake Road, Repair/Rehabilitation of West Boundary bridge, that would be good opportunities to replace signs within the project boundary. For signs outside of such project boundaries, the use of (then) draft national BIA policy (presented to the panel by Robert Fraizer) of blanket replacement was discussed. The tribe expressed that blanket replacement might not be appropriate for them, concerns about limited maintenance resources, conflict of needs and perception by the tribal members were discussed.

The panel agreed that having a sign inventory in place would help identify retroreflectivity maintenance method suitable for new signs (i.e. those installed as part of recent construction projects) and older signs (i.e. those not part of recent construction projects). It was agreed that guesstimating the number of signs on each roadway using either the surface type or functional class will be a good starting point for cost estimates and setting up a priority system for replacing signs that do not meet the minimum retroreflectivity requirements published in the 2009 MUTCD.

The Eastern BIA Region proposed that it would draft a regional policy by coordinating with Regional Road Engineers and the tribes. To maintain a simple and straightforward policy, the tribe decided to wait till the BIA region develops a policy and then adopt it with maybe a subcomponent or modification to account for STF resources and constraints.

CHAPTER 4 – SUMMARY AND CONCLUSIONS

The *Manual on Uniform Traffic Control Devices* (MUTCD) provides the basic principles that govern the design and use of traffic control devices for all streets and highways open to public travel [(1)]. Each classification of signs; regulatory, warning, and guide, serves a distinctive purpose and adheres to strict and uniform design standards. For traffic signs to be effective, road users need to detect and comprehend the message content in a timely manner in both daytime and nighttime. At night, signs not internally illuminated must be fabricated with retroreflective materials.

The national MUTCD contains a standard for maintaining minimum sign retroreflectivity. The key element in the standards is the establishment of a method to maintain sign retroreflectivity at or above the minimums. FHWA along with BIA conducted a two-day pilot program to assist tribes in choosing an appropriate retroreflectivity maintenance method to be compliant with the MUTCD requirements.

The pilot documented in this report was conducted at the Big Cypress Reservation for the Seminole Tribe of Florida (STF). The first day of the pilot included review of the new minimum sign retroreflectivity standard and available/accepted methods for maintaining sign retroreflectivity, sign sheeting identification using the FHWA documents, training on using a hand-held retroreflectometer and visit to various roadways within the reservation. The second day of the pilot included discussions on field visit observations and development of a draft retroreflectivity maintenance method policy for the tribe.

The STF maintains about 16 miles of roadways within the reservation and is in the process of building a field sign inventory using a GIS system. The tribe replaces signs with new construction projects and on an as-needed basis. Common reason for replacing signs include knocked down signs, damaged signs with bullet shots or graffiti, change in orientation.

After field visit and discussions among the panel, it was agreed that having a sign inventory in place would help identify retroreflectivity maintenance method suitable for new signs (ie those part of recent construction projects) and older signs (ie those not part of recent construction projects). The tribe and the Eastern BIA Region discussed various ways to track the number of signs that would need to be replaced. It was agreed that guesstimating the number of signs on each roadway using either the surface type or functional will be a good starting point for cost estimates and setting up a priority system for replacing signs that donot meet the minimum retroreflectivity requirements published in the 2009 MUTCD. To maintain a simple and straightforward policy, the tribe decided to wait till the BIA region develops a policy and then adopt it with maybe a subcomponent or modification to account for STF resources and constraints.

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APPENDIX A – SIGN-IN SHEET

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