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Determining Road Sign Lifetime in North Carolina

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Introduction

ASSET

Road Signs

- 1.2 million signs in North Carolina

NEED

To easily see signs at night

MEASURE

Retroreflectivity

REGULATIONS

Proposed minimum retroreflectivity

STUDY NEED

Determine number of signs meeting minimum



Sign Retroreflectivity

Color	Type	Proposed Minimum	New Value
White	I	50	80
Yellow		50*	70
White	III	50	300
Yellow		50	250

* Sheeting type should not be used



Study Objective

- Provide a road sign replacement simulation tool that NCDOT can use to optimize its signs management in the area of sign retroreflectivity
- Required:
 - Model the performance of NCDOT sign inspectors
 - Determine sign retroreflectivity performance
 - Determine other factors that affect sign performance in North Carolina

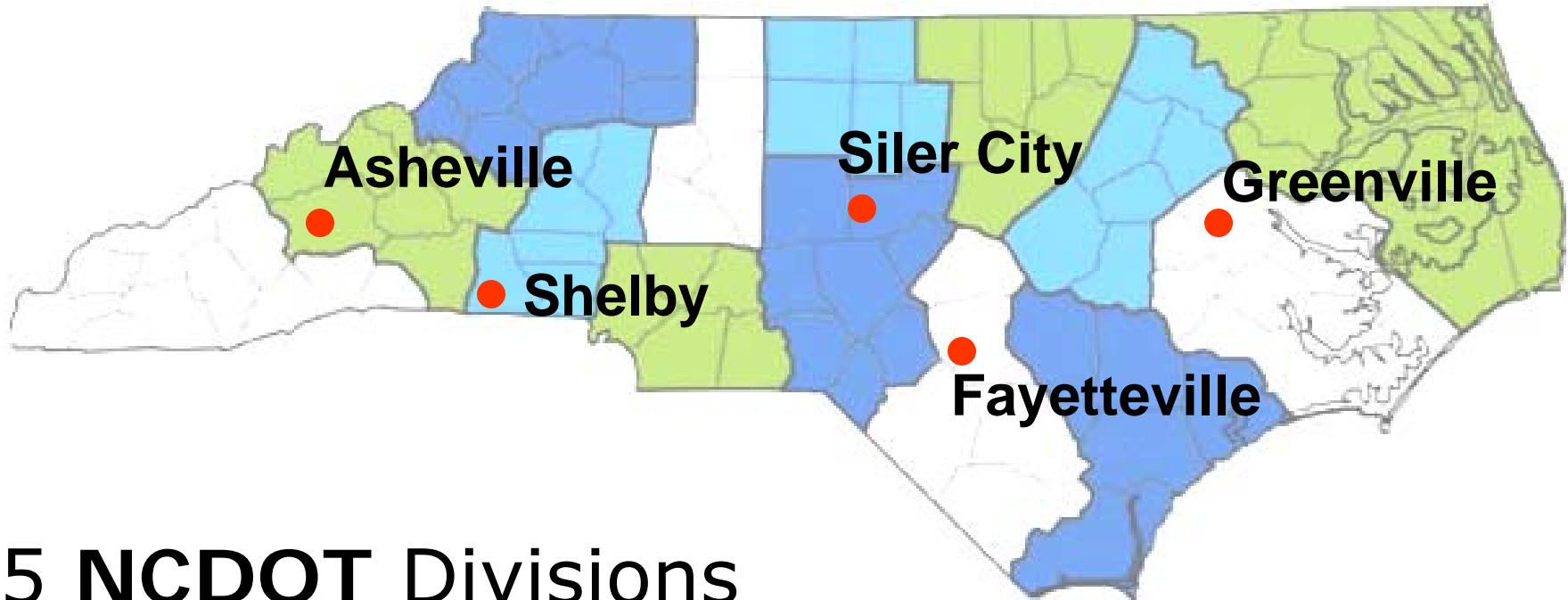


Methodology

- Literature Review
 - Sign retroreflectivity deterioration over time
- ONLY measure sign colors that have a FHWA standard - red, green, white, and yellow
- Visit NCDOT Divisions across the state



Sites Visited



5 NCDOT Divisions



Nighttime Data Collection

- Accompanied sign crew during nighttime visual sign inspection
- Data collected
 - Number and location of rejected signs
 - Reason(s) for rejection
 - Route traveled by sign crew
 - Division sign inspection and replacement procedures
- **1,681** signs evaluated by sign crews





Daytime Data Collection

- Data collected for each measured sign
 - Sign retroreflectivity values
 - Sign age (installation date)
 - Sign color(s)
 - Sign sheeting type
 - Sign message
 - Sign location (GPS)
 - Sign photograph
- **1,057** signs measured



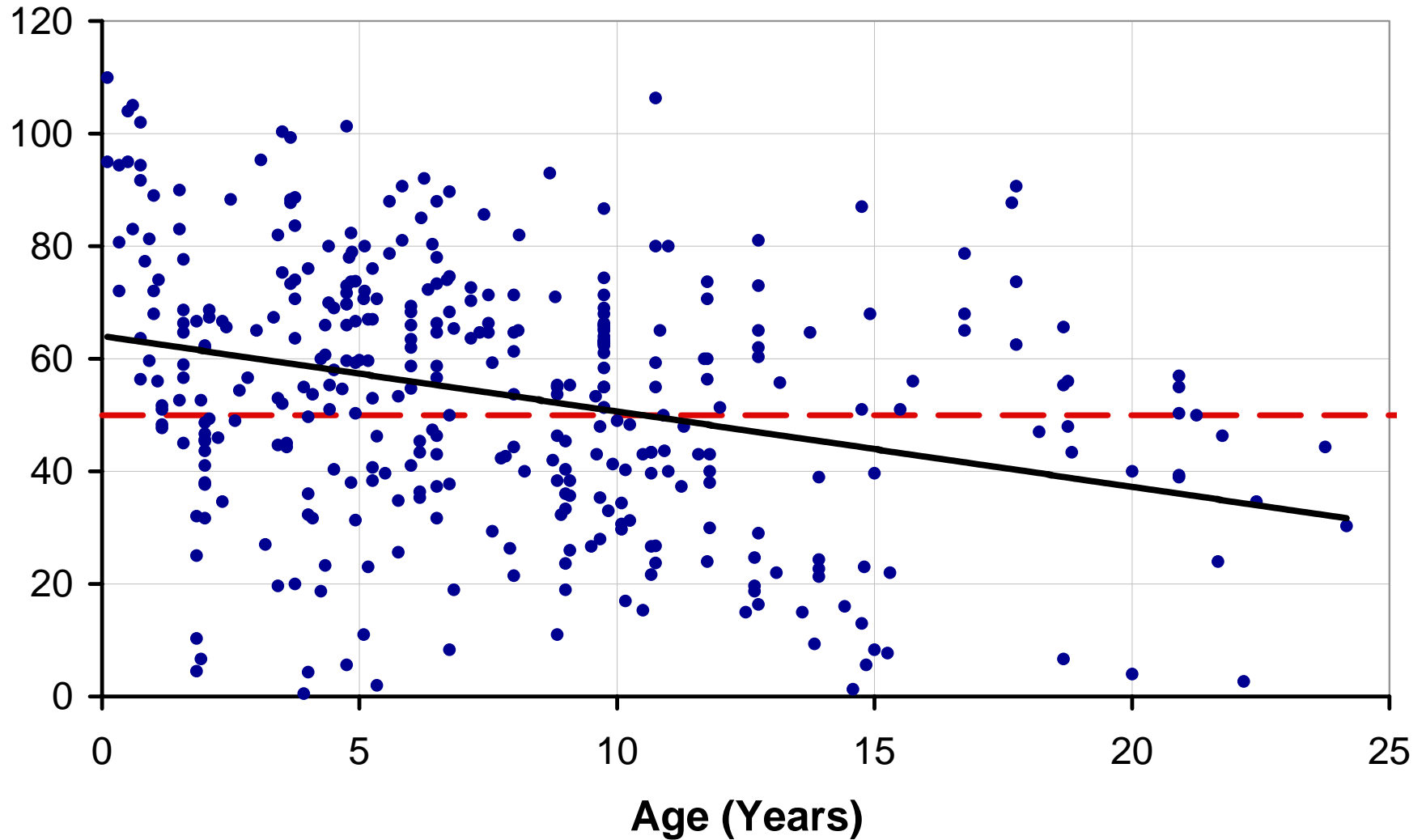
RetroSign ® 4500





Sign Retroreflectivity Performance

NCSU and Louisiana State Study: Type I White Sheeting





Other Factors

- Other factors, such as damage, can also reduce the retroreflectivity of a sign
 - **Vandalism** - paintballs, eggs, paint, guns
 - **Nature effects** - tree sap, dirt, water damage
- Damage causes a sign to be rejected and replaced by sign crew
- The average damage rate in North Carolina is **4.7%** of signs every year





Sign Crew Inspection Performance

- Sign crew visual inspection does **not** identify all signs with deficient retroreflectivity
- It is not uncommon for sign crews to leave deficient signs in place





Signs Rejected Relative to Standard

Retroreflectivity, R	% of signs rejected by sign crew	
	Type I White	Type I Yellow
$0 \leq R < 10$	71	83
$10 \leq R < 20$	83	73
$20 \leq R < 30$	26	47
$30 \leq R < 40$	24	25
$40 \leq R < 50$	10	20
$50 \leq R < 60$	2	4
$60 \leq R < 70$	0	3
$70 \leq R < 80$	0	0
$80 \leq R < 90$	0	0
$90 \leq R < 100$	0	0
$R \geq 100$	0	0



Sign Crew Inspection Performance

- In field, NCSU study found that:
 - **65%** of signs were above standard
 - **35%** of signs were below proposed standard
 - **28%** of all signs were below proposed standard and left in field (not rejected) by sign crew



Sign Simulation

- Simulation uses spreadsheet analysis
- The simulation tool outputs the *number of deficient signs* in the field for a given year
- The *number of deficient signs* can be used to calculate the sign maintenance costs per year to keep the NCDOT in compliance with the proposed FHWA standard



Sign Simulation Inputs

- Sign projected lifetime
- Sign retroreflectivity performance
 - Retroreflectivity deterioration trend with time
 - Should agree with sign lifetime used
- Sign damage rates
 - Calculated for each color and sheeting type
- Sign replacement rates
 - Takes into account sign inspector performance
- Number of signs in field



Sign Simulation Assumptions

- Sign lifetime
- Sign retroreflectivity deterioration vs. time follows assumed *linear* trend
- Regular inspection frequency
- Adequate funding in budget for regular sign maintenance



Simulation Behavior

- How does changing the simulation inputs affect the number of deficient signs per year?
 - Change lifetime
 - Change degradation trend
 - Change damage rate
 - Change replacement rate



Policy Implications

- Since Type III signs have a longer lifetime (+15 yrs), visual inspection performance is not as critical
 - NCDOT is only using Type III signs for all new sign installations
- Ensure that signs are inspected regularly and that sign maintenance budgets are adequate



Policy Implications

- Perform additional sign research
 - Need more retroreflectivity vs. time data
 - Need to measure older signs
 - Will help to better determine sign lifetime
 - Create a sign farm in locations across the state to better test how signs degrade in different geographical areas



Questions?



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