

# Sign Service Life

**Operation Staff Meeting  
November 6, 2019  
Raleigh, NC**

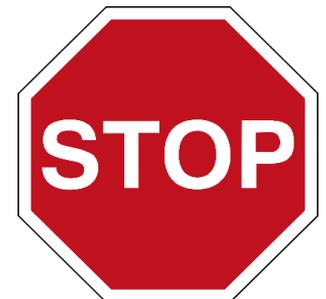
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# Current Sign Service Life

## NCDOT Routine Maintenance Improvement Plan (RMIP) sign service life: 10 years

- There is no study to support this number
- Previous studies indicated that 10 years is an underestimated sign service life



# 1. Literature Review: DOT's Practices

Sign Service Life	Location	Number of DOTs to Adopt
10 years	Arkansas, Maine Mississippi *, North Carolina, and South Carolina	5
12 years	Minnesota, Mississippi *, New York *, South Dakota, Wisconsin, and Wyoming	6
15 years	Michigan, New York *, Ohio, Oklahoma, and Vermont	5
18 years	Indiana	1
<b>Total</b>		<b>15</b>

\* Indicates a range for that state

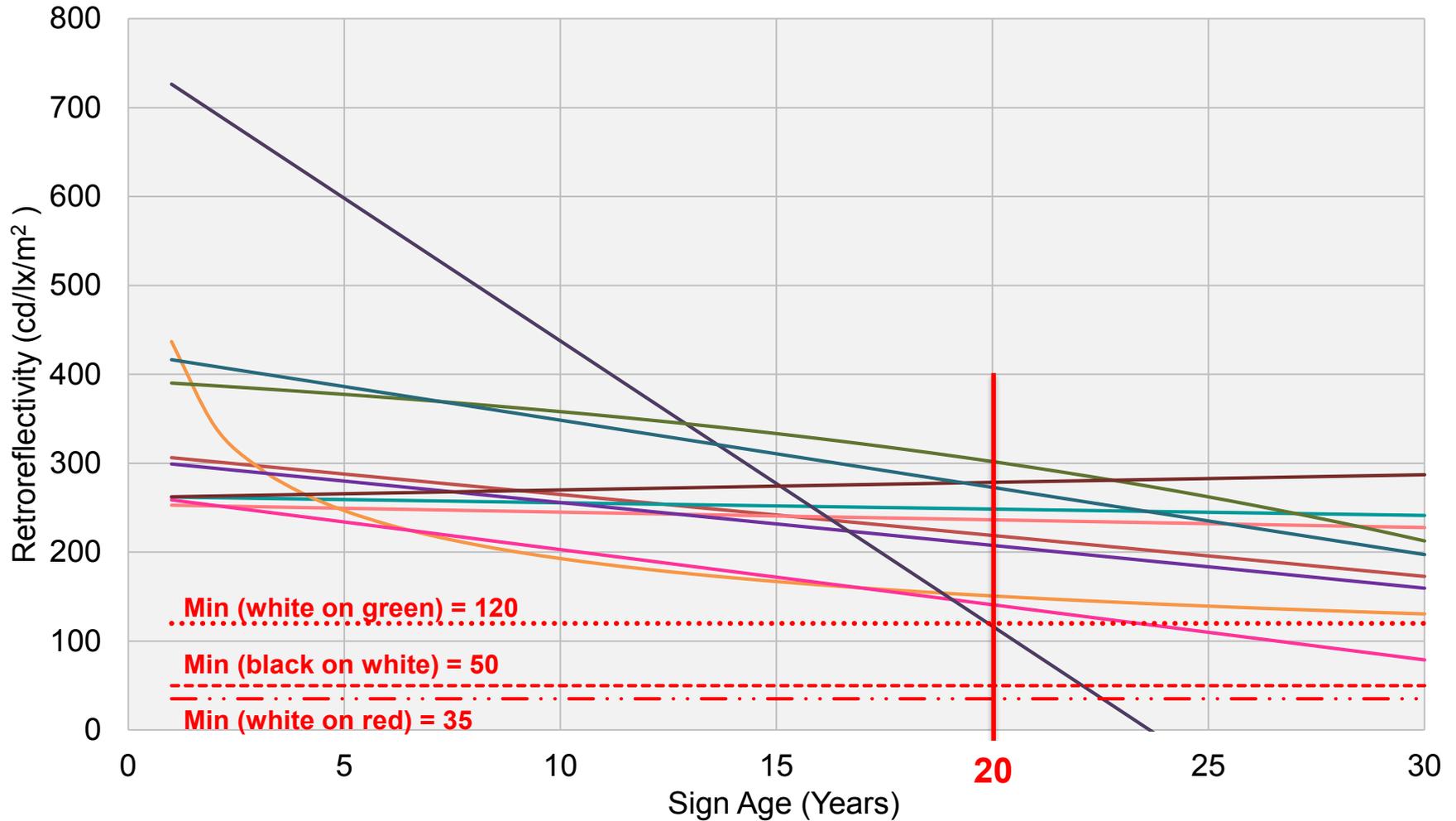
- **Most DOTs use a sign life > 10 years**

# 1. Literature Review: Studies Recommendations

Authors	Location	Sign Service Life-
Dumont et al. (2013)	Minnesota	Minimum: 15 years
Immaneni et al. (2009)	North Carolina	20 to 30 years for white 24 years for yellow and red 37 years for green
Clevenger et al. (2012)	Pennsylvania	Minimum: 15 years
Pulver et al. (2018)	South Carolina	10 years
Kipp and Fitch (2009)	Vermont	15 years for red 15 to 20 years for white, yellow, and green
Pike and Carlson (2014)	Wyoming	Recommendation: 15 years

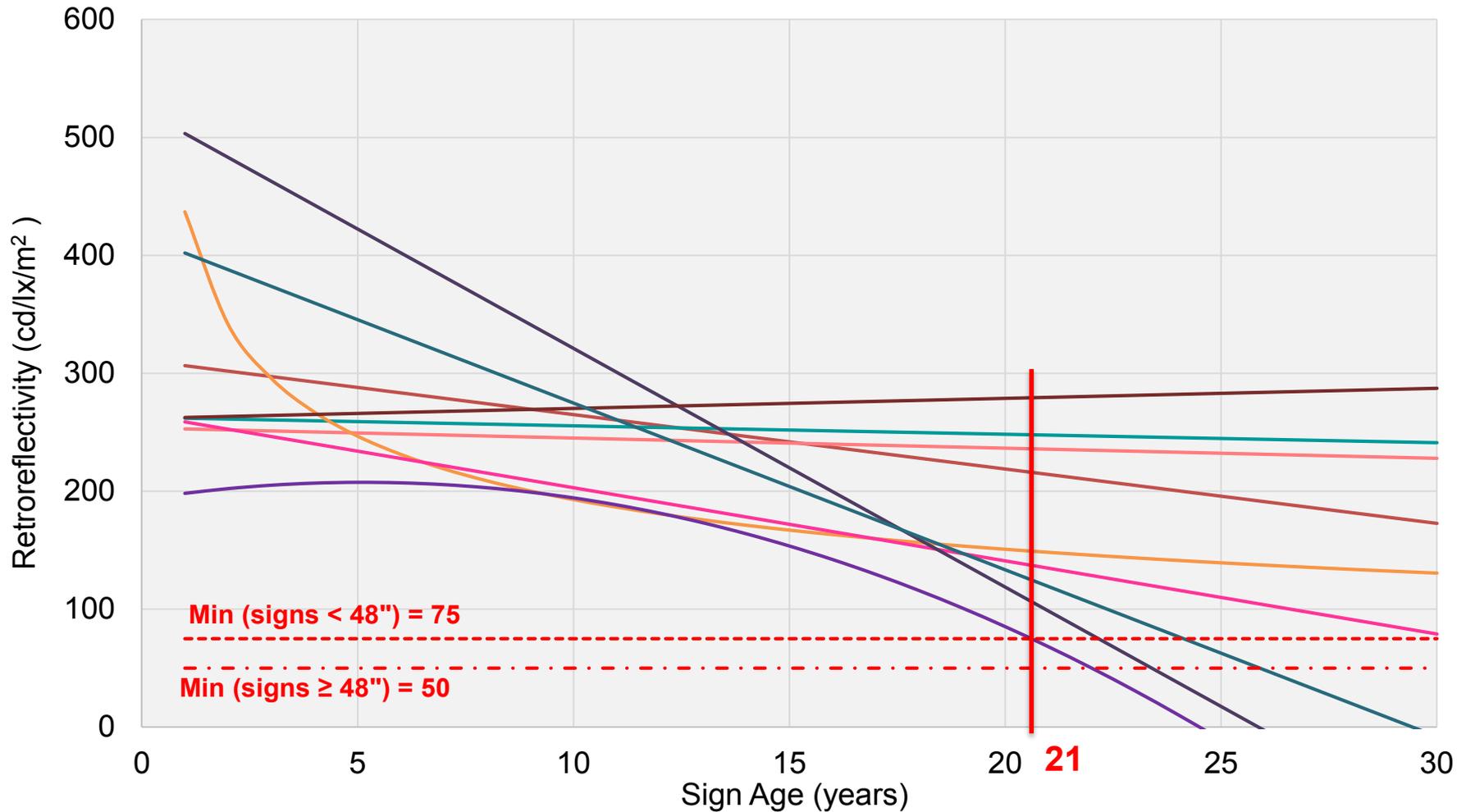
- **Most literature studies recommend a sign life  $\geq$  15 years**

### White Type III Sheeting



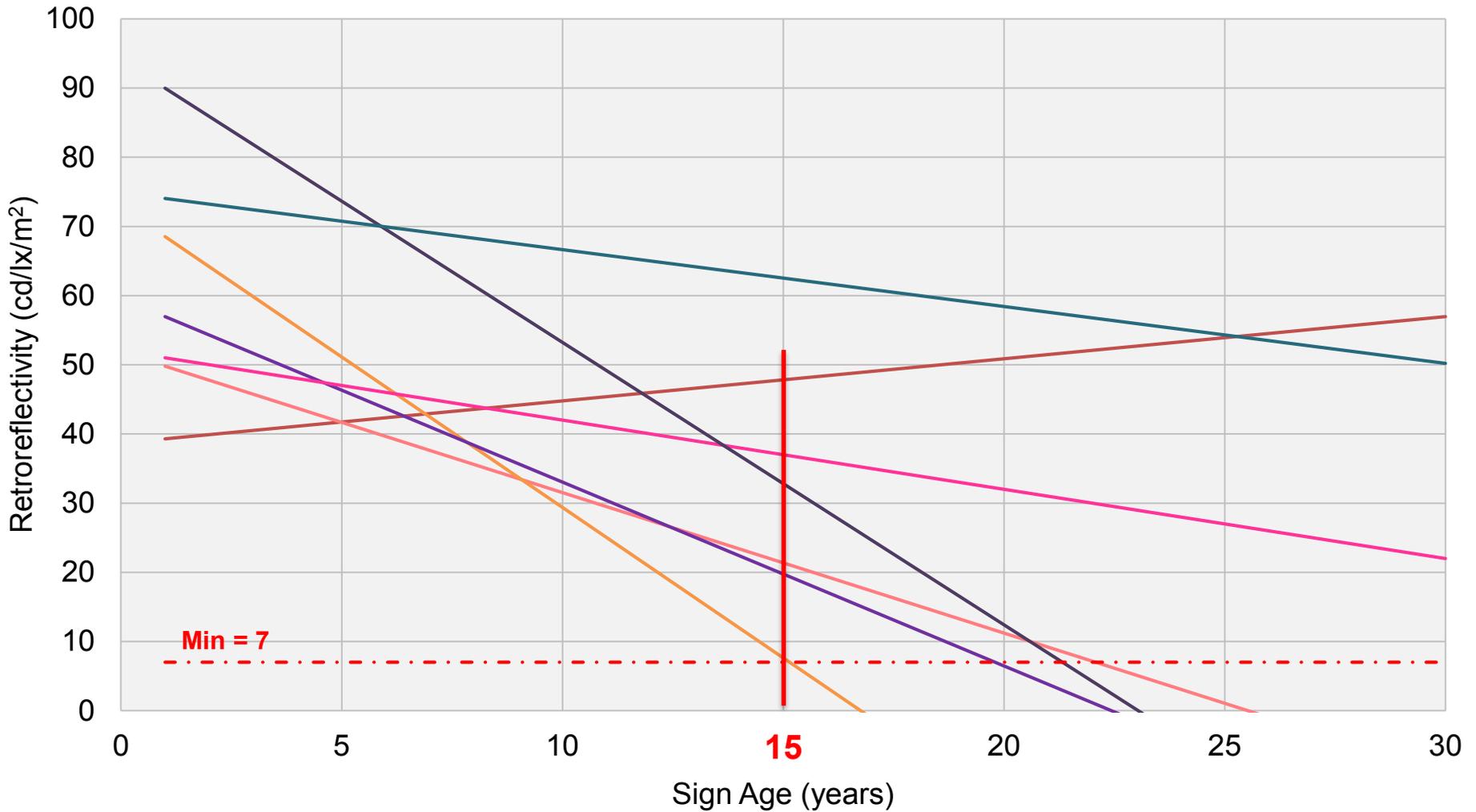
- Black et al.
- Bischoff and Bullock
- Rasdorf et al.
- Kipp and Fitch
- Immaneni et al.
- Re et al.
- Clevenger et al.
- Huang et al.
- Pike and Carlson
- Preston et al.
- ··· Min: White on Red
- ····· Min: White on Green
- - - - Min: Black on White

### Yellow Type III Sheeting



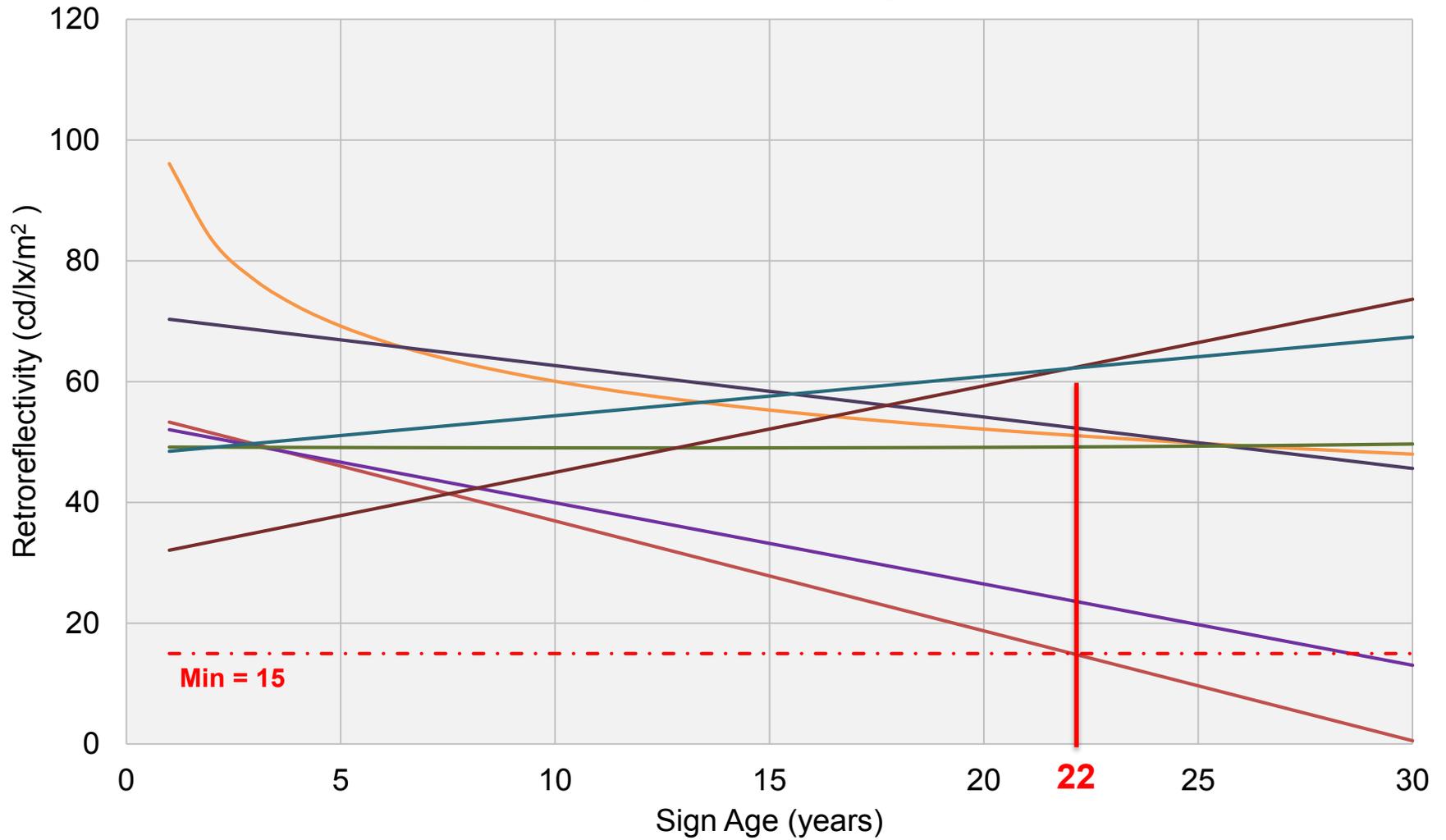
- Black et al.
- Immaneni et al.
- Preston et al.
- Bischoff and Bullock
- Re et al.
- Min: signs ≥ 48"
- Rasdorf et al.
- Clevenger et al.
- Min: signs < 48"
- Kipp and Fitch
- Pike and Carlson

### Red Type III Sheeting



- Black et al.
- Bischoff and Bullock
- Kipp and Fitch
- Immaneni et al.
- Re et al.
- Clevenger et al.
- Preston et al.
- · - Min

### Green Type III Sheeting



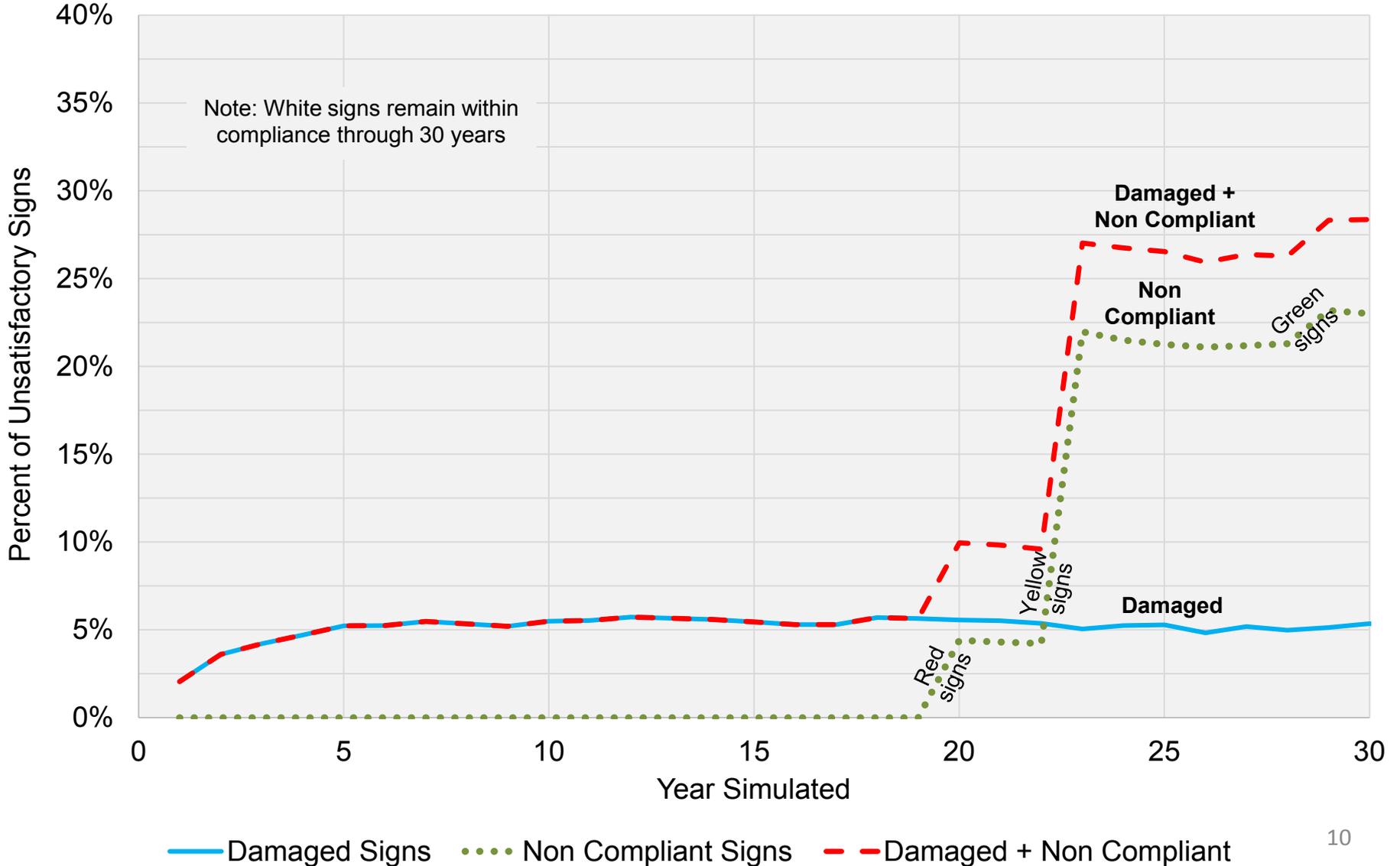
- Black et al.
- Kipp and Fitch
- Immaneni et al.
- Clevenger et al.
- Huang et al.
- Pike and Carlson
- Preston et al.
- - - Min

## 2. Simulation

- Considered only spot replacement (there is no nighttime inspection nor blanket replacement)
- Input data
  - Deterioration models obtained from Immaneni et al. (2009) study
  - Sign color distribution obtained from Palmquist and Rasdorf (2001) study
  - **10,000** signs simulated for a period of **30** years
  - Annual damage rate of **4.04%** (Rasdorf et al., 2006)
  - Annual spot replacement rate of **41.09%** of damaged signs (Rasdorf and Machado, 2018)

# Simulation Results (10,000 signs)

Damage rate 4.04% of signs. Spot replacement 41.09% of damaged signs.  
 Deterioration curves from Immaneni et al. (2009)



## 2. Simulation Results

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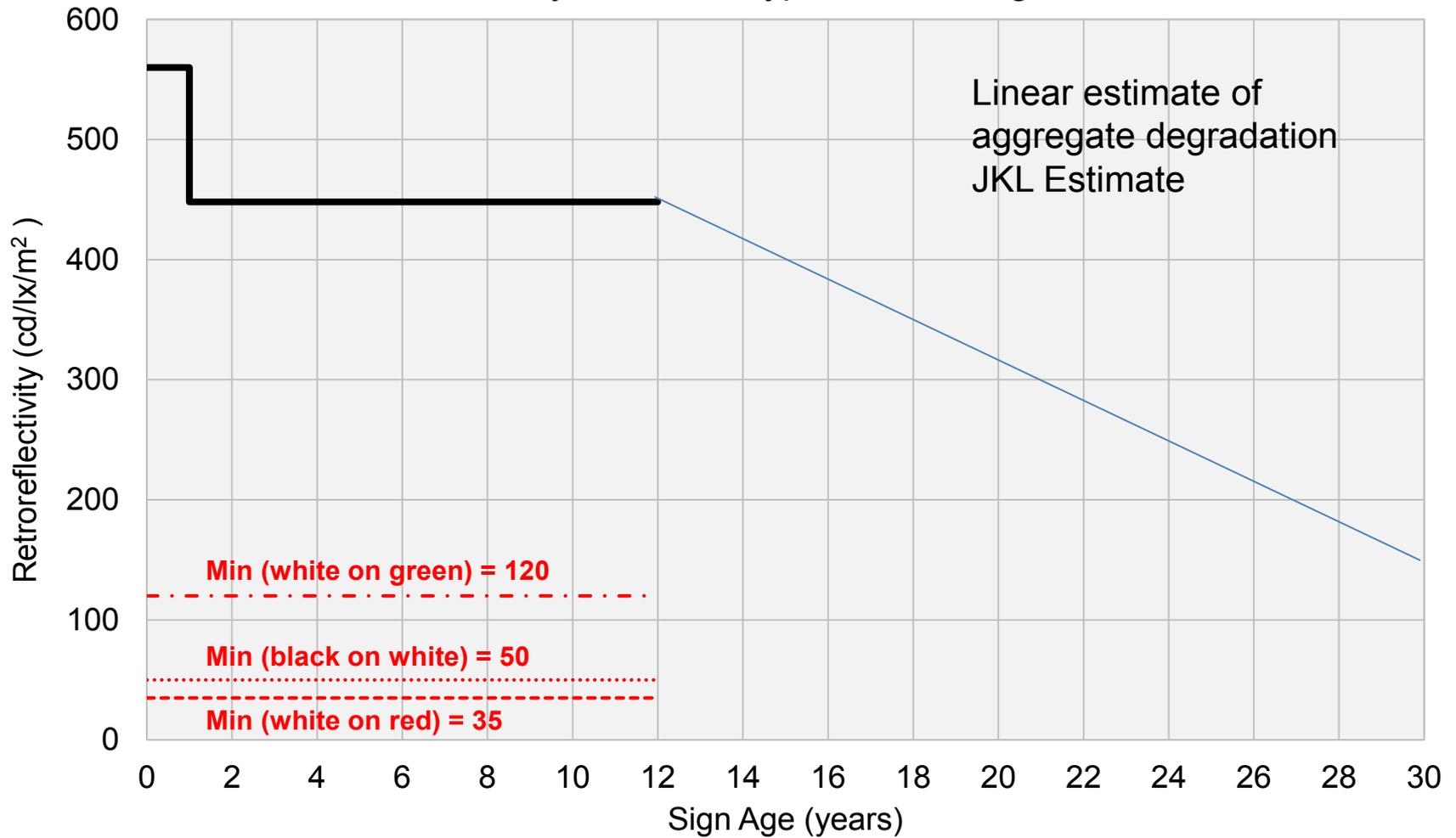
<b>Years</b>	<b>Unsatisfactory Signs (Damaged + Non Compliant)</b>
1 to 5	2% to 5%
6 to 19	5%
20 to 22	10%
23 to 28	26%
29 and 30	28%

# 3. Glass Beaded Versus Prismatic Sheeting

Color	Initial $R_A$		Improvement From Glass-Bead to Microprismatic
	Encapsulated Glass Bead Type III	Microprismatic Type III (High Intensity Prismatic)	
White	250	560	310 (124%)
Yellow	170	420	250 (147%)
Red	45	84	39 (87%)
Green	45	56	11 (24%)

- **Most, if not all, previous studies were done on glass beaded signs**
- **Microprismatic sheeting is superior to previous results**

### Warranty for White Type III Sheeting



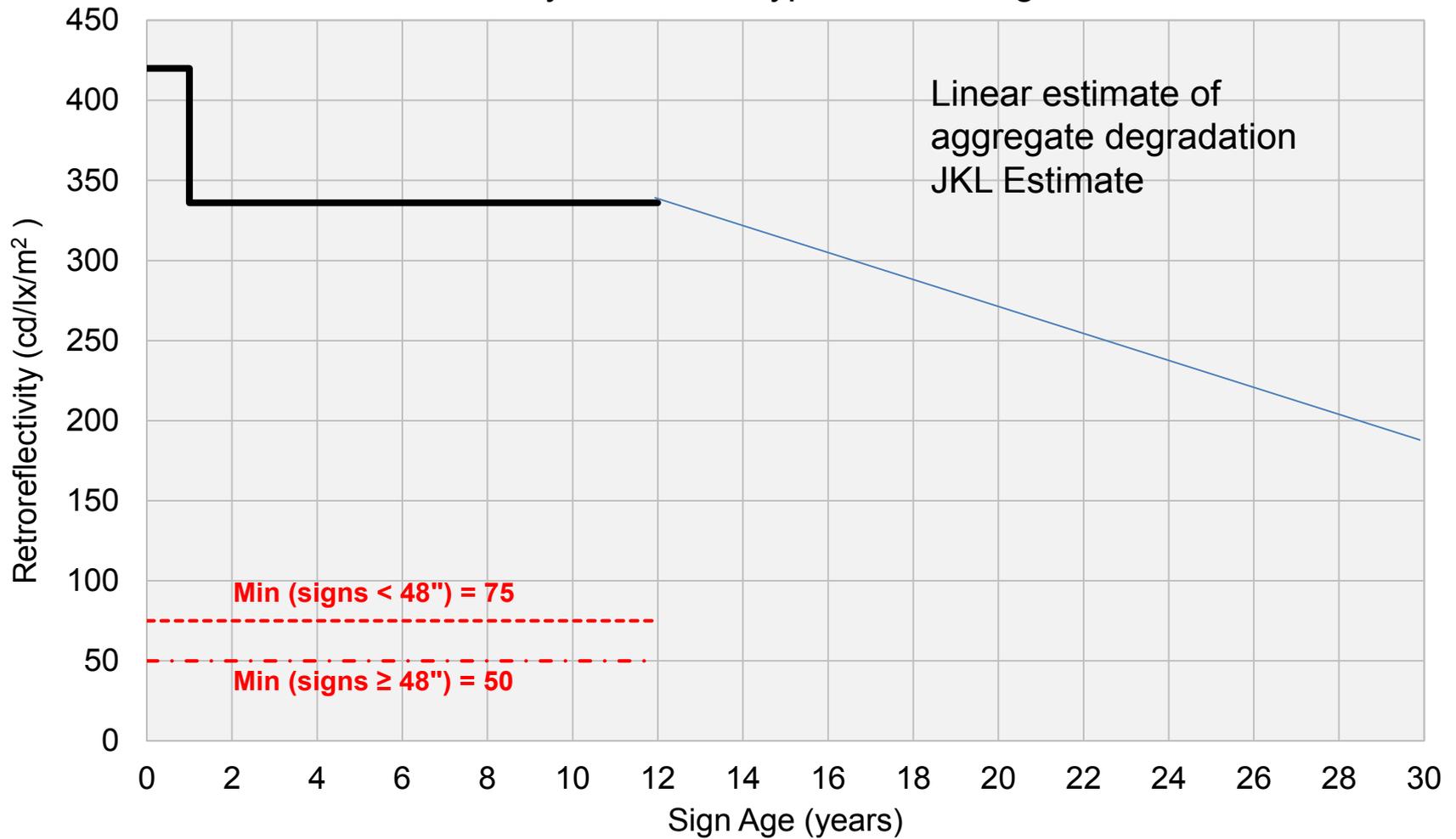
- · - Min White: White on Green

- · - Min White: White on Red

····· Min White: Black on White

— Warranted White

### Warranty for Yellow Type III Sheeting

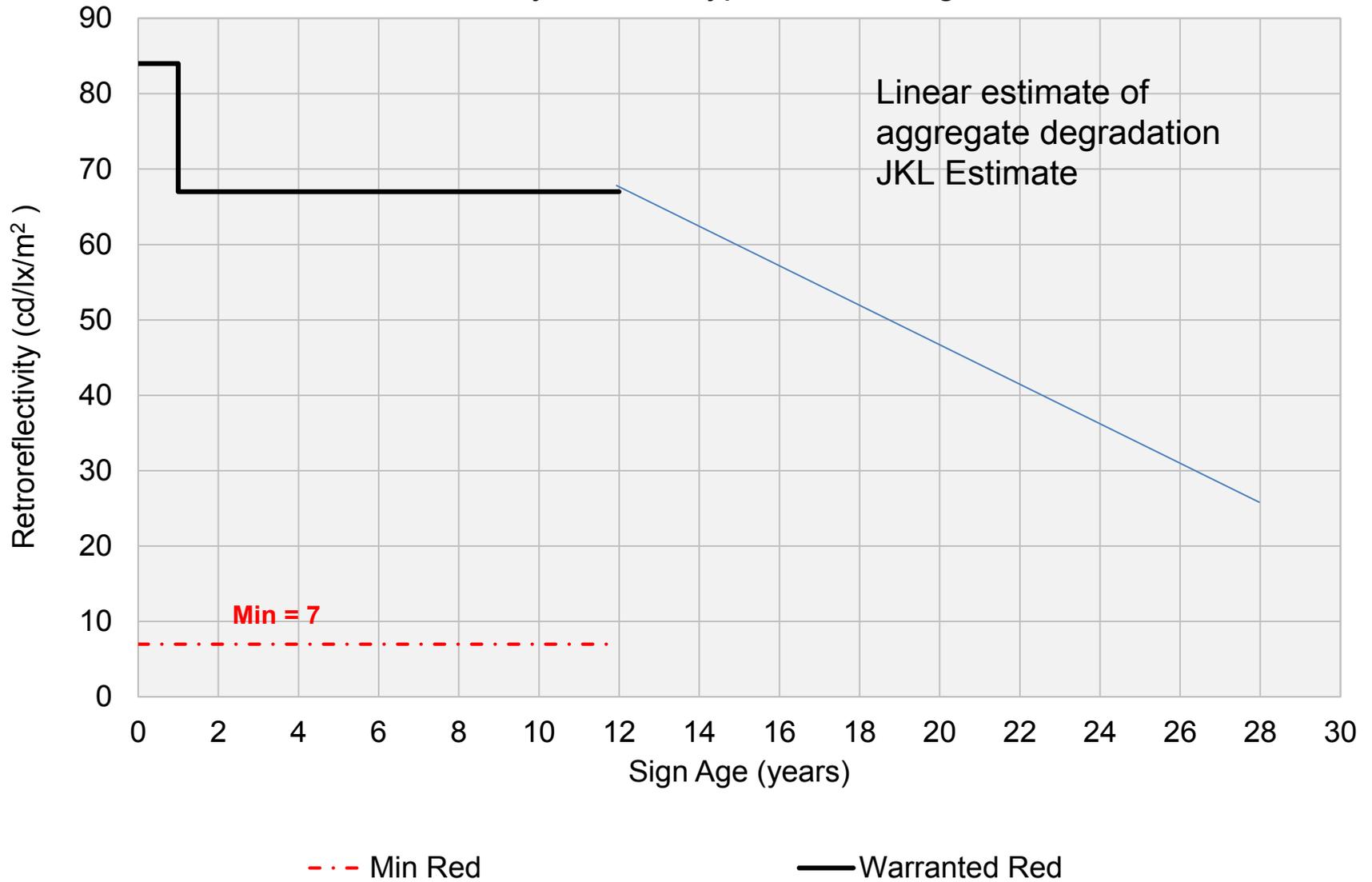


- · - Min Yellow: signs ≥ 48"

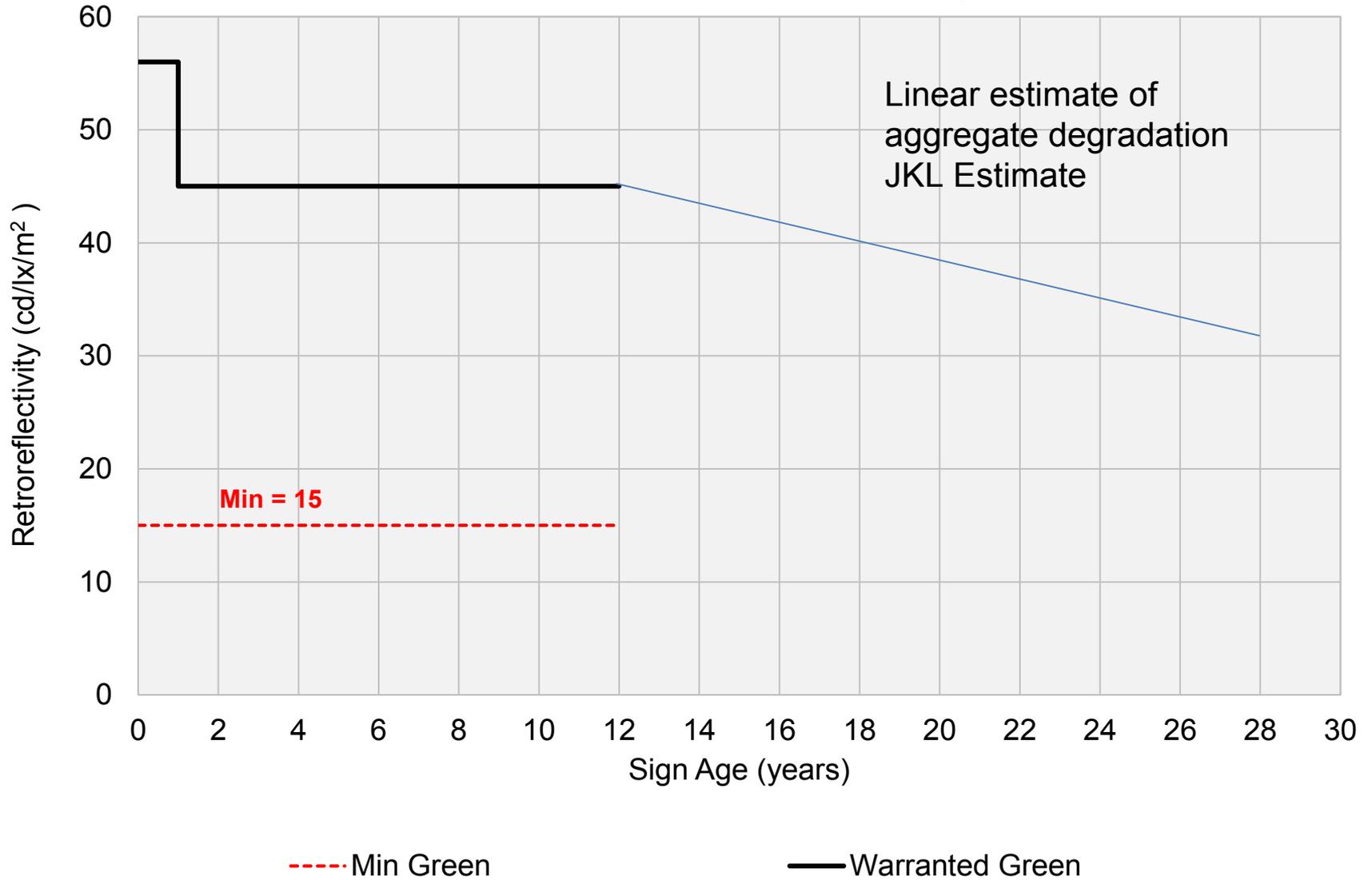
- - - Min Yellow: signs < 48"

— Warranted Yellow

### Warranty for Red Type III Sheeting



### Warranty for Green Type III Sheeting



# 4. Budget Impacts

## Increasing the service sign life from 10 to 20 years

- Reduce annual cost by 50%
- Reduce need for night time inspections
- Double existing length of life
- Better utilization of public funds
- Documented vs. Subjective Decisions
- Create opportunity for budget savings to be utilized to replace outdated over head signs and large ground mounted signs.

# 5. Recommendations

**Considered a Sign life expectancy of 20 years with a 8 year grace period for all signs expect red signs (1 year).**

- Recommended practice based on field data collected, conversations with staff and retro reflective data from industry.
- **1 year grace period for Red signs** (Division can track signs to be used for damaged in areas where sign life will not exceed 20 years)
- 8 year grace period for all other signs. (under sign replacement strategy – if sign is < 8 years stays until next cycle if > 8 recycle
- Signs greater than 8 years can be utilized for replacement of damage signs and missing, but will require tracking. \*\*Do not reuse in areas where it will exceed the life by 20 years. This may be more effort than the benefit.
- Complete interim sign inspections as part of routine maintenance

# 6. Next Steps

- Integrate recommendation into RMIP
- Reanalyze the study again in 15 years with field measurements to confirm data.



**Questions? Comments?**