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Chemical Treatments on Low-Volume Roads

March 3, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

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REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Discuss benefits of chemical treatment program as an unpaved road management strategy
2. Use web-based tool to select the most appropriate chemical treatment

#TRBwebinar

APPLYING PAVEMENT PRESERVATION PRINCIPLES IN UNPAVED ROAD MANAGEMENT WITH SPECIFIC REFERENCE TO FINES PRESERVATION AND DUST CONTROL

David Jones

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12th TRB International Conference on Low Volume Roads

Kalispell, MT, September 15-18, 2019

Outline

- Introduction
- Study approach
- Trial implementation
- PMS implementation
- Conclusions

Introduction

- Unpaved roads
  - Function
  - Problems
  - Sustainability
  - Management
- Improvement options
  - Upgrade to sealed standard
  - Rehabilitation (regravel and reshape)
  - Fines preservation (dust control)
  - Surface stabilization / “waterproofing”
- Need to understand the role of each

Introduction

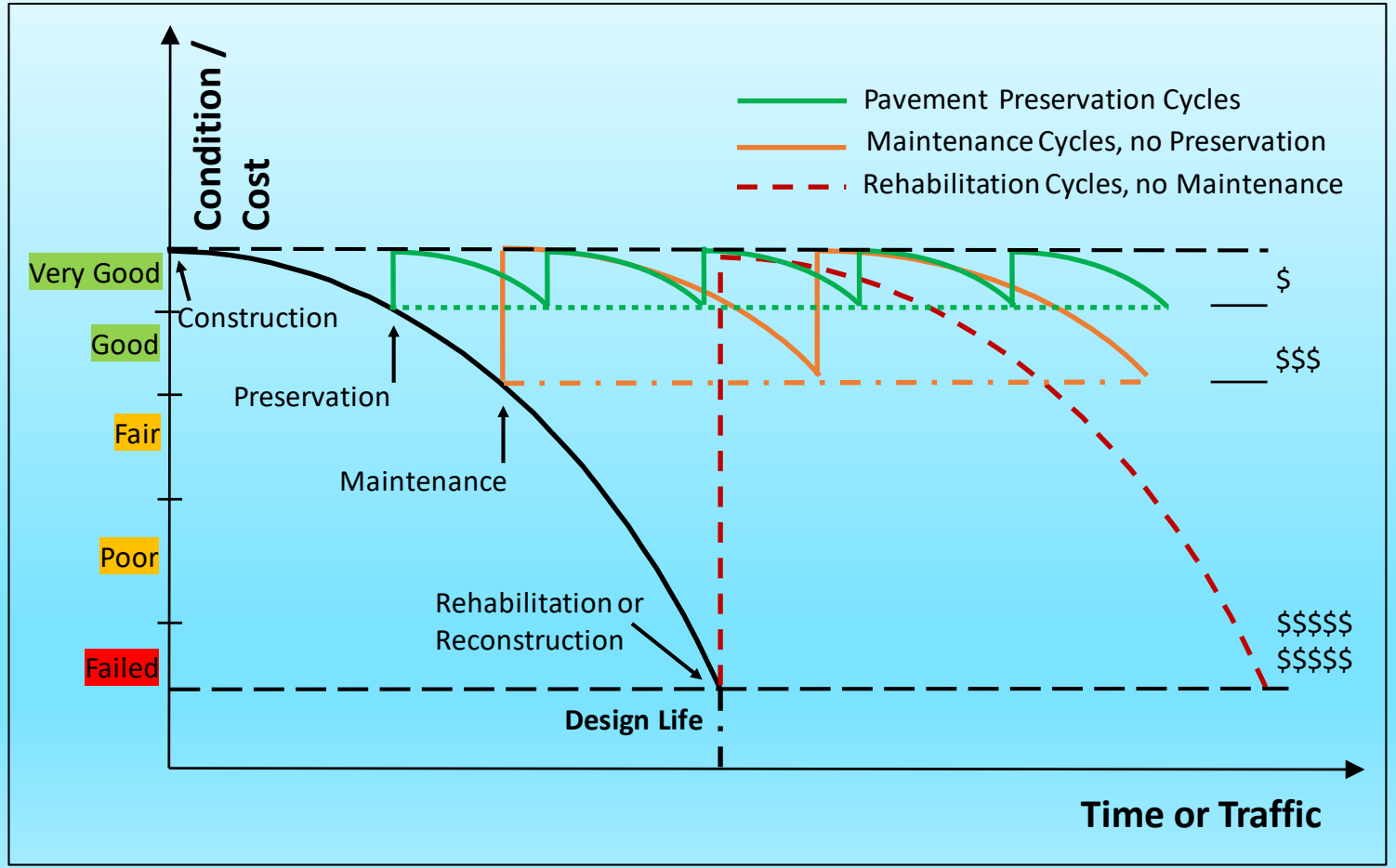
Introduction

- History of fines preservation use
  - 1907 - Chlorides
  - 1913 - Lignosulfonate
  - 1913 – 1970's - Bitumen/tar based, tall oils, resins
  - 1970 – 20xx – Concentrated liquid stabilizers, plant oils, synthetic polymer emulsions, petroleum resins, base oils, etc., and blends
- >200 products currently available in the U.S.
- No formal specifications except calcium chloride and asphalt emulsions
- Comprehensive guidance with selection procedures and example specification language was recently published

Introduction

- Unpaved road management issues:
  - No national "owner" of the problem
  - Very limited funding
  - Dust generally considered as a safety, health and/or nuisance issue
  - Very limited formal research on chemical treatments as pavement management strategies
  - Mostly one-off applications to "see how long a product will last"
  - No protocols or formal test methods
  - No formal product evaluation procedures
  - Proven paved road preservation philosophies are generally not applied

Introduction



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Study Approach

- Quantify benefits of chemical treatment programs in terms of grader maintenance intervals and gravel replacement, as well as dust reduction
- Seven-year study of 30 $CaCl_2$-treated roads with annual or biannual rejuvenation treatments
  - Verified with data collected on roads with other treatments
- Develop multiplier factors for existing unpaved road performance prediction models

Prediction Multipliers

- Gravel loss
  - Multiply predicted/actual loss for untreated road by a factor of 0.5
    - Considered to be conservative based on long-term field performance
- Blading
  - Multiply predicted/actual blading interval of untreated road as follows:
    - Predicted blading of < 7 days - multiply by 14.3
    - Predicted blading of 7 to 14 days - multiply by 8.5
    - Predicted blading of 15 to 45 days - multiply by 4.0
    - Predicted blading of 46 to 90 days - multiply by 3.0
    - Predicted blading of 91 to 120 days - multiply by 2.0
    - Predicted blading of > 120 days - plan for 1 blade per annum

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Trial Implementation

- 24-month study to verify prediction multipliers
  - 9 km (3 x 200 m controls)
  - 400 AADT, 50% trucks (increased to 700)
  - 14-day blading cycle
  - 3-year regraveling cycle
  - Material was out of recommended spec (plasticity)
  - Upgrading to paved standard required geometric and bridge upgrades
- Study based on a product performance guarantee
- Calcium chloride application
  - Yr 1: Initial 2.0L/m^2 , 0.3L/m^2 in month-3, 0.5L/m^2 in month-7
  - Yr 2: 1.0L/m^2

Trial Implementation

Parameter	Predicted Performance		Guaranteed Performance
	Untreated	Treated	
Average riding quality (QI)[a]	120	80	100
Blading interval (days)[b]	40	200	150
Gravel loss (mm/year)[c]	19	9	14
Dust (du)[d]	50	10	15

[a] QI – Quarter- car index, measured with linear displacement integrator (LDI)
[b] Based on QI
[c] Measured with rod and level survey
[d] du - dust units, measured with custom-built, vehicle-mounted, infrared dust measuring device

Trial Implementation

Parameter	Guarantee	0 – 6 months		6 – 12 months		12 – 24 months	
		Control	Treated	Control	Treated	Control	Treated
Riding quality (QI)	100	140	80-120	100	70-110	100	70-110
Dust (du)	15	60	10-30	60	5-40	50	5-30
Gravel loss (mm/yr)	14	23-55	6	20-33	0	23-40	0-10
Blading interval (days)	150	40	182	40	101	50	50

- Guarantee was not changed for the increased traffic
- A drainage issue led to potholing in isolated areas, requiring additional blading
- Treatment exceeded all expectations

Trial Implementation

- Treated and control sections after 24 months

- Break-even traffic was 75 to 175 AADT depending on model and factors

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PMS Implementation

- Agency network of 1,550 km
- Traffic range of 6 to 3,250 AADT, average of 210
- Evaluation to minimize total transportation costs (TTC)
  - Maintenance and vehicle operating costs
  - Road user savings must exceed costs of maintenance
- Cost of treatment compared with routine grader maintenance
- Assumed that roads are regraveled when thickness reduces to 30 mm (not always the case because of limited funds)

PMS Implementation - Blading

- Example road with 342 AADT (1999 costs)

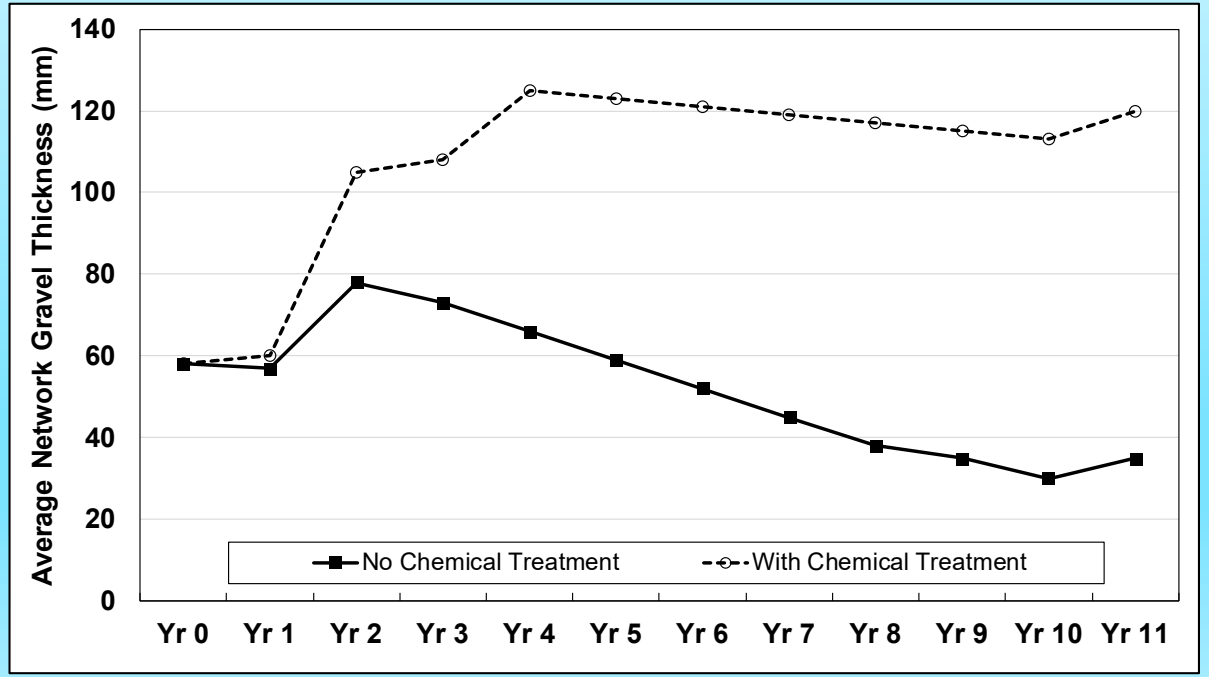
Treatment	NPV Benefit[1] (US$)	Regravel Frequency[2] (years)
Do Nothing	N/A	N/A
Blade 120 days	154,150	7
Blade 60 days	348,229	7
Blade 30 days	446,422	7
Treat & blade 90 days	511,705	13
Treat & blade 120 days	489,424	13

[1] Benefit calculated as savings in VOC minus costs

[2] Required regravel frequency according to gravel loss model

PMS Implementation – Gravel Loss

- Constrained budget
- Some gravel replacement in Yr 2 with select chemical treatments (annual rejuvenation thereafter)



Reality Check – USA in 2012

- County road evaluations in Idaho and Colorado, and USFS roads in Montana
- Treatments:
  - Magnesium chloride in Idaho and Montana
  - MgCl/plant-based in Colorado
- Costs
  - Untreated average maintenance cost
    - Annual $7,800/km
  - Treated average maintenance cost
    - Yr 1 - $4,000/km
    - Subsequent years - $2,900/km

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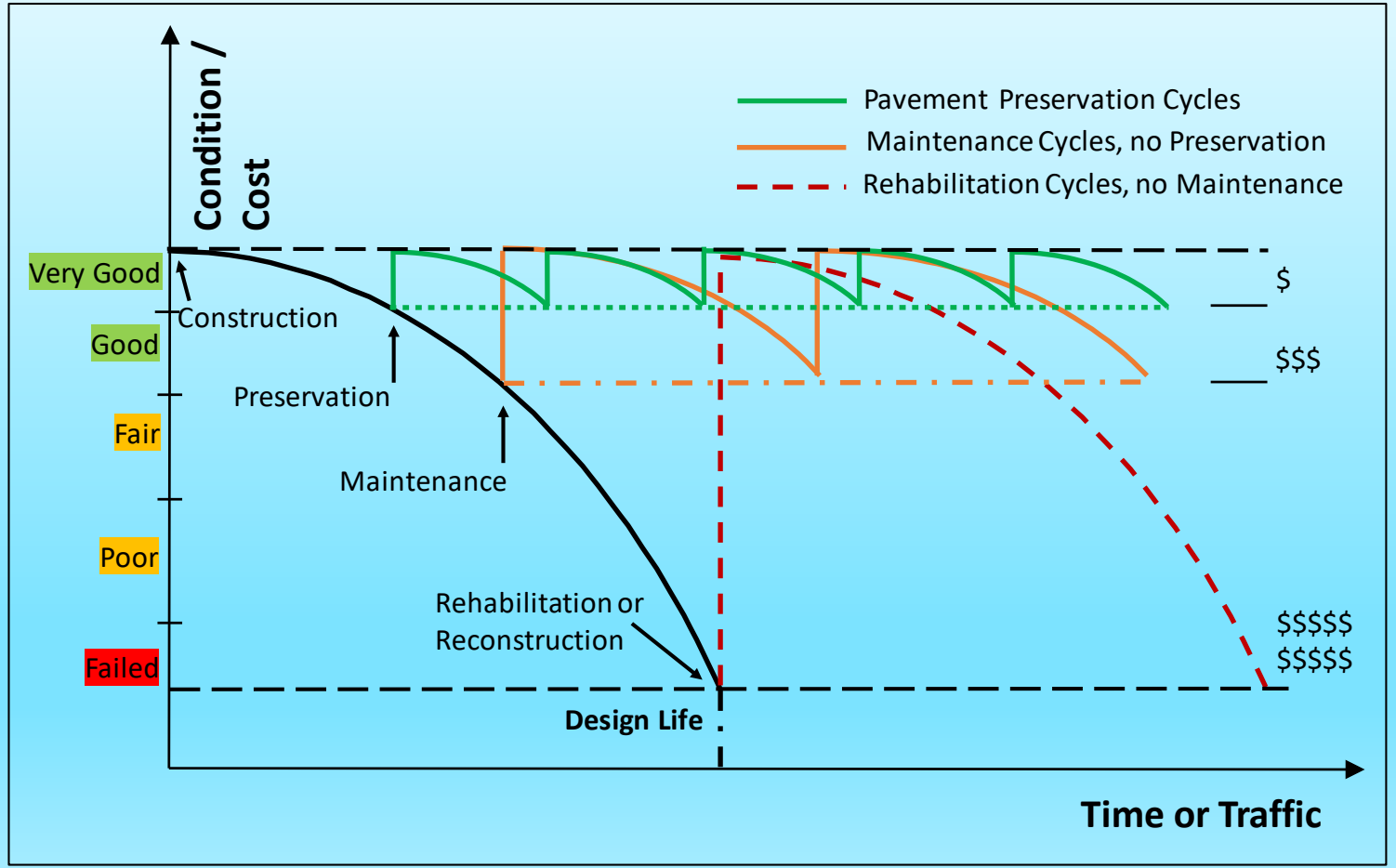
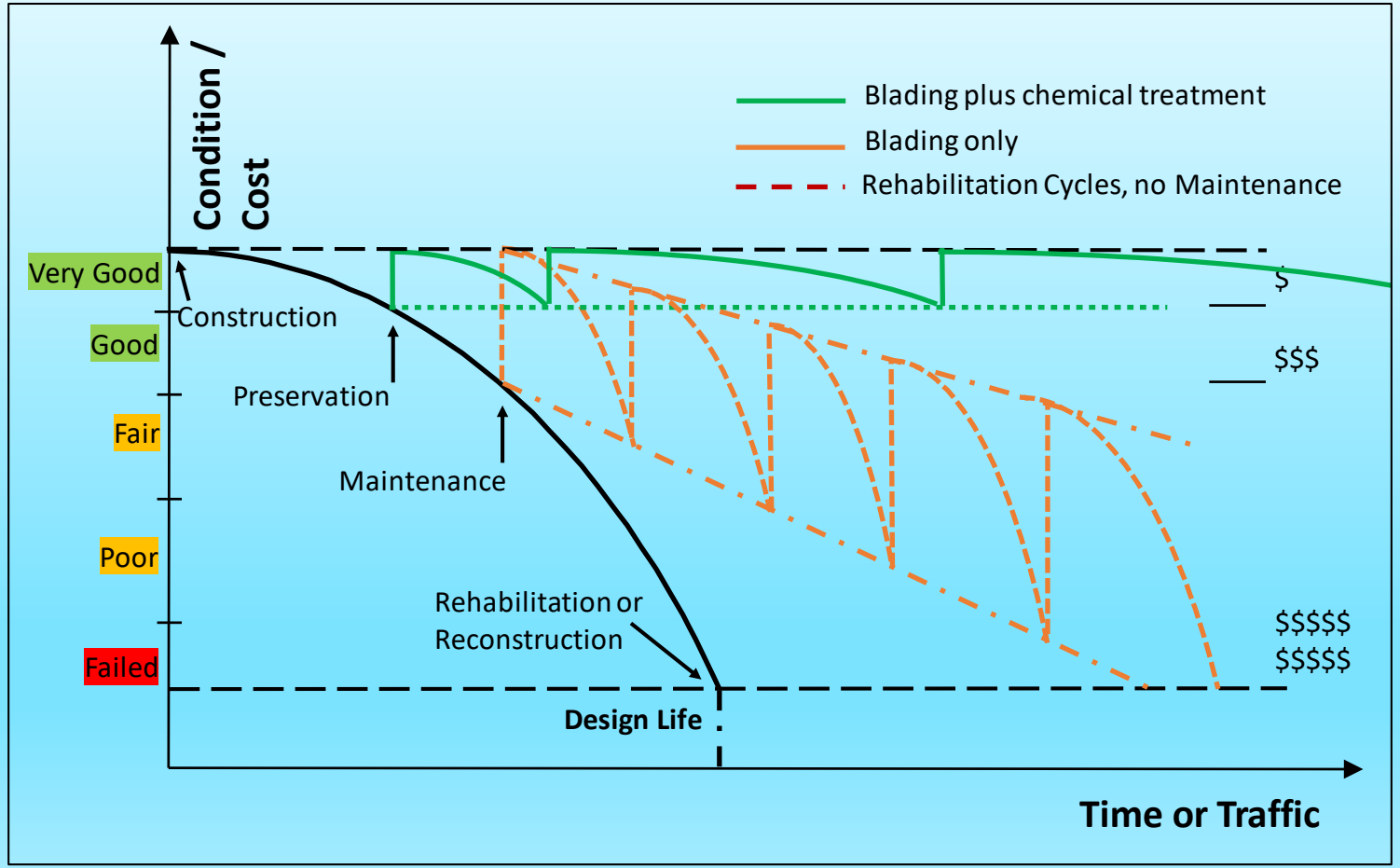
Conclusions

- Most chemical treatment research is based on dust suppression performance for a single application
  - Not useful for agency management systems
  - Expensive if factored into maintenance costs
- Research should focus on long-term performance with rejuvenation and measured dust suppression, blading interval, and regraveling interval
- Monitoring and PMS analyses show that savings to the agency and road user are significant

Paved Road Preservation



Unpaved Road Preservation



Thank-you!

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UNPAVED ROAD CHEMICAL TREATMENT SELECTION TOOL DEMONSTRATION

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Abstract

- Tool developed for selecting chemical treatments for unpaved roads
- Part of a comprehensive chemical treatment selection guide. Procedure can be done manually as well
- Based on research and inputs from practitioners and the industry
- Available since 2017
  - No complaints raised to date

Abstract

- Rubbish in, rubbish out
  - Road investigation and laboratory indicator tests are important and must be done
- Acknowledgements:
  - Jon Lea, UCPRC, for writing the code
- Link to the tool:
  - www.ucprc.ucdavis.edu/dustcontrol