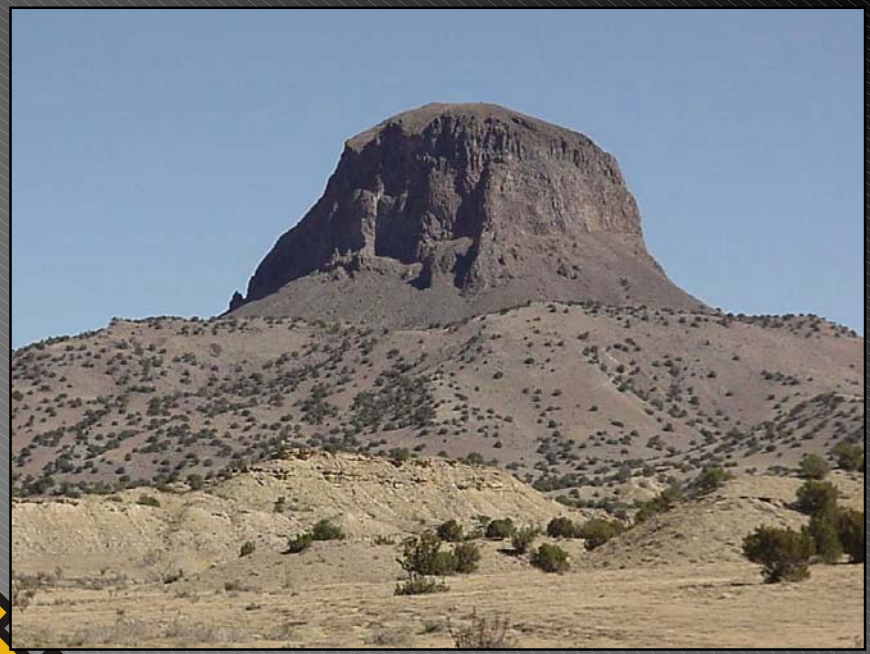

NM 44

A Case History of Long-Term Warranted Performance

Richard W. May
PRDI-Mesa

Background

- 1992-1996 : 36 deaths, 264 seriously-injured

Background

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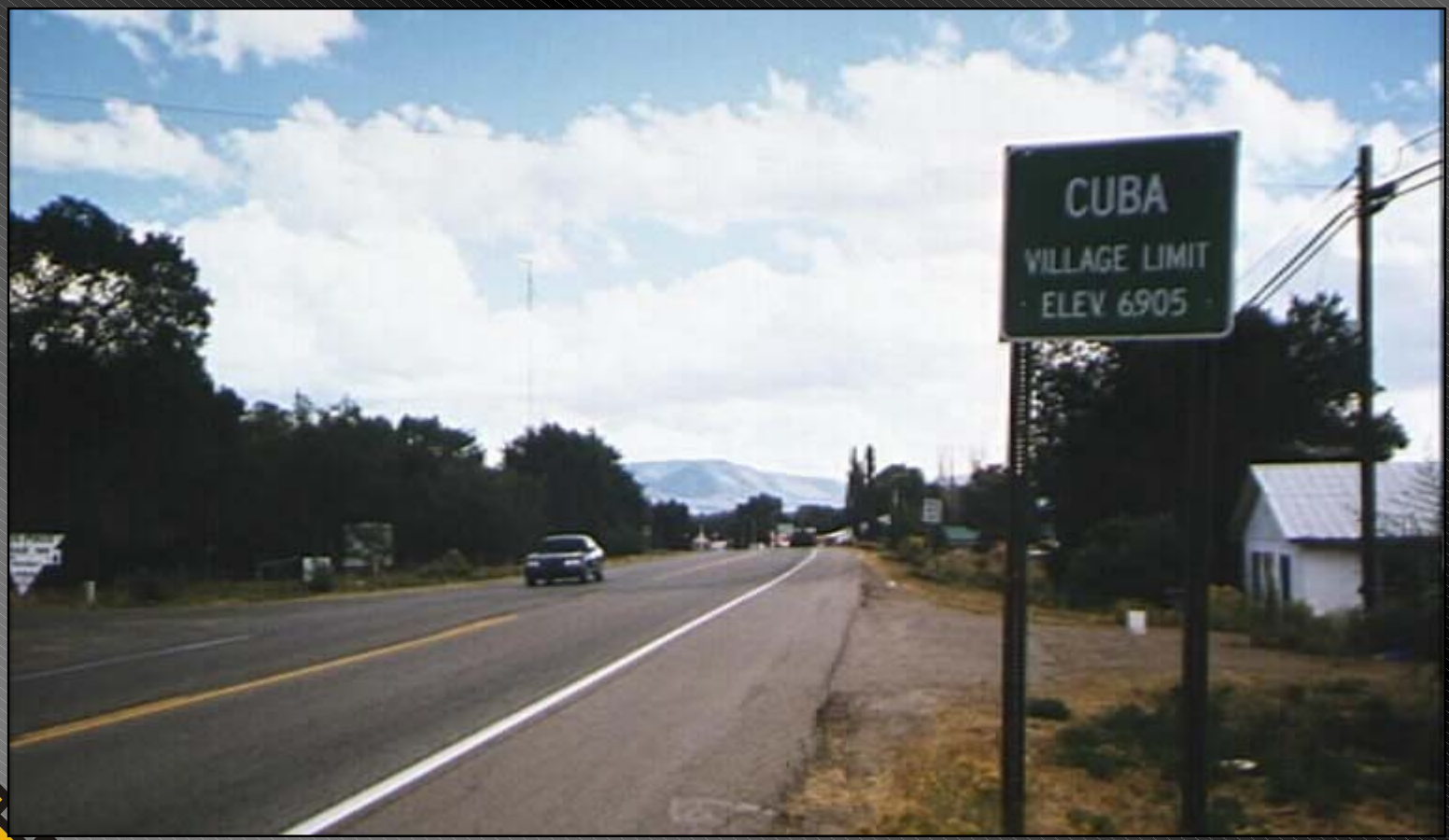
- **4th highest population - 9th highest unemployment**



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- **Current funding required 27 years to upgrade**

Background

- 1992-1996 : 36 deaths, 264 seriously-injured
- 4th highest population - 9th highest unemployment
- Current funding required 27 years to upgrade
- **Future maint & rehab estimate : $16,000/ln mile/year**

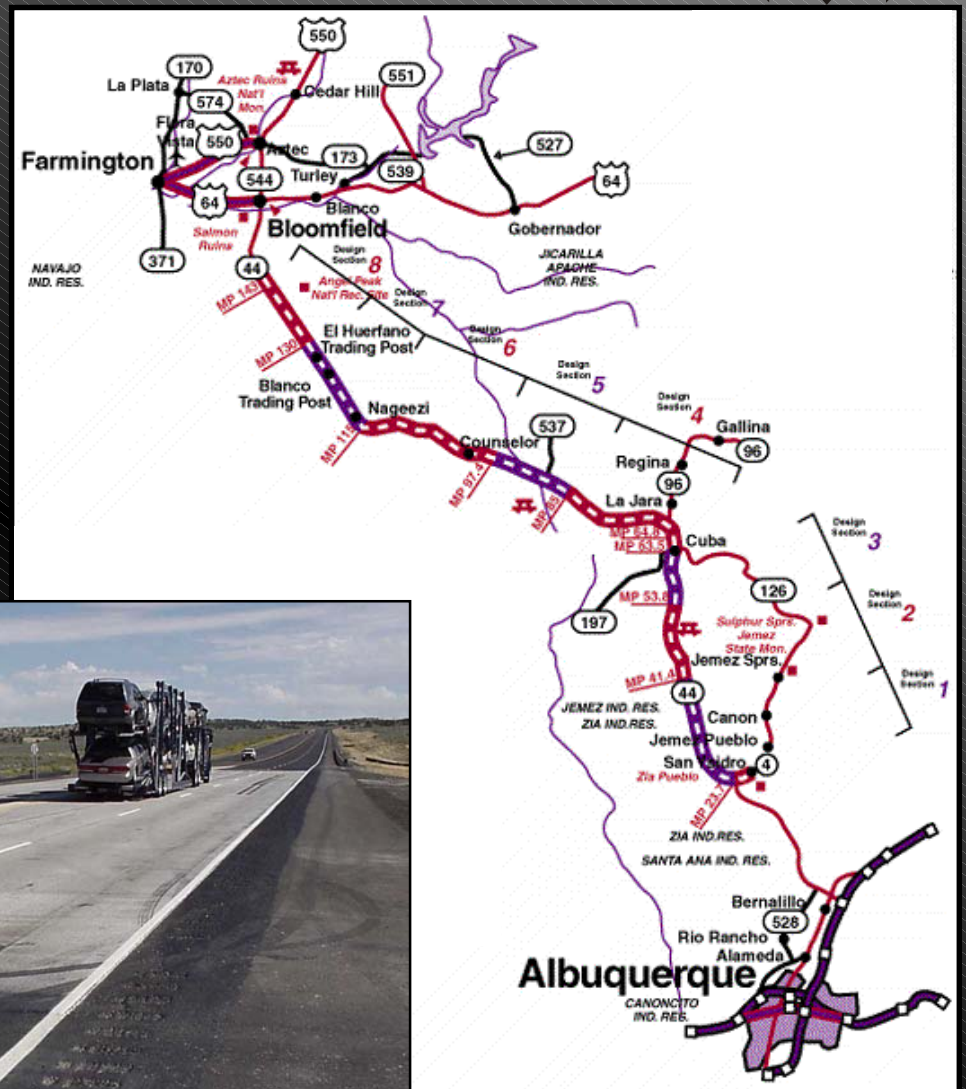
550

Timeline

- 1995 Construction Cost Estimate for widening and rehab : $237 M
- FHWA Financing Conceived in April 1997
- RFP issued August 29, 1997
- Contract signed July 27, 1998
- Substantially Completed November 21, 2001
- Warranty until November 20, 2021

Scope of Project

- 118 miles of total reconstruction
- 61 % on Native American Land
- Limited R-O-W
- 7 bridges
- 393 culverts
- 3 WIM sites



Pre-Bid Phase

- VE Meeting - Oct 13, 1998 (30%)
- VE Meeting - Jan 19, 1999 (60%)
- Pre-Bid Conference - Jan 25, 1999
- NMSHTD Technician Certification Program
  - tried to utilize much of state specs to reduce confusion

CH2MHILL

FLATIRON
STRUCTURES COMPANY LLC

550

Pre-Bid Phase

- Not Design-Build >>> Design, Low Bid, Build
- Professional Services Contract with Warranty
  - created uncertainty and apprehension
- Mesa/NMSHTD bids out initial and future work

Warranty Agreement

> "X-Y-Z" terms

- X Years (20)
- Y Traffic (4 million ESAL)
- Z Total Expenditures ($110 million)

Warranty Agreement

> "X-Y-Z" terms

- X Years (20)
- Y Traffic (4 million ESAL)
- Z Total Expenditures ($110 million)

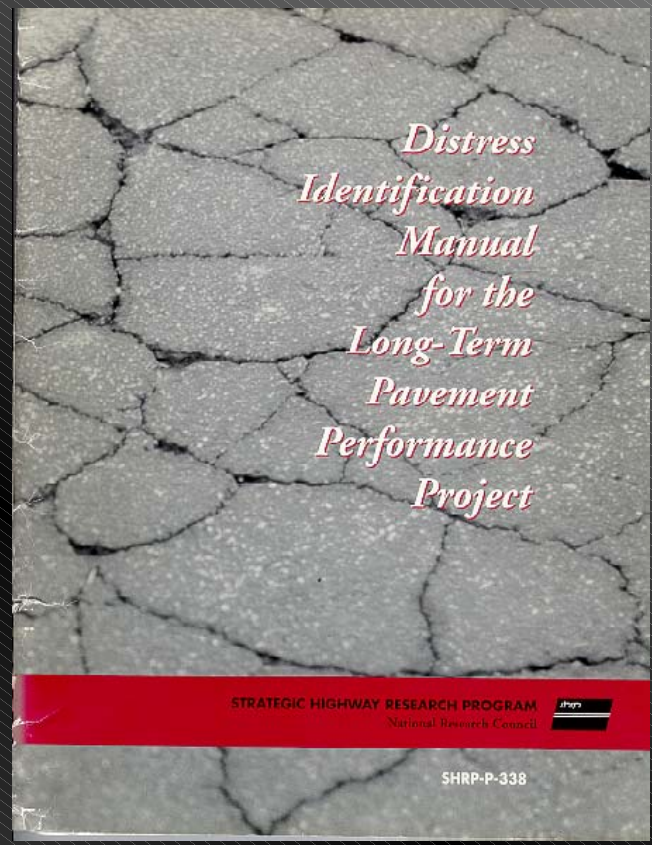
- **Cost : $6,400 / ln mile / year**
- **Contractor : material & workmanship of specs**
- **Mesa : Transfer of Long-Term Performance Risk**
- **Backed by Surety Bonds**

> involved with design, composition, construction

Warranted Condition

Annual, Automated, Measurable, and Objective

- Rut Depth
- Depressions & Shoving
- Crack Width
- Crack Spacing
- Potholes
- Raveling
- Delamination, Bleeding
- IRI Smoothness



SHRP P-338

> incentive for preventative maintenance

Traffic

NM 44

NMSHTD Traffic Projections

ESAL Forecast for Heavy Commercial Trucks

20-Year Period

Location	1997 RFP Cumulative ESAL (millions)	Negotiated Warranty Traffic (millions)
MP 2.300 to MP 23.439	3.802	
MP 23.439 to MP 63.424	1.878	4.000
MP 67.915 to MP 85.365	2.778	4.000
MP 85.365 to MP 123.195	2.909	4.000
MP 123.195 to MP 142.785	3.512	4.000

Climate

Weather Station	Elevation (feet)	Mile Post	Mean Low Air Temp (C)	Min	Mean High 7-day Temp (C)	Max	98% Grade
Corrales	5016	-7	-16.7	-21.1	35.8	38.1	64-16
Bernalillo	5050	0	-19.4	-32.8	37.3	40.0	64-22
Cuba	6905	64	-26.3	-35.6	33.1	36.9	64-28
Cont. Divide	7275	76					
Chaco Canyon	6175	SW114	-26.9	-38.9	35.2	37.0	64-28
Bloomfield	5807	145	-19.7	-27.8	36.1	38.9	64-22
Farmington	5400	155	-22.5	-36.7	36.9	38.9	64-28

< 13 in. annual precipitation

Range of Soils

Stiff Plastic Clays

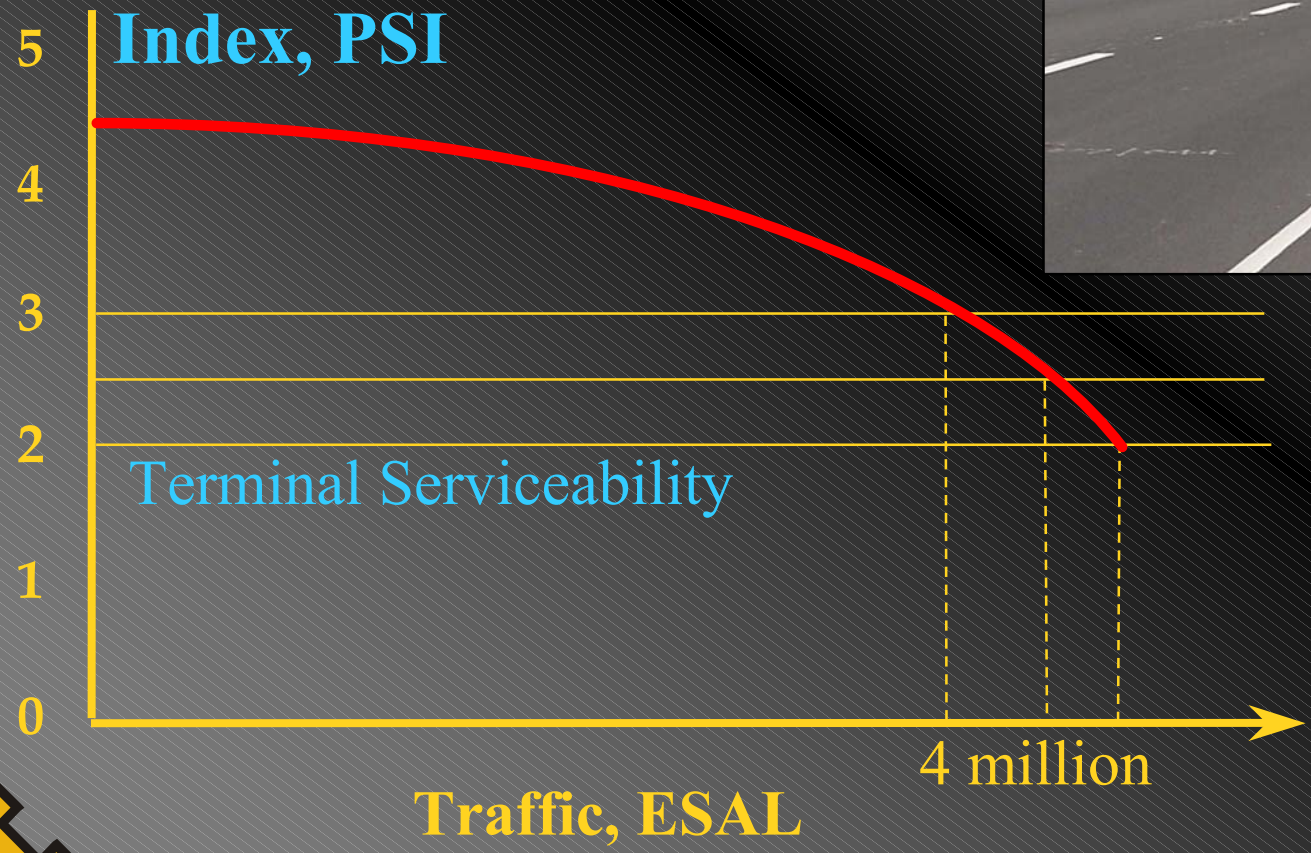
Silty Sands

Range of Properties

Summary of Design Subgrade Values
NM 44

Design Section	Begin Mile Post	End Mile Post	Design 90% SG R-Value	Design 90% SG Mr (psi)
1-1	23.74	25.60	12.0	7,660
1-2	25.60	28.20	24.5	14,598
1-3	28.20	41.40	13.0	8,215
2-1	41.40	53.80	12.0	7,660
3-1	53.80	63.50	11.8	7,521
4-1	64.78	85.00	13.3	8,382
5-1	85.00	97.42	14.3	8,937
6-1	97.42	104.20	13.6	8,548
6-2	104.20	108.20	21.1	12,711
6-3	108.20	115.00	11.5	7,383
7-1	115.00	120.60	12.1	7,716
7-2	120.60	130.00	18.4	11,212
8-1	130.00	143.00	22.1	13,266

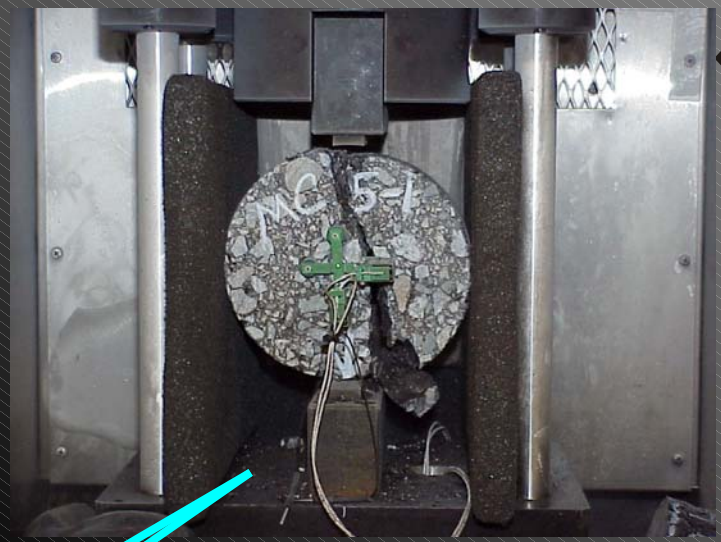
Pavement Design

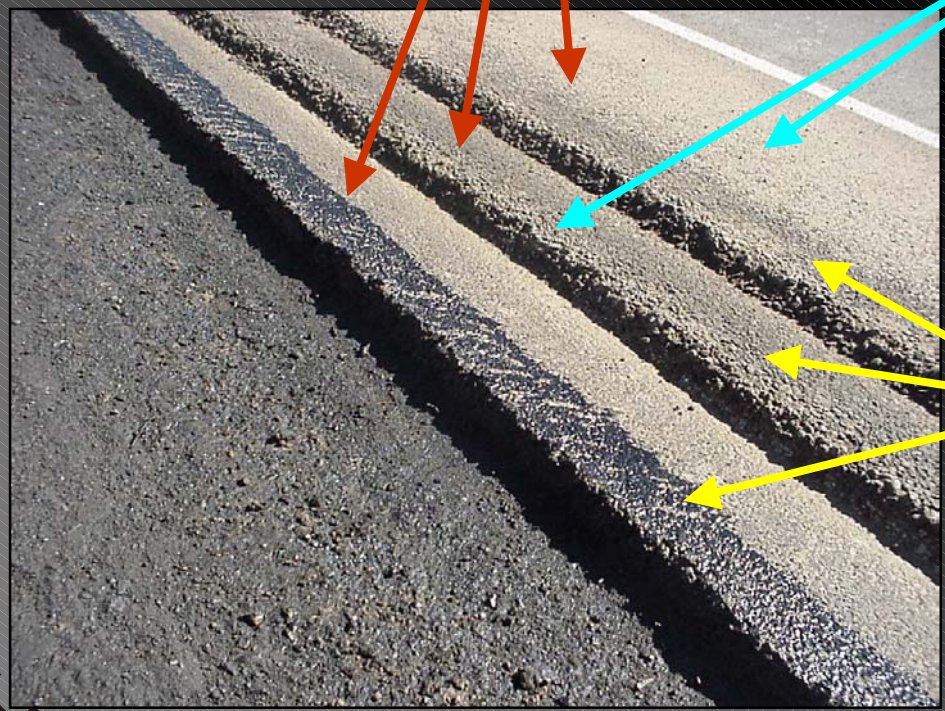


Layered Approach

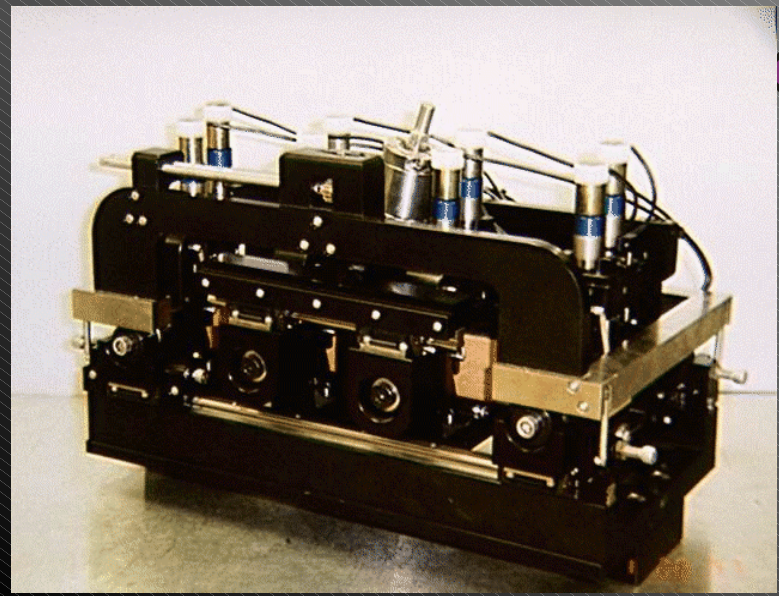
Where are our potential problems ?

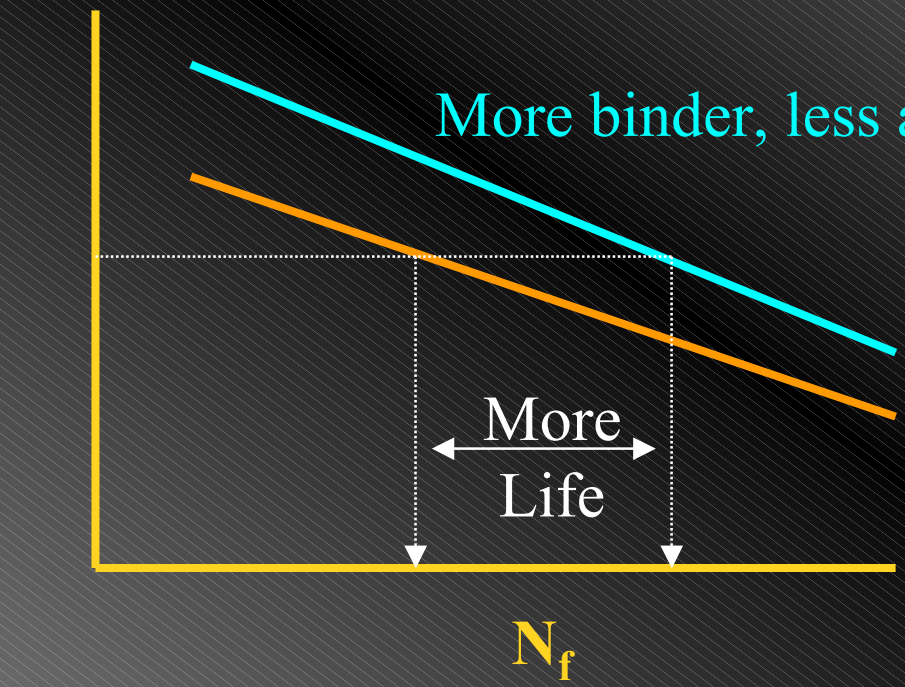
Address each specific problem
at the most effective location in the system





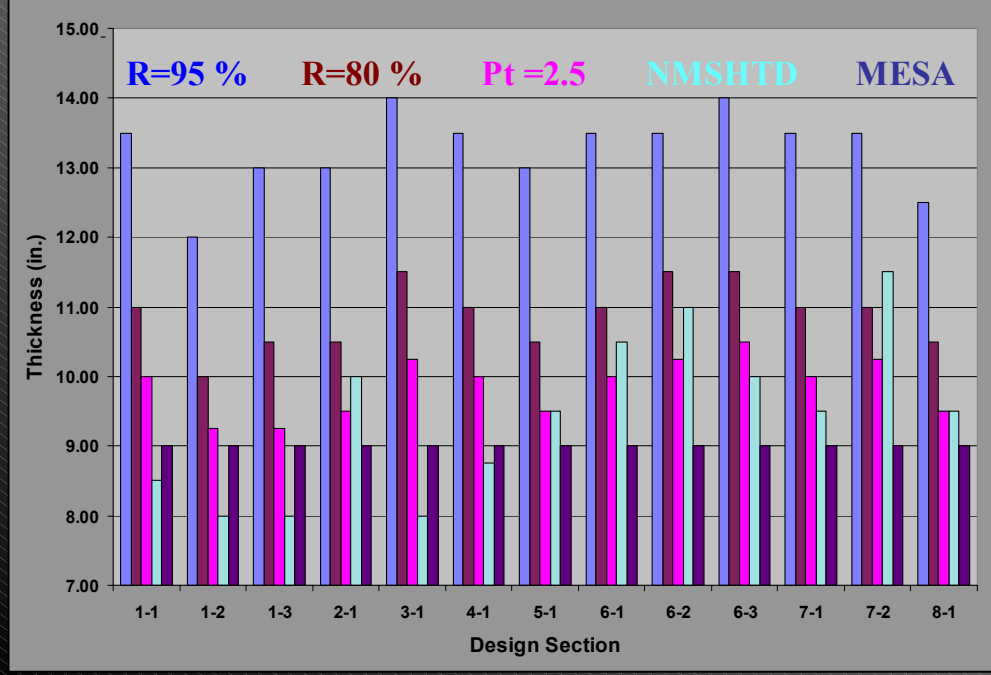
Resilient Base





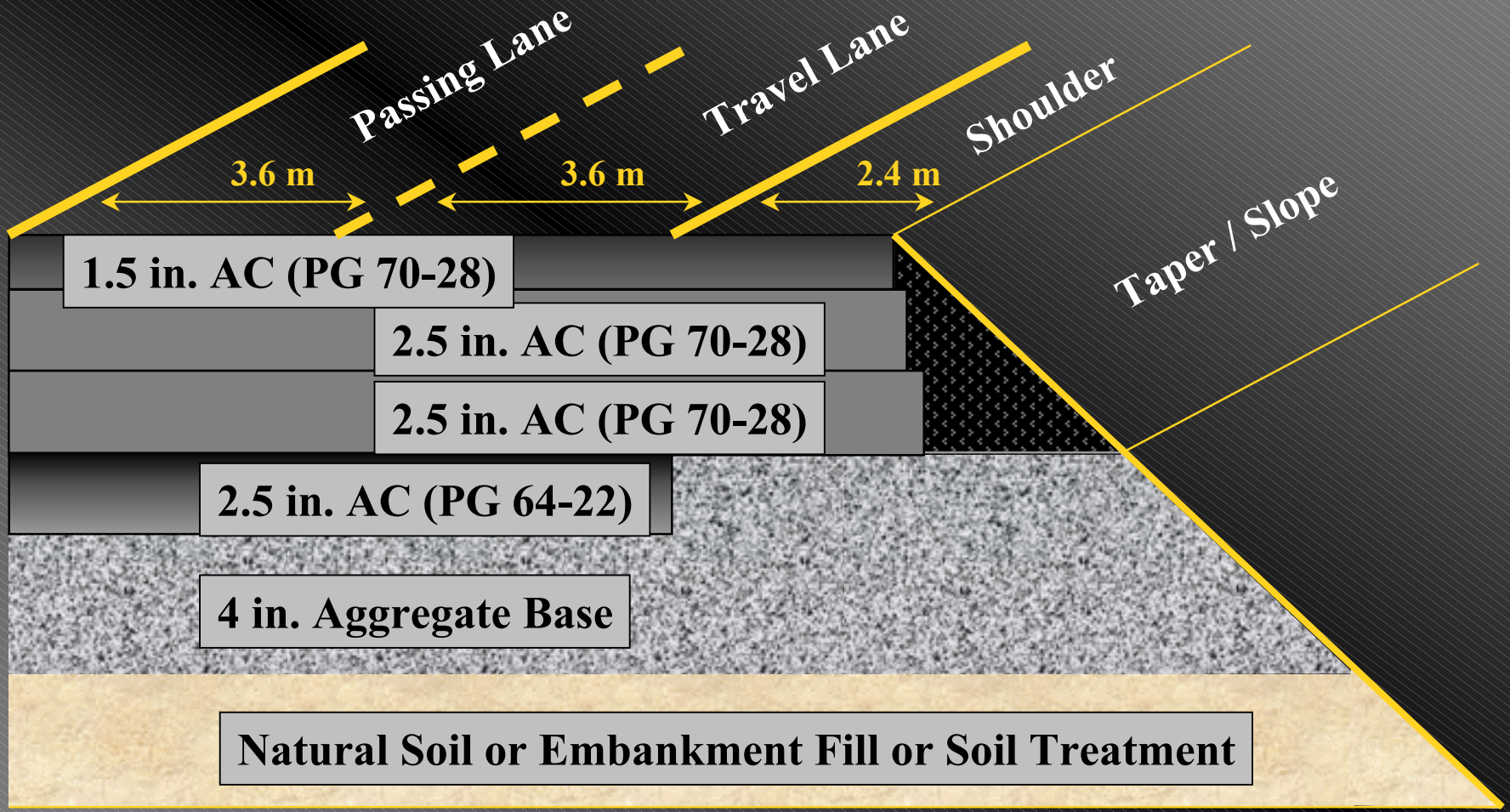
Design Comparisons

Weighted Averages



- AASHTO (R=95%; P_t=3.0) : 13.3”
- AASHTO (R=80%; P_t=3.0) : 10.9”
- AASHTO (R=80%; P_t=2.5) : 9.8”
- NMSHTD (Probabilistic) : 9.4”
- MESA (Layered Analysis) : 9.0”

Final Design Section



Goal


OLD :
Roller
Coaster
Roughness
w/patches
NEW :
Durable, Tough
Mat on a Stable
Platform
CAT

550

Over-excavation & Borrow

Soil Treatment

Lime, Fly Ash

Bidding Process

- two-stage approach
- edited NMSHTD specs
  - plan SY vs. tons
- Pkg 3 - Sundt (6/99)

Bidding Process

- two-stage approach
- edited NMSHTD specs
  - plan SY vs. tons
- Pkg 3 - Sundt (6/99)
- **re-engineering effort**
  - **design, material specs**
  - **aggregate sources**
  - **7 small to 3 large packages**

Bidding Process

- two-stage approach
- edited NMSHTD specs
  - plan SY vs. tons
- Pkg 3 - Sundt (6/99)
- re-engineering effort
  - design, material specs
  - aggregate sources
  - 7 small to 3 large packages

- **Pkg 1-2 : E.L. Yeager Construction (11-4-99)**
- **Pkg 4,5,6 : FNF Construction (12-14-99)**
- **Pkg 7,8 : Western Mobile/Lafarge (2-3-00)**

RAP

- 800,000 tons generated

RAP

- 800,000 tons generated
- **allowed as an option :**
  - **substitute for aggregate base**

RAP

- 800,000 tons generated
- allowed as an option :
  - substitute for aggregate base
  - **shoulder taper**

RAP

- 800,000 tons generated
- allowed as an option :
  - substitute for aggregate base
  - shoulder taper
  - **< 30% of AC Base**

RAP

- 800,000 tons generated
- allowed as an option :
  - substitute for aggregate base
  - shoulder taper
  - < 30% of AC Base
  - **driveways, turnouts**

Construction

NM 44
AC Quantities

Warranty Segment Design Section	Number of Lifts	A 1& 2	B 3	C 4& 5& 6	D 7 & 8	All
Asphalt Concrete (tons of mix)						
Surface Course	1	100,079	29,980	176,297	95,120	401,476
Binder Course	2	346,294	111,712	574,876	317,058	1,349,940
Base Course	1	128,528	57,885	245,559	122,488	554,460
Total	4	574,901	199,577	996,732	534,666	2,305,876
Asphalt Binder (tons of liquid)						
PG 70-28	3	25,634	7,428	41,293	22,706	97,061
PG 64-22	1	7,069	3,010	13,495	6,738	30,312
Total	4	32,703	10,438	54,788	29,444	127,373

Need for over 1 million tons of Aggregate Base

QC/QA

NM 44 Pay Factors and Acceptance Tolerances

Based on Percent Within Limits (PWL)

AC Lift	Surface Course		Binder/Base Course	
Pay Factor Item	Accept % Tolerance	% in Total PWL	Accept % Tolerance	% in Total PWL
P 4.75 mm	+/- 5	5	+/- 5	5
P 0.6 mm	+/- 4	5	+/- 4	5
P 0.075 mm	+/- 1.5	5	+/- 1.5	5
Density (% Gmm)	92 - 96	45	92 - 96	55
Thickness	Design - 10	15	Design - 10	30
Smoothness	< 5 in./miles	25		

Total Thickness within 0.5 in. of Design

PWL Results

Warranty Segment Design Section	*Number of Lots or PWL Range*	A 1& 2	B 3	C 4& 5& 6	D 7 & 8	Total/Avg Project
P 4.75 mm	# Lots < 60	0	3	0	1	4
P 0.6 mm	# Lots < 60	0	0	0	7	7
P 0.075 mm	# Lots < 60	6	5	3	2	16
AC Density	# Lots < 60	10	0	1	2	13
AC Thickness	# Lots < 60	4	0	7	0	11
Surf Smoothness	# Lots < 60	0	1	1	0	2
Total	Total # Lots	1255	488	2055	1156	4954
	% Lots => 90	72.9	82.2	73.2	83.4	77.9
	75 < % Lots < 89	15.4	12.3	18.8	11.4	14.5
	60 < % Lots < 74	10.1	3.7	7.3	4.2	6.3
	% Lots < 60	1.59	1.84	0.68	1.04	1.06
	# Lots < 60	20	9	12	12	53

R&R Decisions

- managing schedule, costs, long-term quality
- not automatic remove & replace
  - engineering judgement (gradation, high density)
  - laboratory performance testing (compared to design)
  - ‘work-arounds’ (thickness)
- **warranty agreement unchanged**

Smooth Hot Surface Joints

> Echelon Paving

Field Challenges

- Cold Weather
  - AC Base (> 45 F)
  - PMAC (> 55 F)
  - Option to pre-heat up to 200 F
  - Specs met during cold paving

Field Challenges

- Traffic Shifting
  - no traffic prior to 4 lifts ?
  - 5-mile NO-construction zones ?
  - MOU
  - maintain traffic safely, accelerate paving schedule, clean surface

Sulfate Reaction Heaving

- Potentially 18 miles
- Ca-based additives
- Water-activated

Sulfate Reaction Heaving

How addressed...

- mill humps
- maintain drainage

Results : < 500 feet since opening to traffic

Public Relations

- involved local businesses (1400)
- update/employ area residents

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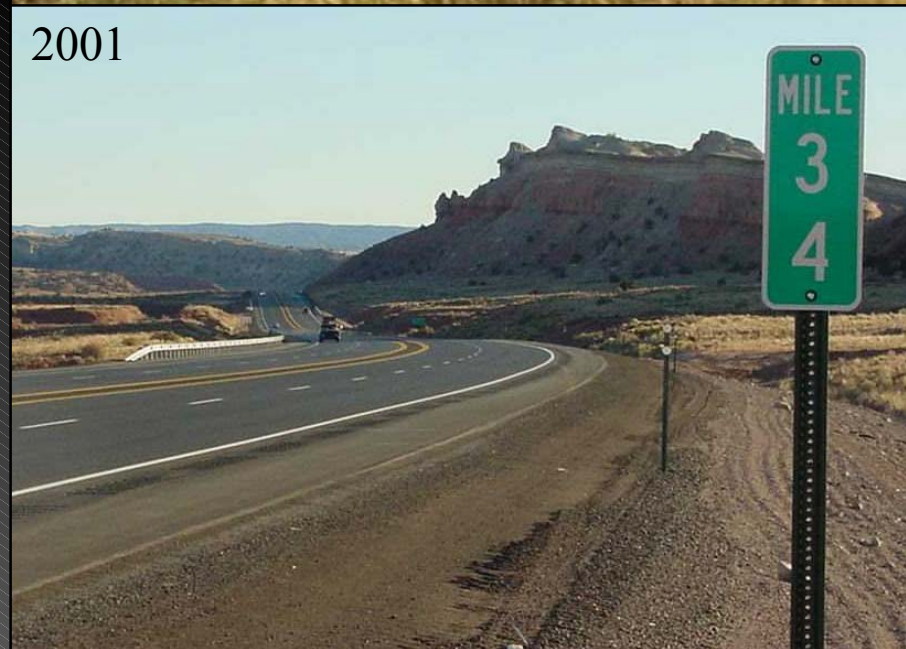
- update/employ area residents
- **single focal point w/NMSHTD**
- **“Eye on the Road” - 5000**
- **Web Site & ‘1-800’**



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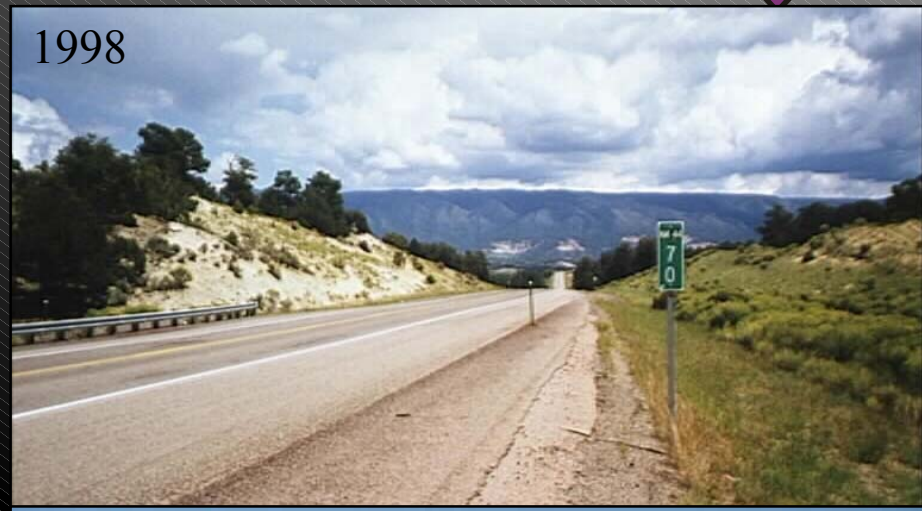

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- **replaced memorials**

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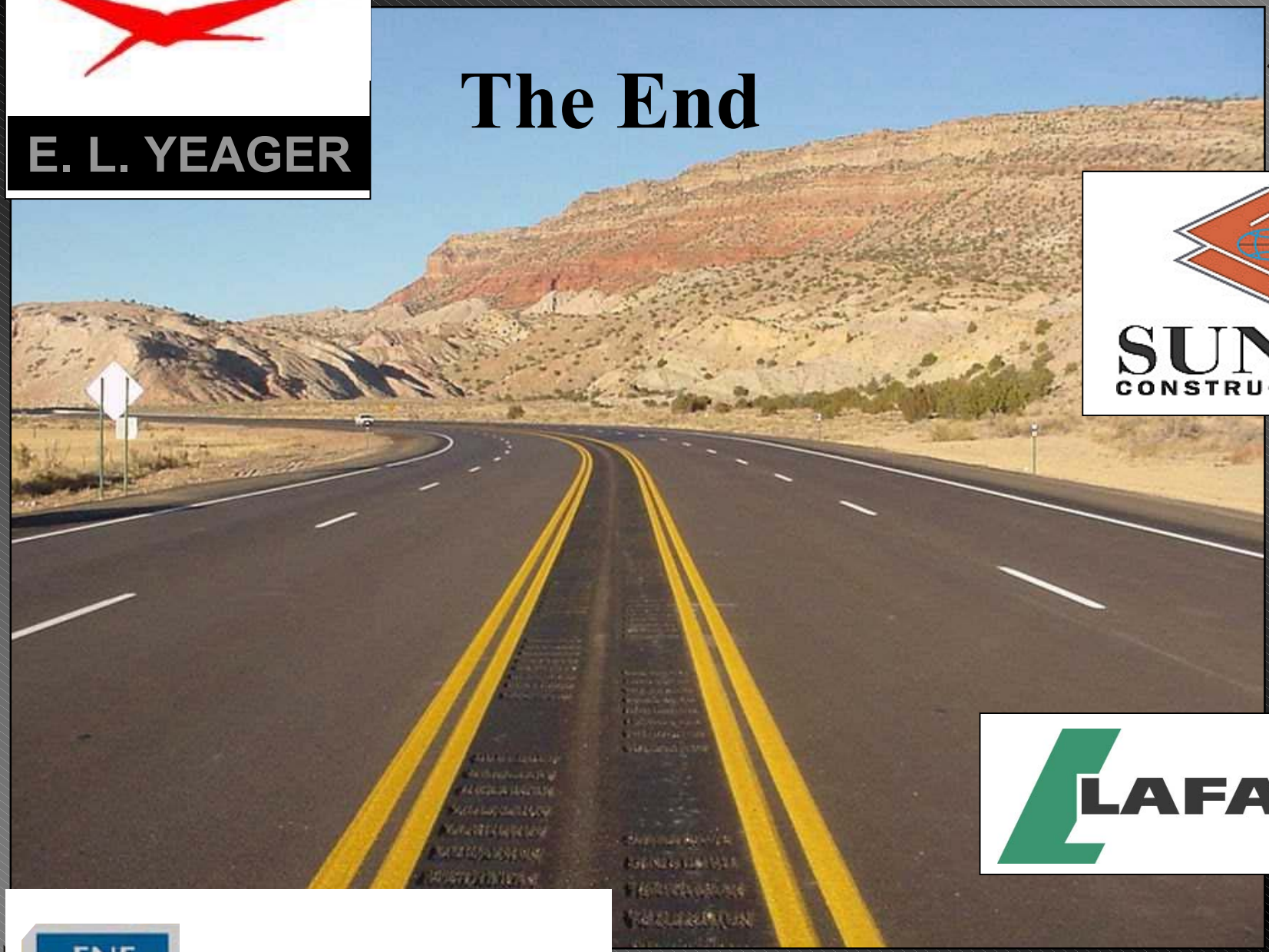
- single focal point w/NMSHTD
- “Eye on the Road” - 5000
- Web Site & ‘1-800’
- job forums
- training programs
- replaced memorials
- **ribbon-cutting**

Summary

- Reconstructed 118 miles
- June 4, 1999 to November 21, 2001
- Cost : $215 million
- 4 Warranty Segments (IRI : 51 - 65)



The End

E. L. YEAGER

44

SUNDT CONSTRUCTION INC.

LAFARGE

FNF CONSTRUCTION, INC.

Questions ??

550