



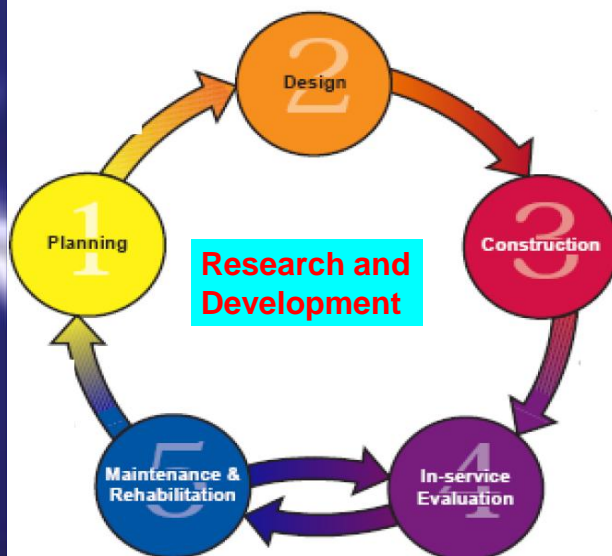
Driving Indiana's Economic Growth

Best Use of PMS Program Information

Samy Noureldin, INDOT R & D
Joyce Stone, INDOT Planning
William Flora, INDOT Planning

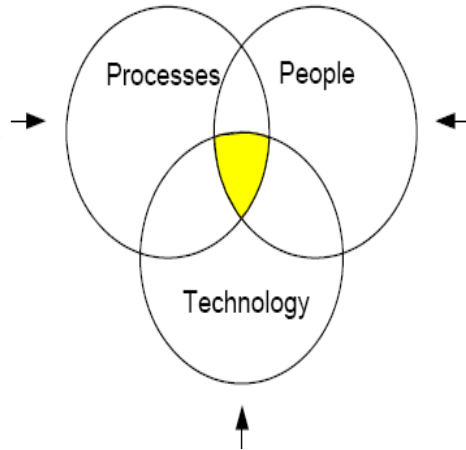


Asset (Pavement) Management Loop





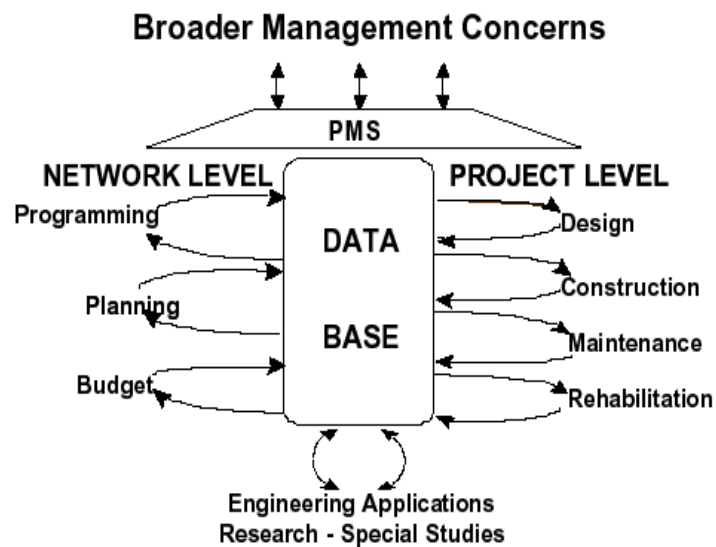
Overlap for Success



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Network Level vs Project Level

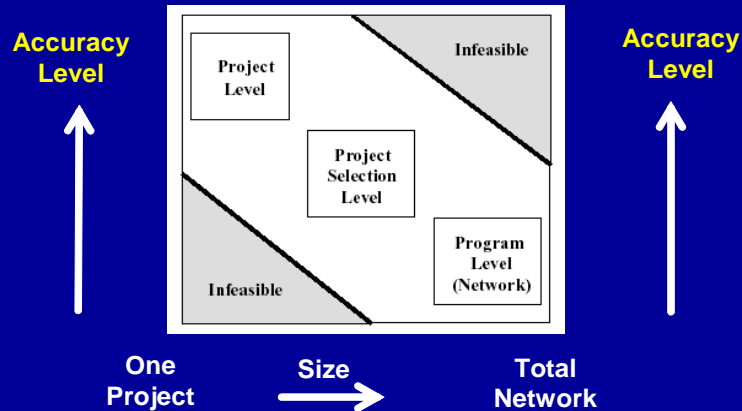


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Network Level vs Project Level

Data Quality



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Pavement Management Needed Items

- Inventory
- Condition assessment
- Trigger Values (Good-Fair-Poor Distribution)
- Performance prediction measures and trend indicators
- Pavement Treatment Mix of Fixes
- Cost estimates of options and resulting impacts
- Engineering/economic optimization tools

Pavement Management System Goals

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Pavement – Inventory

INDOT System Information

Route System	Lane Miles
All Routes	27,217
Interstates	4,261
Non – Interstates – NHS	5,154
Non – NHS	17, 802

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Pavement – Condition Assessment

- PSI and PSR
- PCI and PCR – Distress Index
- Rut Depth
- IRI
- PQI
- Friction Number/Skid Number
- Pavement Deflection
- Texture Depth (emerging)

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PSI and PSR

- Pavement Serviceability Index or Rating
- Panel of Experts
- Zero to 5
- AASHO Road Test – 1958 to 1961

ASTM E1927(2003)

Standard Guide for Conducting Subjective Pavement Ride Quality (Serviceability) Ratings

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PSI and PSR

HMA Surface

$$PSI = 5.03 - 1.9 \log (1 + SV) - 0.01 (C + P)^{0.5} - 1.38 (RD)^2$$

Concrete Surface

$$PSI = 5.41 - 1.8 \log (1 + SV) - 0.09 (C + P)^{0.5}$$

PSI = Present Serviceability Index (0-5)

SV = Slope Variance

C = Cracking Length in ft per 1000 ft² Area

P = Patching area in ft² per 1000 ft² Area

RD = Rut Depth in Inches

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INDOT PCR Distress Identification

COMPOSITE OR FLEXIBLE PAVEMENT RATING FORM				
TYPE:	Comp OR Flex:		SEVERITY	EXTENT
DATE:			0=GOOD	0=NONE
RATER:			1= LOW	1=OCCASIONAL
ROUTE TYPE:			2=MODERATE	2=FREQUENT
ROUTE NO.:			3=HIGH	3=EXTENSIVE
DIRECTION:			WEIGHTxSEVERITYxEXTENT=DEDUCT PTS.	
REF. MARKER:				
DISTRESSES	WTS	SEVERITY 1/2/3	EXTENT 1/2/3	DEDUCT POINTS
1 RAVELING	0.5			
2 PATCHING	1.0			
3 HOLES	1.0			
4 RANDOM/ALLIGATOR CRACKS	1.5			
5 TRANSVERSE/BLOCK CRACKS	2.5			
6 LONGITUDINAL JOINTS	1.5			
7 EDGE CRACKS	2.0			
8 WIDENING CRACKS	1.0			
9 PUMPING	1.0	Y OR N	Y=5, N=0	
10 MAINTENANCE PERFORMED	1.0	Y OR N	Y=3, N=0	
TOTAL DEDUCTS				
100 - DEDUCTS = PCR				

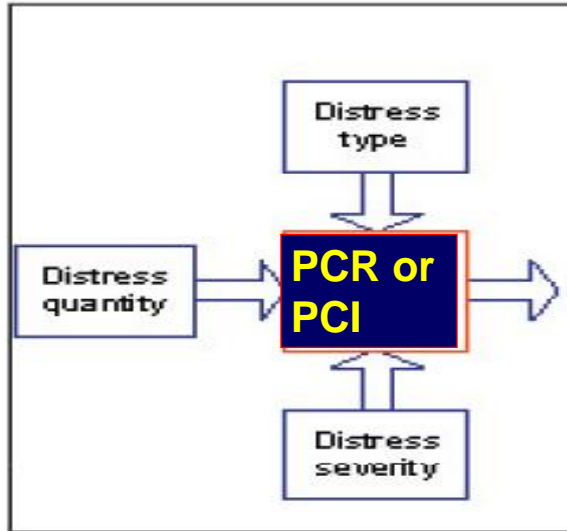


INDOT PCR Distress Identification

JOINTED CONCRETE PAVEMENT, JCP RATING FORM				
TYPE:	JCP		SEVERITY	EXTENT
DATE:			0=GOOD	0=NONE
RATER:			1= LOW	1=OCCASIONAL
ROUTE TYPE:			2=MODERATE	2=FREQUENT
ROUTE NO.:			3=HIGH	3=EXTENSIVE
DIRECTION:			WEIGHTxSEVERITYxEXTENT=DEDUCT PTS.	
REF. MARKER:				
DISTRESSES	WTS	SEVERITY 1/2/3	EXTENT 1/2/3	DEDUCT POINTS
1 D-CRACKS	1.0			
2 PATCHING	1.0			
3 FAULTING	1.5			
4 JOINT or CRACK SPALLS	1.5			
5 TRANSVERSE CRACKS	1.0			
6 LONGITUDINAL CRACKS	0.5			
7 CORNER BREAKS	1.0			
8 PUMPING	1.0	Y OR N	Y=5, N=0	
9 MAINTENANCE PERFORMED	1.0	Y OR N	Y=3, N=0	
TOTAL DEDUCTS				
100 - DEDUCTS = PCR				

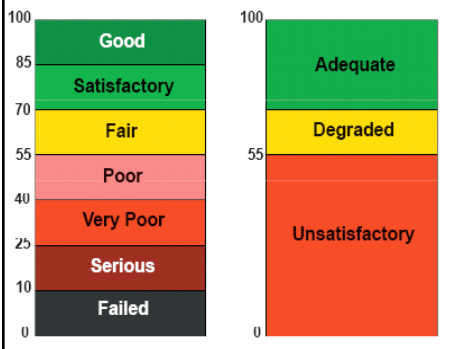


PCI and PCR

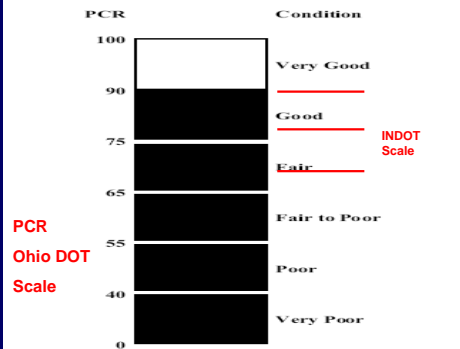


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PCI

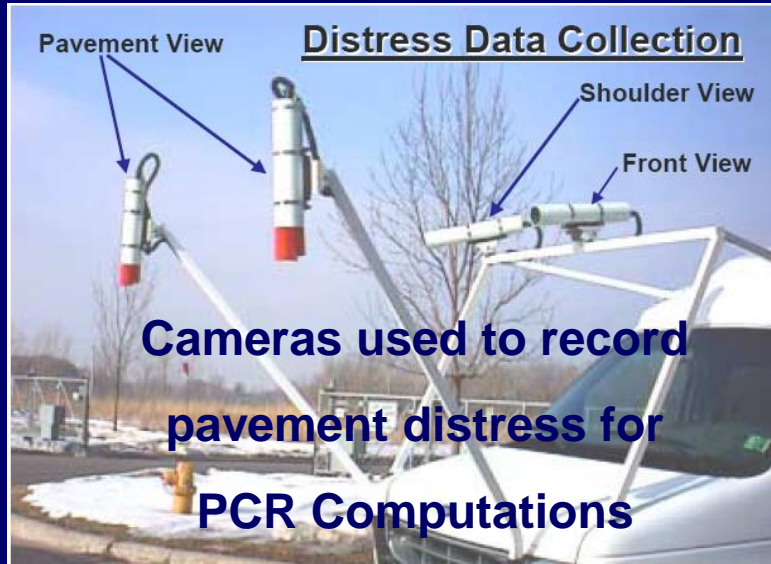


PCR





Network Level PCR



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Network Level IRI, Rut Depth and Faulting



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Network Level Friction Number



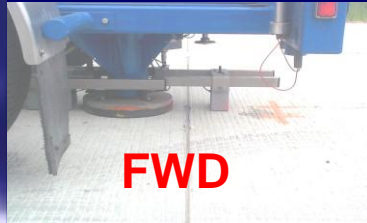
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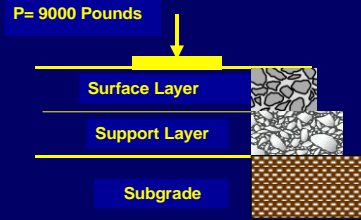
Falling Weight Deflectometer



Project Level Pavement Deflection



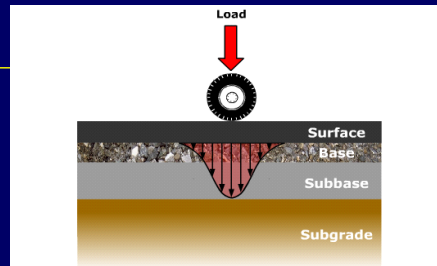
FWD



D2	D1	D3	D4	D5	D6	D7	D8	D9
-12	0	8	12	18	24	36	48	60



Network Level?



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Project Level Pavement Deflection

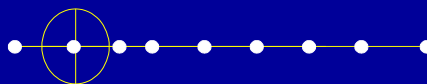
FWD Standard Tests

AASHTO T - 256
ASTM D 4694

9000 Pounds 68 F



D2	D1	D3	D4	D5	D6	D7	D8	D9
-12	0	8	12	18	24	36	48	60



FWD

Deflection Basin is Dependent Upon Thickness & Material Properties

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Trigger Values

Pavement Condition Rating (**PCR**)

Condition	PCR
Excellent	90 – 100
Good	80 – 90
Fair	70 – 80
Poor	< 70

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Trigger Values

Ride Quality (**IRI**) and Serviceability (**PSI**)

Condition	IRI (in/mile)	IRI (mm/m)	PSI
Excellent	< 60	< 1	>4.0
Very Good	60 – 100	1 – 1.6	3.5 – 4.0
Good	100 – 150	1.6 – 2.4	3.0 – 3.5
Fair	150 – 200	2.4 – 3.2	2.5 – 3.0
Poor	> 200	>3.2	< 2.5

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Trigger Values

Pavement Quality Index (PQI)

$$PQI = 10 PSI + 0.5 PCR - 25 \text{ Rut Depth}$$

Condition	PQI
Excellent	90 – 100
Good	80 – 90
Fair	70 – 80
Poor	< 70

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Trigger Values

Pavement Surface Skid Resistance

- 40 mph, Smooth Tire, Wet Pavement Surface

Condition	Friction Number
Excellent	>40
Very Good	35 – 40
Good	25 – 35
Fair	20 – 25
Poor	< 20

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Trigger Values

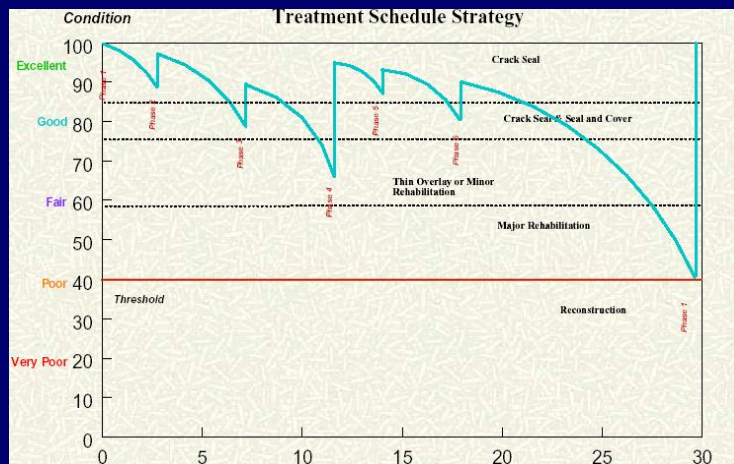
Pavement Deflection

Center Deflection in mils , 9000 Pounds (40 KN), 68 F (20 C)

	Interstates	Heavy Traffic	Medium Traffic	Light Traffic
Excellent	< 4	< 5	< 6	< 8
Very Good	4 – 6	5 – 7	6 – 8	8 – 10
Good	6 – 8	7 – 9	8 – 10	10 – 12
Fair	8 – 10	9 – 11	10 – 12	12 – 14
Poor	>10	>11	>12	>14
ESALs, Millions	> 30	10 – 30	3 – 10	< 3



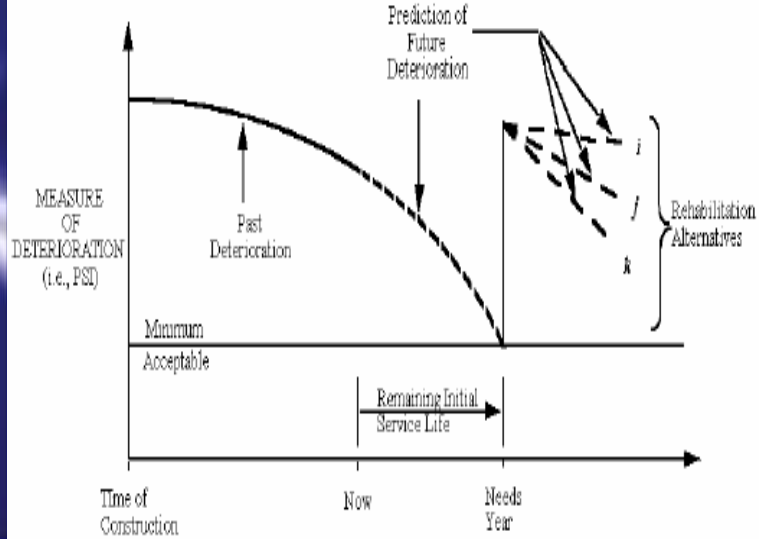
Performance Prediction – PCR Preservation- Rehabilitation



Remaining Life, Years (or in Terms of ESALs)



Performance Prediction – PCR Rehabilitation

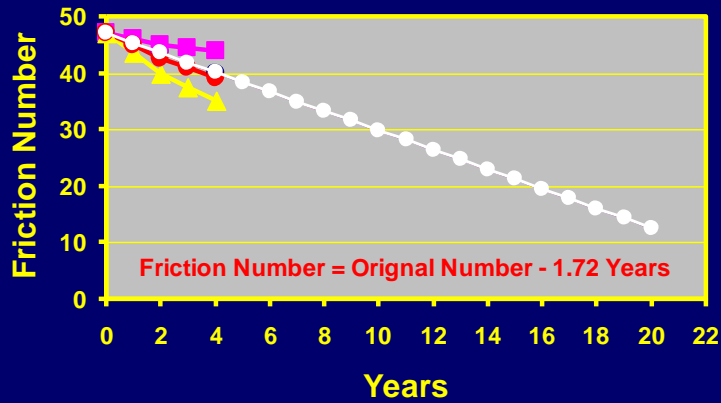


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Performance Prediction – FN/SN Preservation

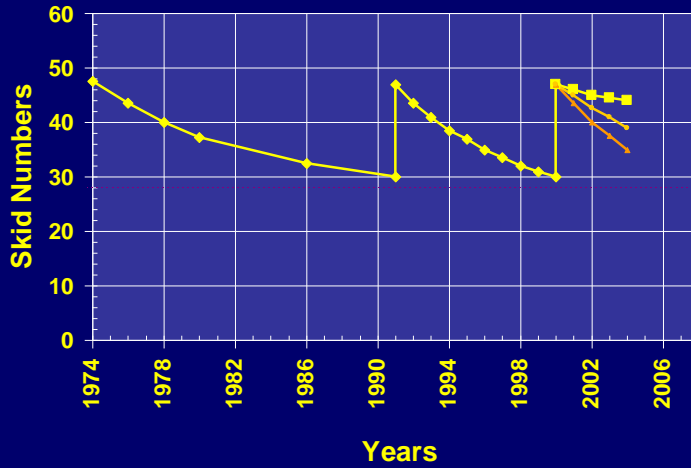
Friction Performance



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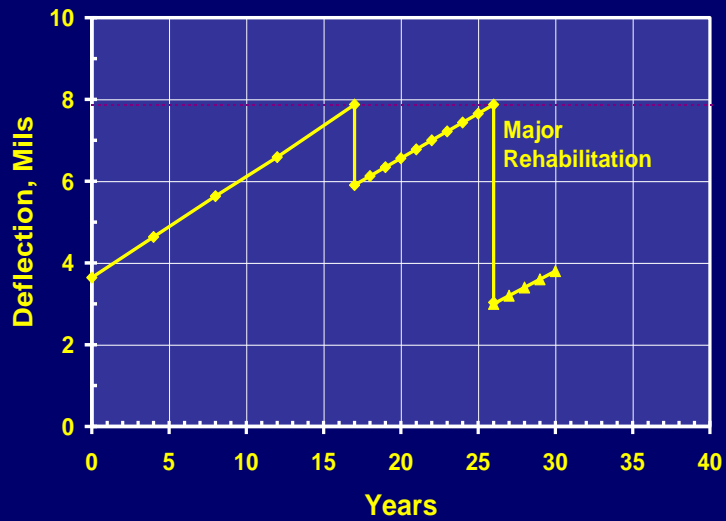
Performance Prediction – FN/SN Preservation



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Performance Prediction – Deflection Rehabilitation



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Pavement Treatment Mix of Fixes

Preservation/Rehabilitation

Condition	IRI	PSI	Rutting	PCR	PQI	Deflection	Friction	Texture	Treatment
1	Good	Good	Good	Good	Good	Good	Good	Good	None
2									
3				Fair					
4								Poor	
5									
6									

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Pavement Treatment Mix of Fixes

Preservation

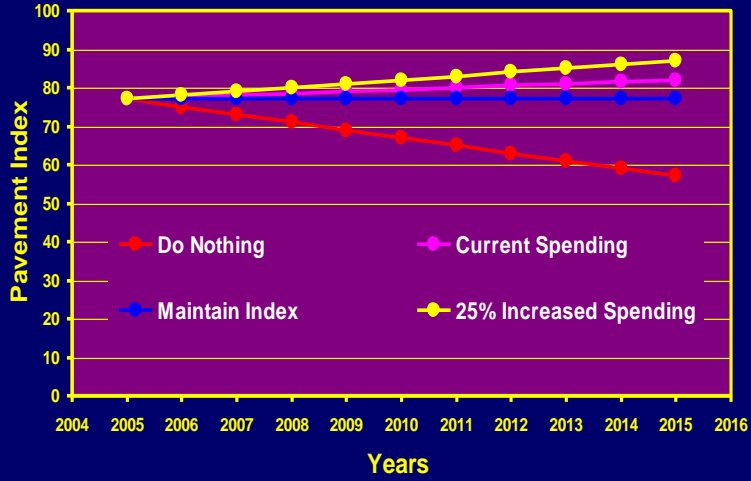
Condition	Structural Cracks	Functional Cracks	Reflection Cracks	PCR	Treatment
1	Good	Good	Good	Good	None
2					
3				Fair	
4					
5			Poor		
6					

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Network Impact

Budget Planning



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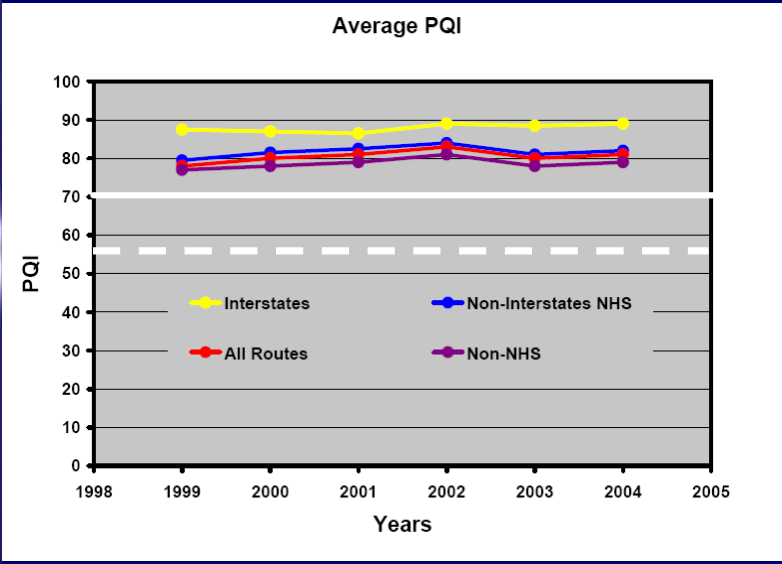
PMS GOALS – PQI

Route System	Goal PQI	Goal Lane Miles <70	2004 PQI	2004 Lane Miles <70
All Routes	>75	<10%	79	11%
Interstates	>80	<10%	88	1%
Non-Interstate NHS	>75	<10%	79	9%
Non-NHS	>75	<10%	77	13%

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PMS GOALS – PQI



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Ohio DOT PMS Goals

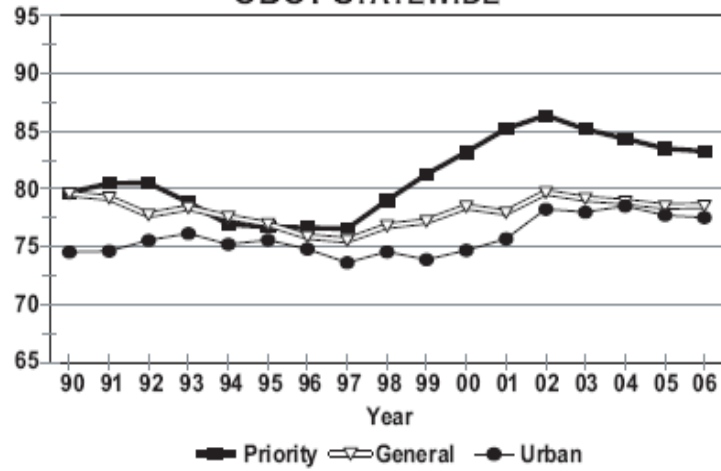
DISTRICT PAVEMENT GOALS			
System	FY 2004	FY 2006	FY 2008
Priority > 65 PCR	91%	90.5%	90%
General > 55 PCR	93%	91.5%	90%
Urban > 55 PCR	93%	92%	90%

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Ohio DOT PMS Goals

WEIGHTED AVERAGE PCR
ODOT STATEWIDE



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