Pavement Management Index Values – Development of a National Standard

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Background

- NCHRP 20-74A Development of Service Levels for the Interstate Highway System
- Develop level-of-service measures for Interstate pavements
  - Functional Measure
  - Structural Measure
- Goal was to use existing data
- Three Pilot States

Objective of the Study

- Asses whether a uniform national pavement rating could be extrapolated from existing pavement management data for Interstate Highways
- Identify how each of the pilot states measure and report pavement distress data and determine how this data is used as an indication of pavement performance

Pavement Performance Measures Considered

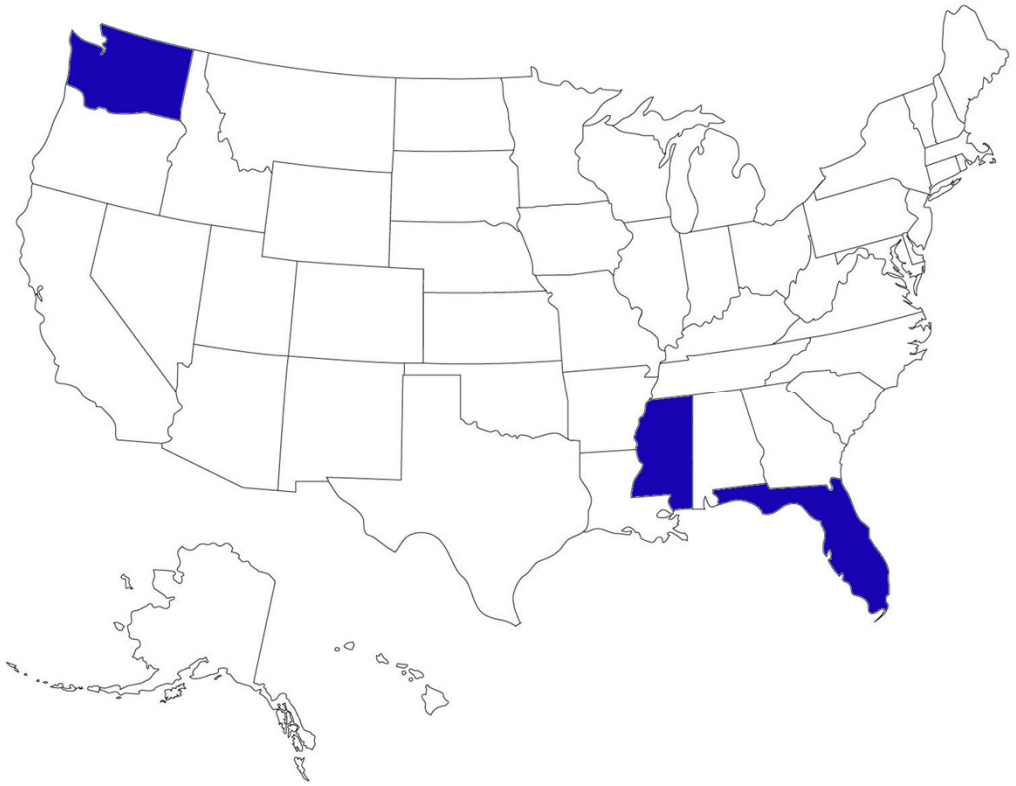
- Functional Considerations
  - Roughness
  - Rutting
  - Friction
- Structural Considerations
  - Pavement Distress*
  - Pavement Stiffness

Pavement Performance Measures Recommended

- Functional Measure
  - Mean International Roughness Index
- Structural Measure
  - Single distress index value?
  - Equivalent measures of fatigue type distress

Pilot States

- Florida
- Mississippi
- Washington



Agency Index Values

- Florida
  - Cracking Rating (CR)
- Mississippi
  - Pavement Condition Rating (PCR)
- Washington
  - Pavement Structural Condition (PSC)

Florida Crack Rating Details

- Consider 3 categories of cracking
- Report only significant cracking
  - Engineering judgment
  - Does not include isolated areas of cracking
- Cracking is reported in categories for location, severity and extent

Florida Distress Definitions

- Class 1B
  - Hairline cracks < 1/8”, longitudinal or transverse (L&T)
- Class II
  - Cracks > 1/8” but < ¼”, L&T, may have moderate spalling or branching
  - Includes cracks with cells less than 2’, (e.g. alligator cracking)
- Class III
  - Cracks > ¼”, open, L&T, progressive Class II, ravelling, patching

Florida Distress Reporting

Percent of Pavement Area Affected by Cracking	Confined to Wheel Paths (CW)					
	Predominate Cracking Class					
	1B Cracking		*II Cracking*		*III Cracking*	
	Code	Deduct	Code	Deduct	Code	Deduct
00 -- 05	A	0	E	0.5	I	1
06 -- 25	B	1	F	2	J	2.5
26 -- 50	C	2	G	3	K	4.5
51+	D	3.5	H	5	L	7

- Notes:
  - Cracking classes cannot be combined. Only the predominate type of cracking is coded
  - Total percent of cracking (all severity levels combined) is coded in the majority of predominate cracking severity category.

- Example: 1B=10%, II=6%, III=6%, Total=22% predominate is class 1B in the 6-25% category (code B)

Florida Crack Rating Determination

- Crack Rating (CR)
  - Scale from 0 to 10
  - CR = 10 indicates a pavement with little or no observable distress
- CR = 10 – (CW + CO)
- Example:
  - CW – Code B = 1
  - CO – Code G = 1.5
  - CR = 10 – (1+1.5) = 7.5

Mississippi Distress Rating Details

- Evaluate distresses based upon LTPP Distress Manual
  - Minor modifications

Distress Type	Severity Levels	Type of Measurement
Longitudinal Cracking	Low, Medium, High	Length (ft.)
Transverse Cracking	Low, Medium, High	Length (ft.)
Patching	Low, Medium, High	Area (sq. ft.)
Fatigue (Alligator) Cracking	Low, Medium, High	Area (sq. ft.)
Block Cracking	Low, Medium, High	Area (sq. ft.)
Edge Cracking	Low, Medium, High	Length (ft.)
Potholes	Low	Quantity (count)
Raveling	Low, Medium, High	Area (sq. ft.)
Bleeding	Low, Medium, High	Area (sq. ft.)

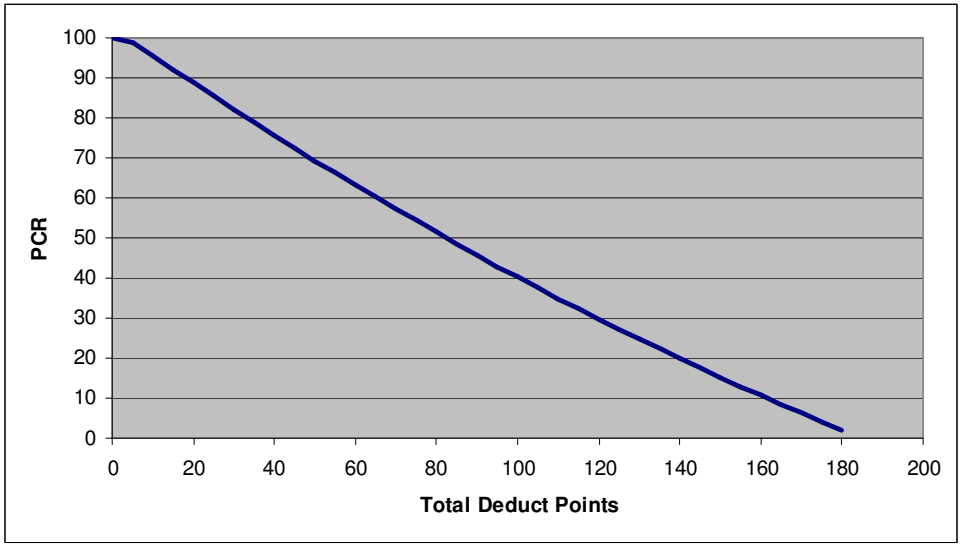
Mississippi PCR Calculations

Distress Description	Severity Level	Deduct Point (DP) Factor	Pavement Type
Fatigue (Alligator) Cracking	0	0.4	FLEX
Fatigue (Alligator) Cracking	1	0.5	FLEX
Fatigue (Alligator) Cracking	2	0.6	FLEX
Block Cracking	0	0.16	FLEX
Block Cracking	1	0.25	FLEX
Block Cracking	2	0.34	FLEX
Longitudinal Cracking	0	0.3	FLEX
Longitudinal Cracking	1	0.65	FLEX
Longitudinal Cracking	2	1.0909	FLEX
Transverse Cracking Low	0	0.4348	FLEX
Transverse Cracking Medium	1	1.444	FLEX
Transverse Cracking High	2	1.7	FLEX

- Density based deductions
- Multiply density by DP

Mississippi Pavement Condition Rating

- Pavement Condition Rating (PCR)
  - Scale from 0 to 100
- Flexible Pavements:
  - Sum all deduct points for every distress type and severity to determine the total deduct points (TDP)
  - PCR = $(0.0008*TDP^2)-(0.7022*TDP)+102.48$



Washington Distress Rating Details

Distress Type	Severity Levels	Used in Index Calculations
Rutting & Wear	L, M, H	Yes
Alligator Cracking	L, M, H	Yes
Longitudinal Cracking	L, M, H	Yes
Transverse Cracking	L, M, H,	Yes
Raveling	L, M, H	No
Flushing	L, M, H	No
Patching	L, M, H	Yes
Corrugation & Waves	L, M, H	No
Sags & Humps	L, M, H	No
Block Cracking	L, M, H	No
Pavement Edge Condition	N/A	No

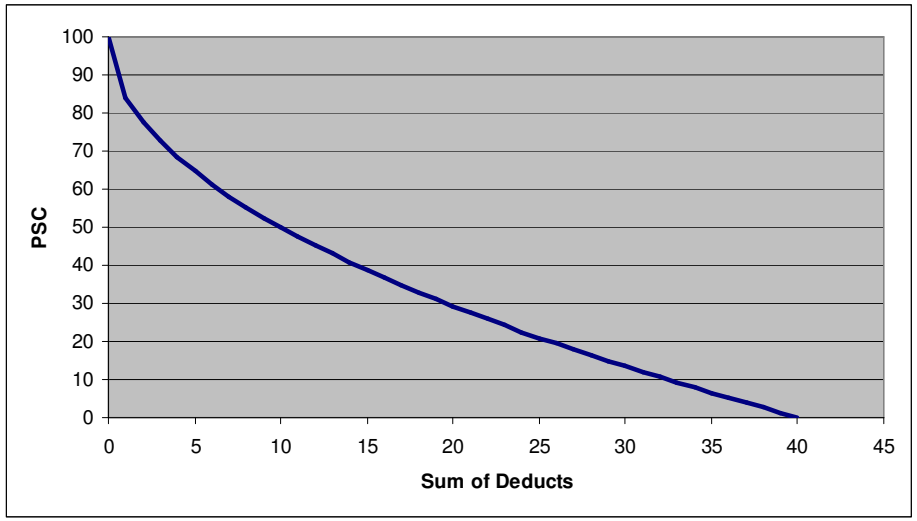
Washington PCR Calculations

Distress	Type Coefficient	Coefficient	Power
% Length Patching High (max = 28.5%)	0.75	1	1
% Length Patching Med (max = 16.5%)	0.75	0.445	1.15
% Length Patching Low (max = 8.1%)	0.75	0.13	1.35
% Both Wheel Paths of Alligator Cracking High	1	1	1
% Both Wheel Paths of Alligator Cracking Med	1	0.445	1.15
% Both Wheel Paths of Alligator Cracking Low	1	0.13	1.35
% Length Transverse Cracking High	0.8	1	1
% Length Transverse Cracking Med	0.8	0.445	1.15
% Length Transverse Cracking Low	0.8	0.13	1.35
% Length Longitudinal Cracking High	0.1	1	1
% Length Longitudinal Cracking Med	0.1	0.445	1.15
% Length Longitudinal Cracking Low	0.1	0.13	1.35

- Sum Deducts (SD) =
  (Type Coefficient*(Coefficient*%Distress)^Power)

Washington Pavement Structural Condition

- Pavement Structural Condition (PSC)
  - Scale from 0 to 100
  - Combination of alligator, long, trans cracking and patching
- Flexible Pavements:
  - PSC = 100 – 15.8 *(SD^0.5)



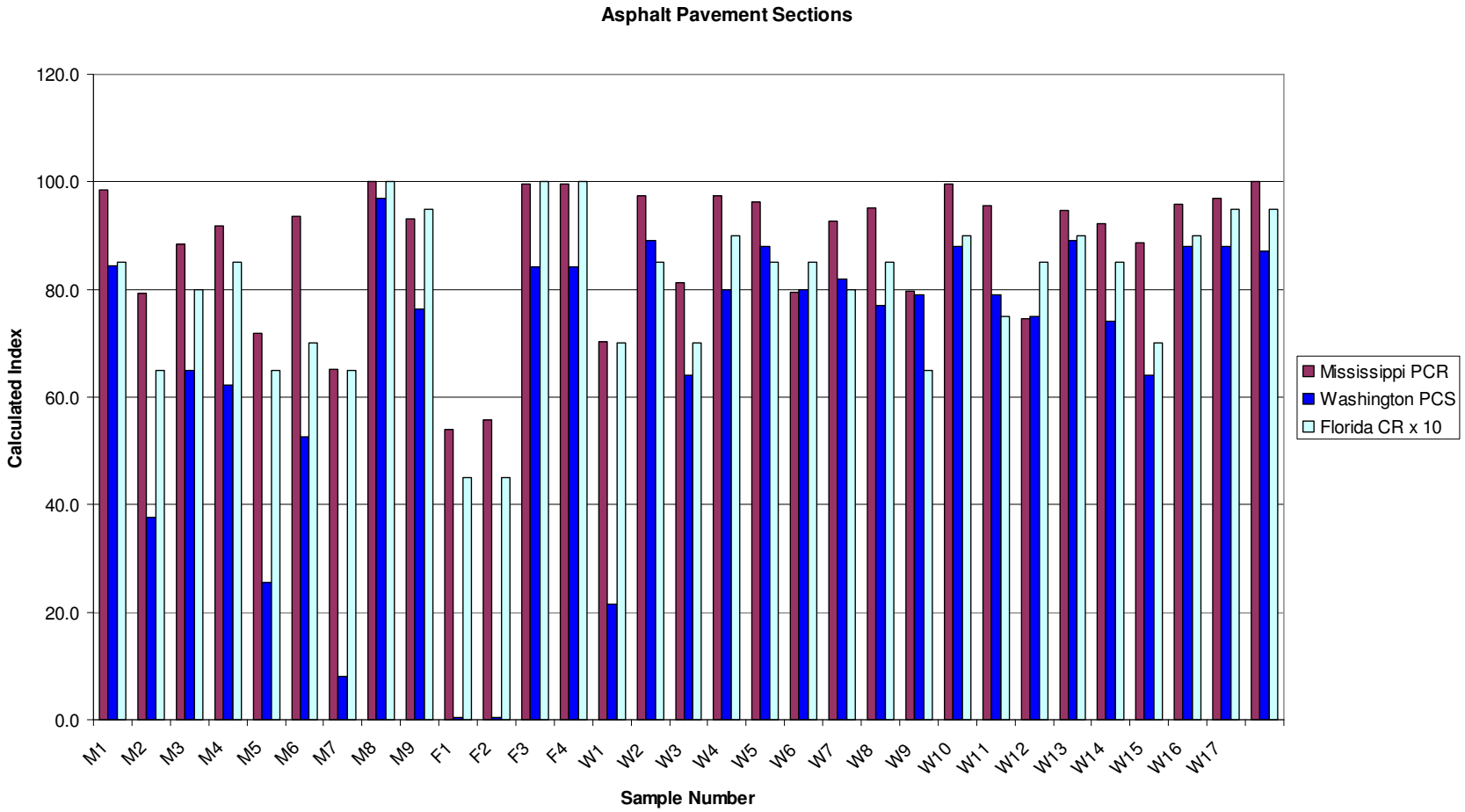
Summary of Agency Variations

- Florida
  - Reports significant cracking only at most prominent severity
  - Quantity is reported in categories
  - Index is 0 to 10 basis
- Mississippi
  - Reports detailed type, severity and quantity
  - Distress density/deduct based
  - Index is 0 to 100 basis
- Washington
  - Reports detailed type, severity and quantity
  - Distress density/deduct based
  - Index is 0 to 100 basis

Agency Index Comparisons

- Used sample data from each agency to calculate other agency index values
  - Sample of 40 miles of Interstate data
- Several assumptions made to allow for transfer of data between systems
  - Maximum area for Florida
  - Engineering judgment
  - Florida CR increased by factor of 10

Asphalt Pavement Sections



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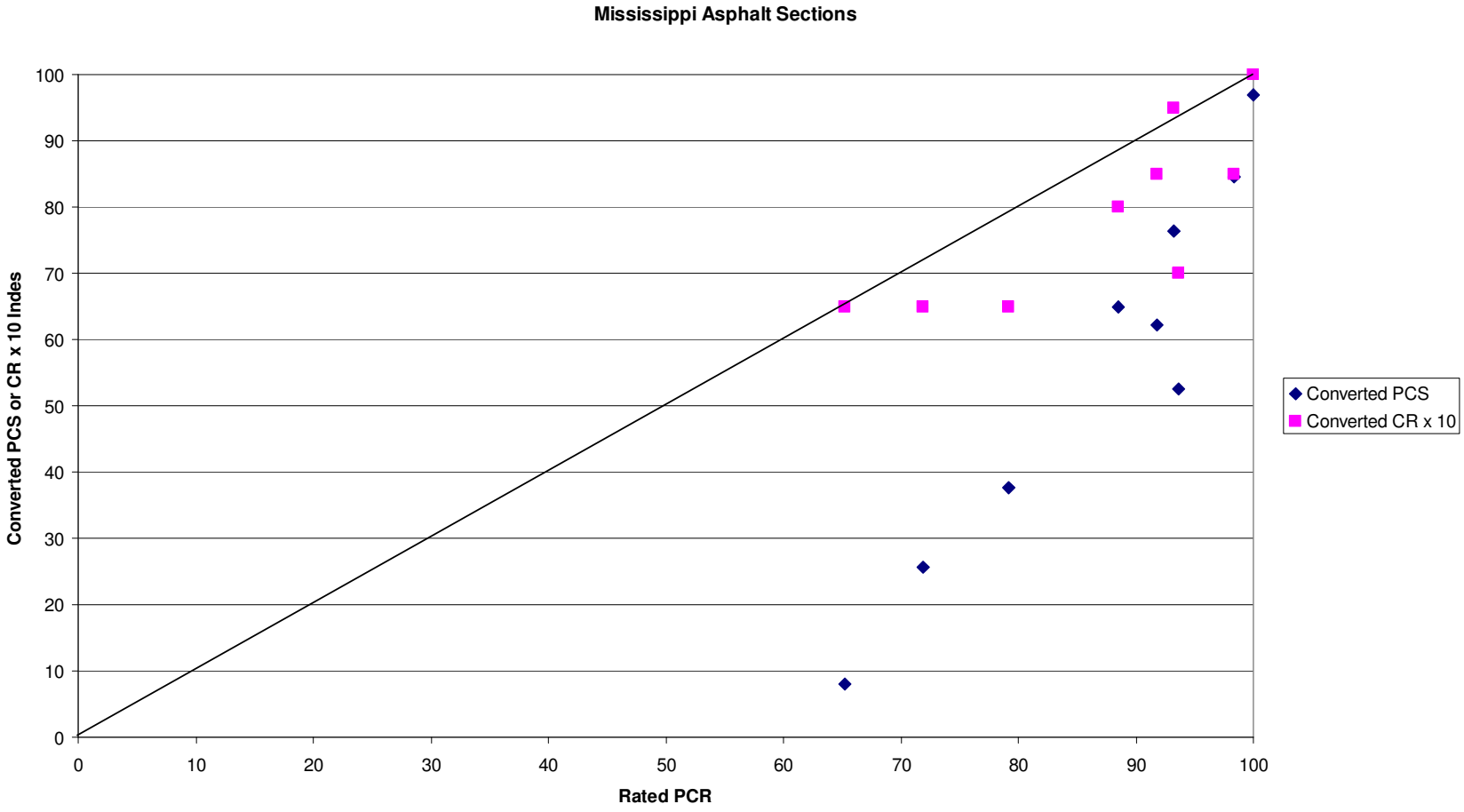
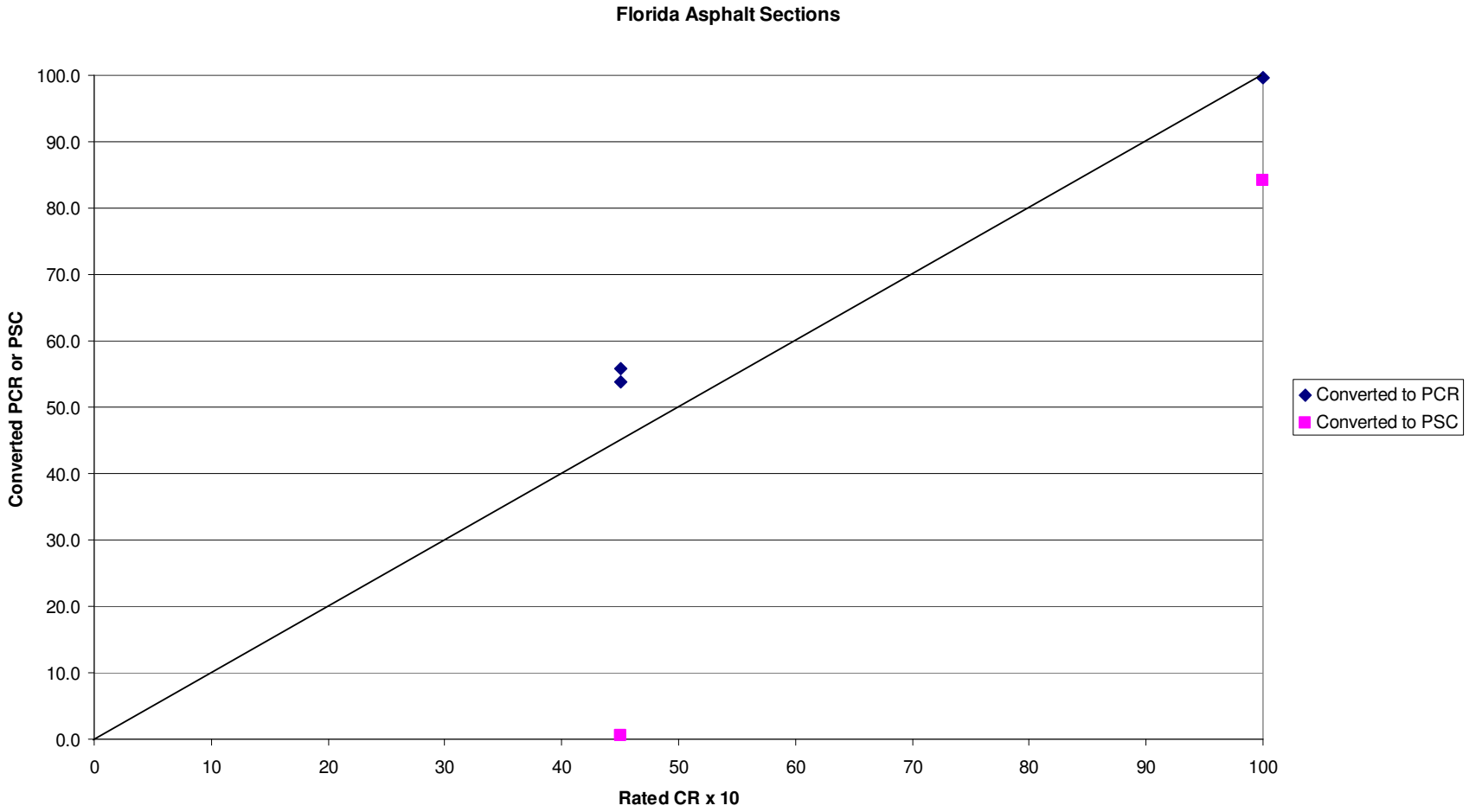
Mississippi Data



Florida Data



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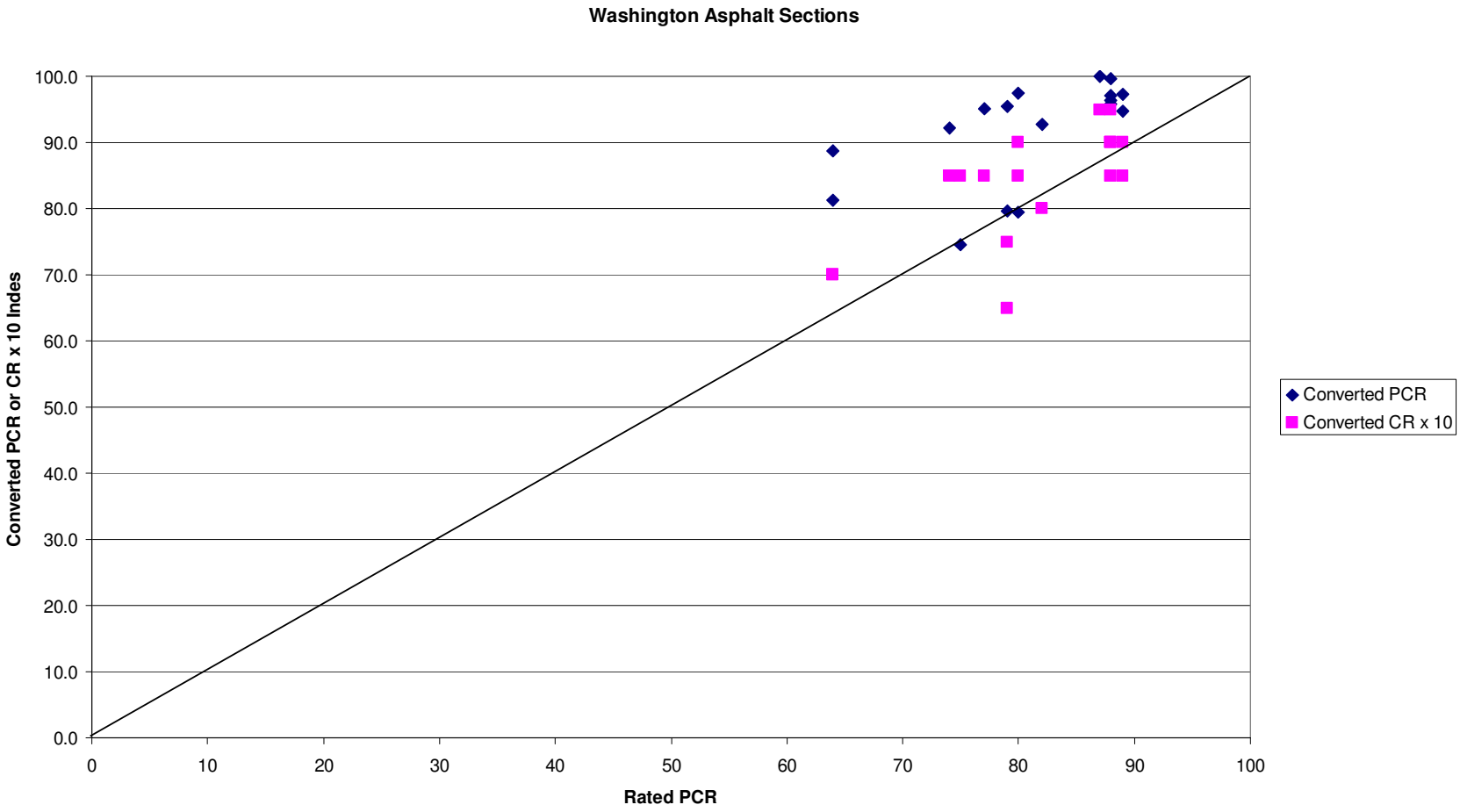
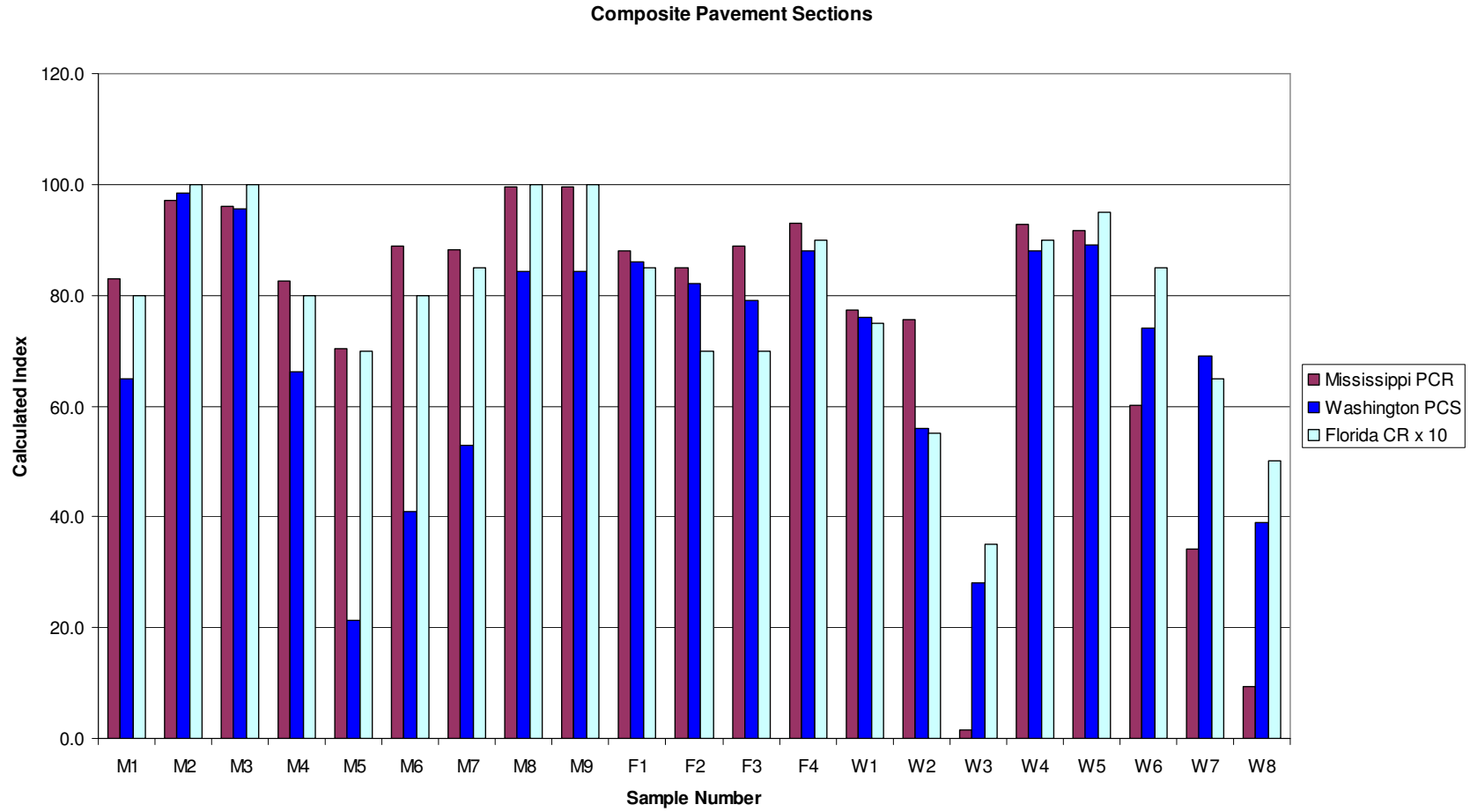
Washington Data



Composite Pavement Sections



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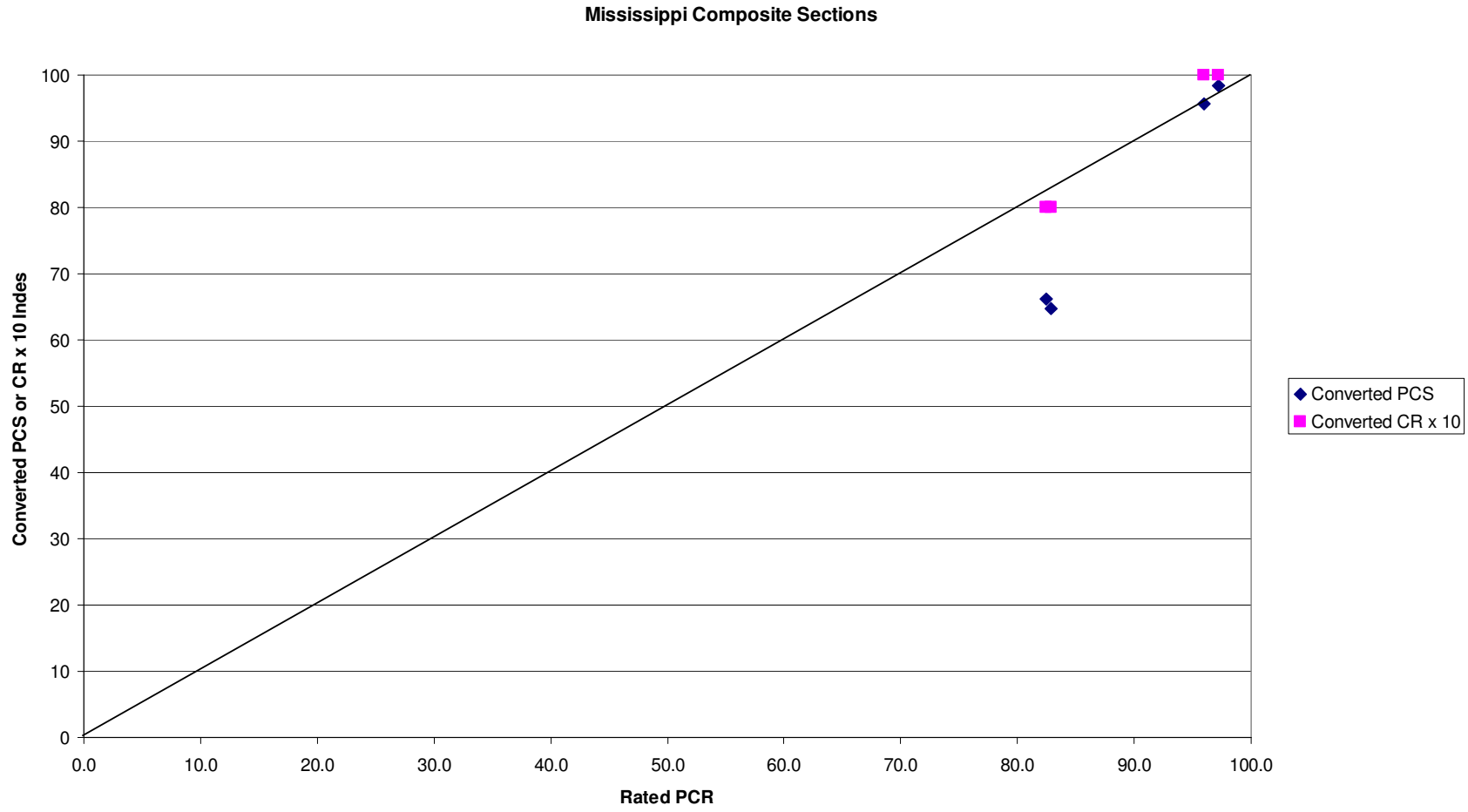
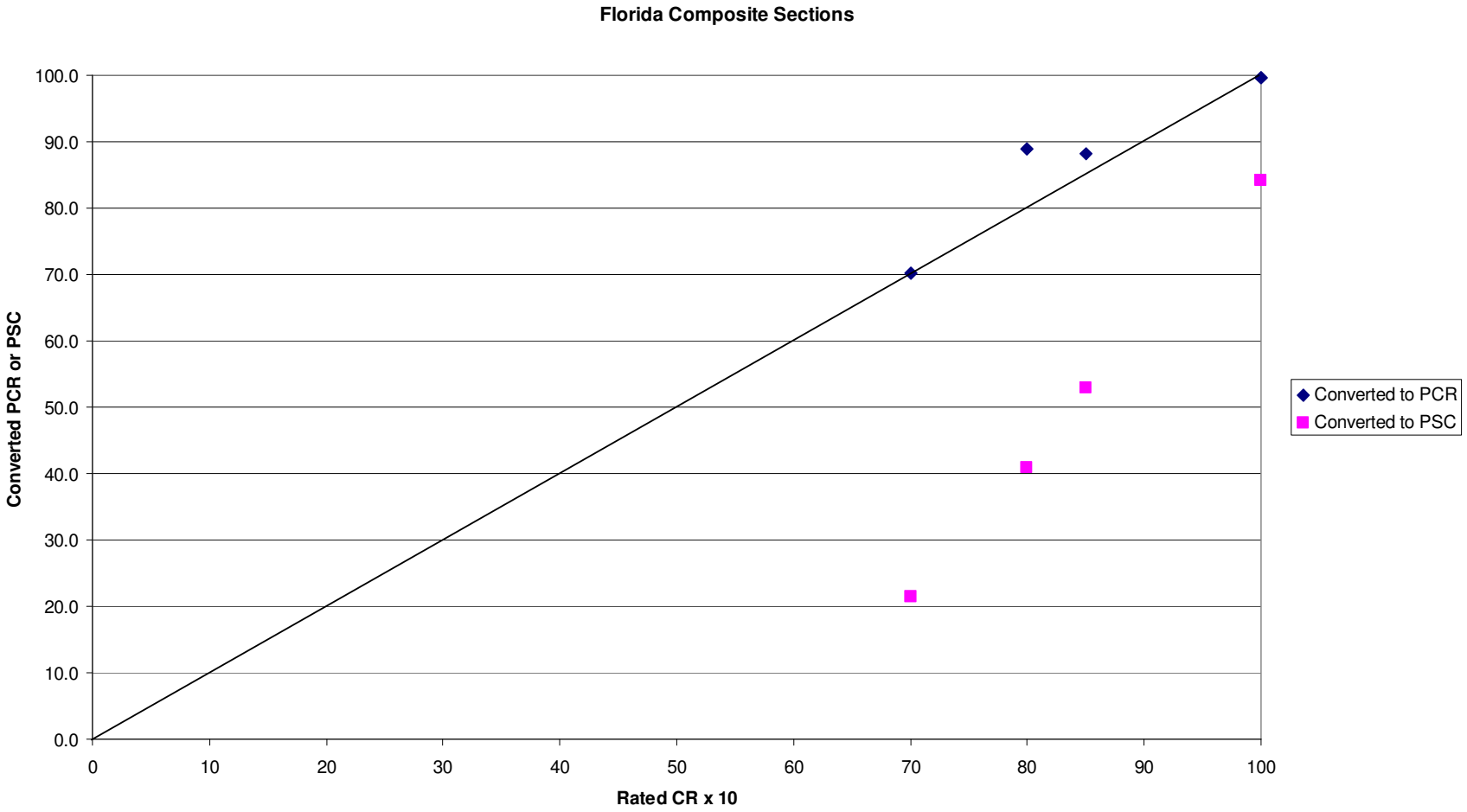


Florida Data



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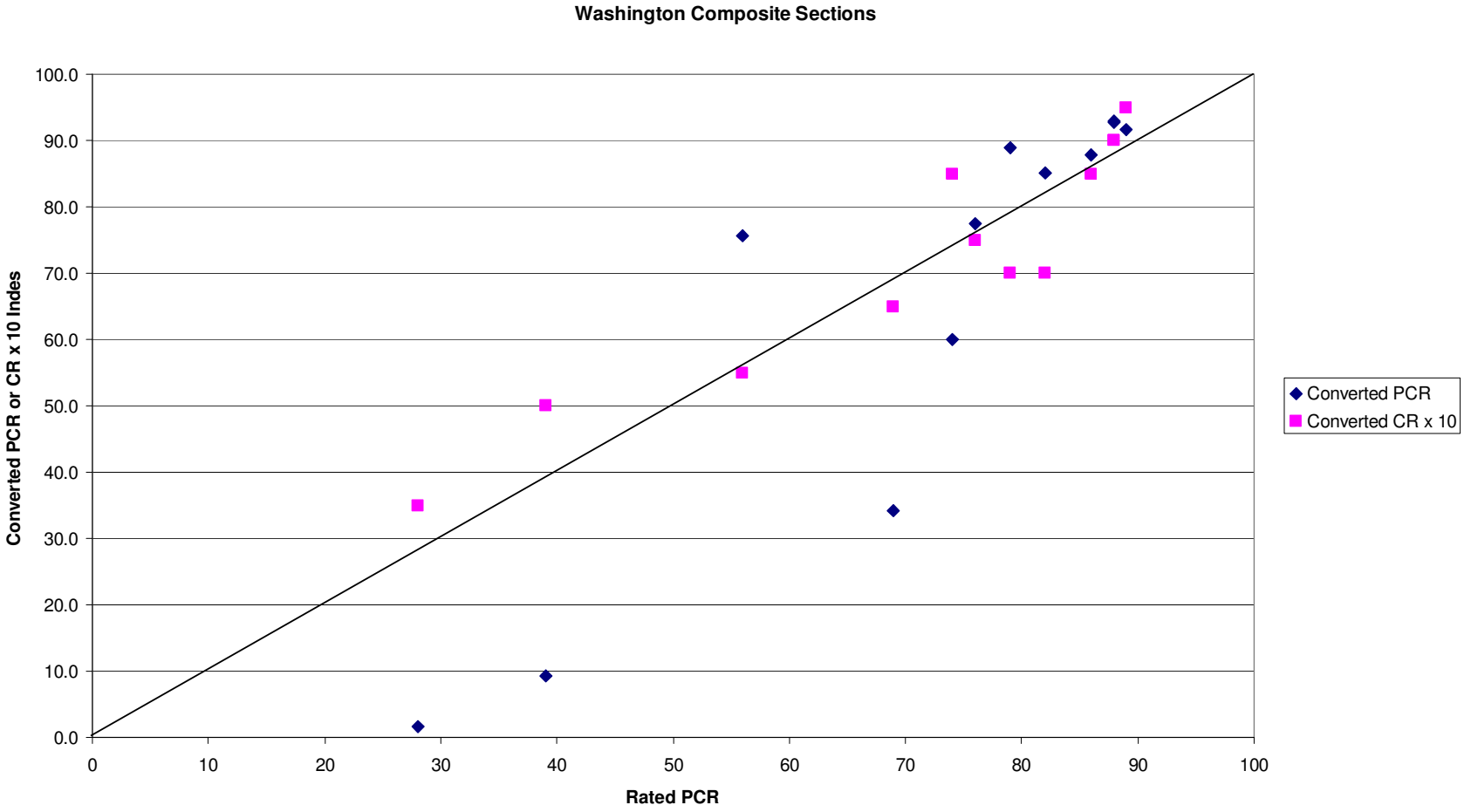

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Summary of Comparisons

- None of the three index values are fully compatible
  - Difference in definitions
    - Type & severity
  - Difference in reporting
    - Actual quantities
  - Difference in performance concerns
- Does not allow for development of a consistent national LOS measure
- For national LOS, must simplify and standardize the distress types and severity levels used

Development of National Standard

- HPMS 2010+ Requirements
  - Rutting – average rutting to nearest 0.1 inch
  - Faulting – average fault depth to nearest 0.1 inch
  - Fatigue cracking - % area with “fatigue type” cracking to nearest 5%
  - Transverse cracking - length in feet per mile of the transverse cracking to the nearest foot
- Agency provides an indication of the basis for their distress measures

Conclusions

- Data collection methods and frequency vary by agency
- Distress definitions and reporting requirements vary significantly by agency
- Distress data is not interchangeable between agency index value computations
- The HPMS 2010+ distress data requirements remain too subjective to provide comparable distress data
- The development of a national pavement condition index will require specific distress data collection protocols to establish data uniformity among states
- Comparison of functional pavement performance indicators can be readily adapted from information currently maintained in state agency pavement management systems

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- Thank You

- Questions?