

QA/QC

Washington State Experience

**National Pavement Management Conference
Norfolk, Virginia
May 6-9, 2007**





Presentation Outline

- Introduction
- Pavement Condition Data
- Performance Curves
- Region Acceptance



Pavement Management System

- Pavement condition assessment was required by law in the late 1960's
- Pavement management system has developed over the years by in-house pavement management staff
 - Software
 - Pavement condition data collection
- QC/QA process conducted by in-house staff



Pavement Condition Data

- WSDOT maintains ~ 18,000 lane miles
- Annual pavement condition survey
 - 100 percent of the pavement surface in the survey lane (10,000 lane miles)
 - Rutting/wear
 - Faulting
 - Roughness (IRI)
 - Pavement Structural Condition (PSC)
 - Flexible pavements - longitudinal cracking, alligator cracking, transverse cracking, raveling, flushing and patching
 - Rigid Pavements – panel cracking, joint and crack spalling, pumping or blowing, faulting or settlement, patching, raveling or scaling
 - Skid resistance (half of state collected each year)



Automated Survey Process

- Adopted in 1999
- Pathway Services, Inc.
 - PathRunner automated data collection vehicle
- Conducted July – October
- Collected at posted speed (< 65 mph)
- Digital images of pavement surface, front and right shoulder images are collected
- Longitudinal and transverse profile data collected at the same time

Automated Survey Process





Automated Survey Process

- Digital images played back at slow speeds (2-5 mph) on special workstations
- Trained crews identify distress types and severity
- Location and extent of the distresses are tracked by computer
- Profile data automatically analyzed for rutting, wear, joint and crack faulting and IRI

Automated Survey Process

The screenshot shows a software interface for an automated survey process. The main window is titled "Distress Features Input" and contains a grid of feature types. A blue arrow points from this window to the "Distress Features Database" window, which displays a table of recorded features. Below the database table is the "PathView II, Road Condition Information System" window, which displays a table of road segments.

Alig Low	Alig Med	Alig High	Long Low	Long Med	Long High
Transv Low	Transv Med	Transv High	ChipSealPatch	Blade Patch	DagOut Patch
RavLocal	RavWheel	RavEntire	FlushLocal	FlushWheel	FlushEntire
Alig Low	Alig Med	Alig High	Long Low	Long Med	Long High
PCCPCrk Low	PCCPCrk Med	PCCPCrk High	Spall Low	Spall Med	Spall High
Pumping Low	Pumping Med	Pumping High	PCPatchLow	PCPatchMed	PCPatchHigh
PCRAvelLow	PCRAvelMed	PCRAvelHigh	PCCPNoDis	No Distress	UnFlatable
Bridge	Construction	45	46	47	48
49	50				

Num	Name	Severity	Location	Seal	Width	Length	Pvm	Set	Start Image	End Image	Dist	Start La	Start Lo
250	No Distr	Low	CEN	No	0.0	0.0	-	101	00:17:20:09	00:17:20:09	0	46.633790	000000
251	No Distr	Low	CEN	No	0.0	0.0	-	101	00:17:30:21	00:17:30:21	0	46.634360	000000
252	Transv L	Low	CEN	No	0.0	0.0	-	101	00:17:32:20	00:17:32:20	0	46.634360	000000
253	No Distr	Low	CEN	No	0.0	0.0	-	101	00:17:51:13	00:17:51:13	0	46.633380	000000

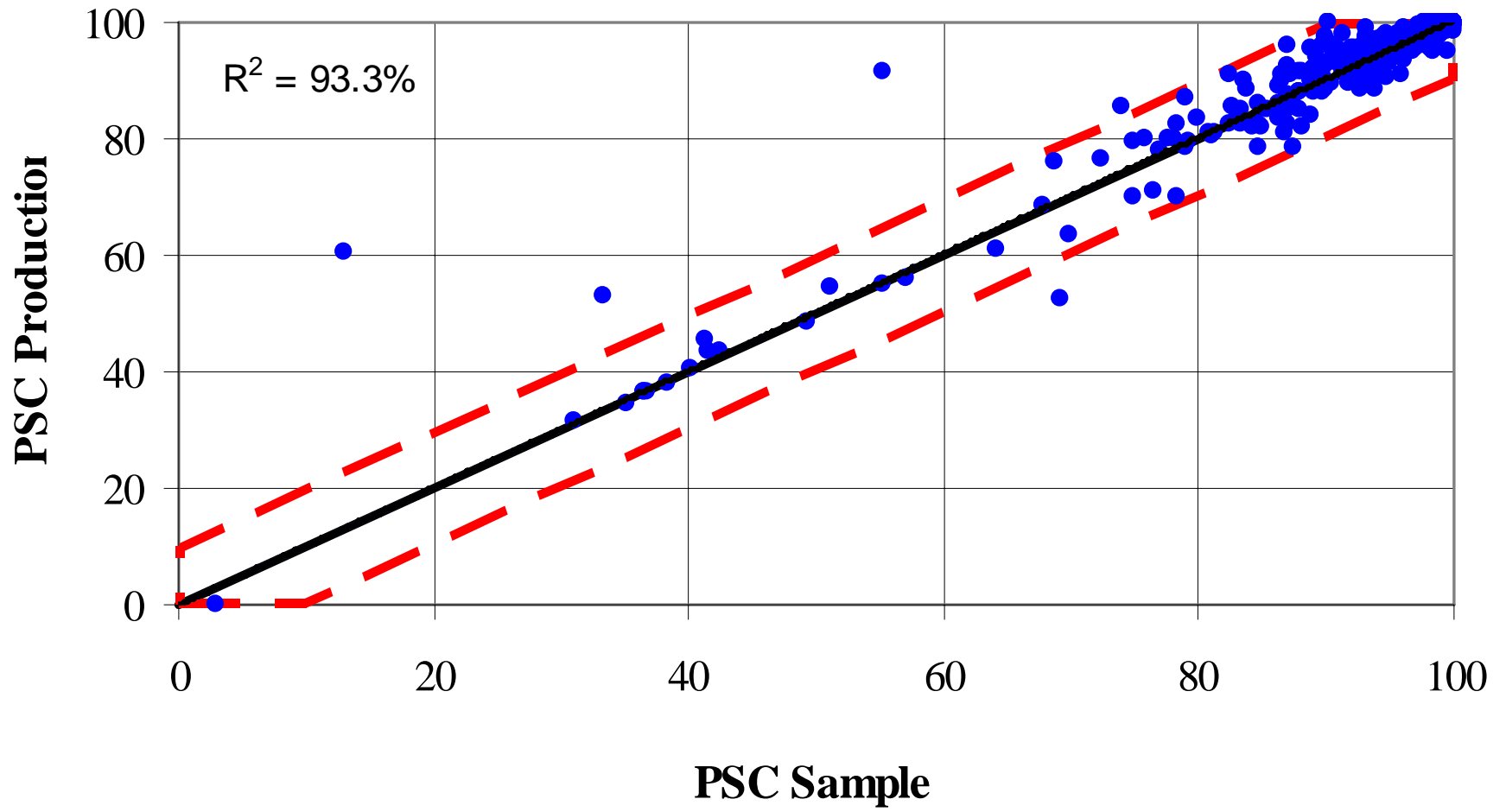
Num	NumD1	NumD2	TMid3	Di	Co	Road	From	To	FRIPost	TRIPost	FDIPost	TDIPost	DD	Starf
10	797	56		4	21	006	MP MARKER -	MP MARKER -	42.990	41.990	42.990	41.990	D	
11	796	56		4	21	006	MP MARKER -	MP MARKER -	41.990	40.990	41.990	40.990	D	
12	795	56		4	21	006	MP MARKER -	MP MARKER -	40.990	39.990	40.990	39.990	D	
13	794	56		4	21	006	MP MARKER -	MP MARKER -	39.990	39.000	39.990	39.000	D	
14	793	56		4	21	006	MP MARKER -	MP MARKER -	39.000	38.000	39.000	38.000	D	
15	792	56		4	21	006	MP MARKER -	MP MARKER -	38.000	36.990	38.000	36.990	D	
16	791	56		4	21	006	MP MARKER -	MP MARKER -	36.990	36.000	36.990	36.000	D	



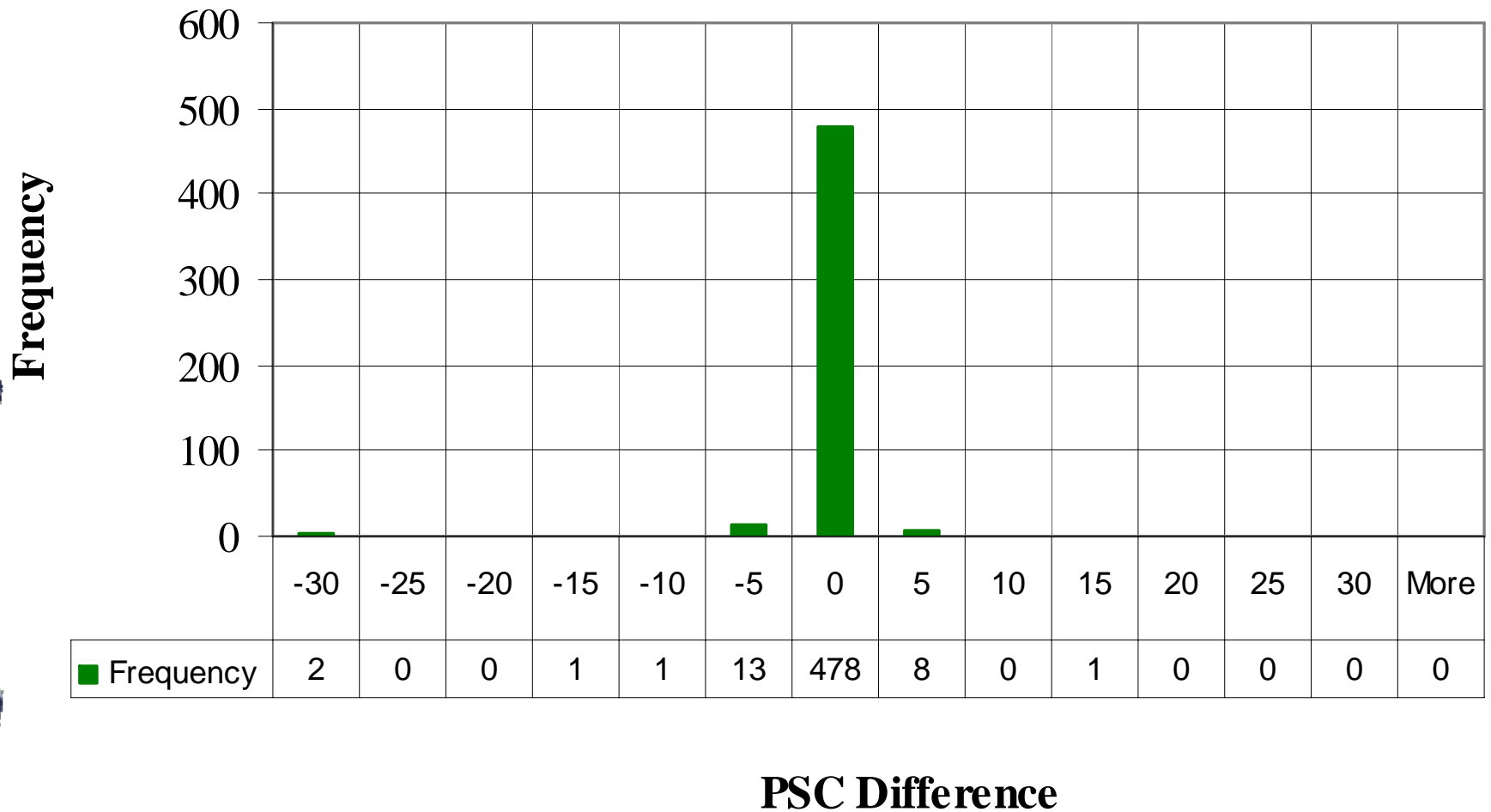
Quality Control of Distress Data

- Complete “production” rating of a set (~ 80 mi)
 - Five random sample sections of ~ 1 mi are selected and re-rated (sample “rating”) by a different rater
- PSC is calculated for the “production” and “sample” ratings
 - Compared for any statistical differences using paired t-test and Wilcoxon signed rank test
- For the 2005-2006 pavement rating, 504 sample sections (each approximately 1 mile in length) were analyzed

Quality Control of Distress Data



Quality Control of Distress Data





Quality Control of Distress Data

- Both tests indicated the null hypothesis, that there are no mean differences, couldn't be rejected at the 5% level of significance
- The paired t-test showed, at the 95% confidence interval, the mean differences to be within -0.76 and 0.31 PSC points
 - PSC ranges from 0 (worst) to 100 (perfect)



Quality Control of Distress Data

- In addition, pavement management staff also perform spot checks on condition assessment
 - Five 1.0 mile random samples
 - Each sample is reviewed for accuracy according to the type and severity of the noted distress
 - Completed immediately after a set is rated
 - Inaccuracies are discussed with the rater and the set is re-rated if necessary



Benefits of Digital Imaging System

- Images are shared with regional staff
 - Loaded onto external hard drives
 - Plans for deployment of a web-based system in 2008
- Regional staff review
 - Has greatly reduced site visits
 - Improved region understanding of pavement distress and performance prediction



Performance Curves

- Once the pavement rating has been finalized the performance prediction for each individual segment (and project length) of roadway is determined
- Performance is based on a best-fit process
- Each project is reviewed for accuracy

Performance Curves

View/Edit Performance Curves - G:\PAVEMENT\2005PMS\CURVEFIT\PROJECTS.MDB

Graph Project Unit

State Route: 2 Roadway Type: MAINLINE Direction: Increasing MP Begin: 139.85 MP End: 140.42 Qualifier:

Action: Standard Curve Regress Other Equation Reset Forced Curve Clear

Index: PSC PRC PPC

Begin Year: 2000 Due Year: 2010

Pavement Code: 21A Due Group: Not Due

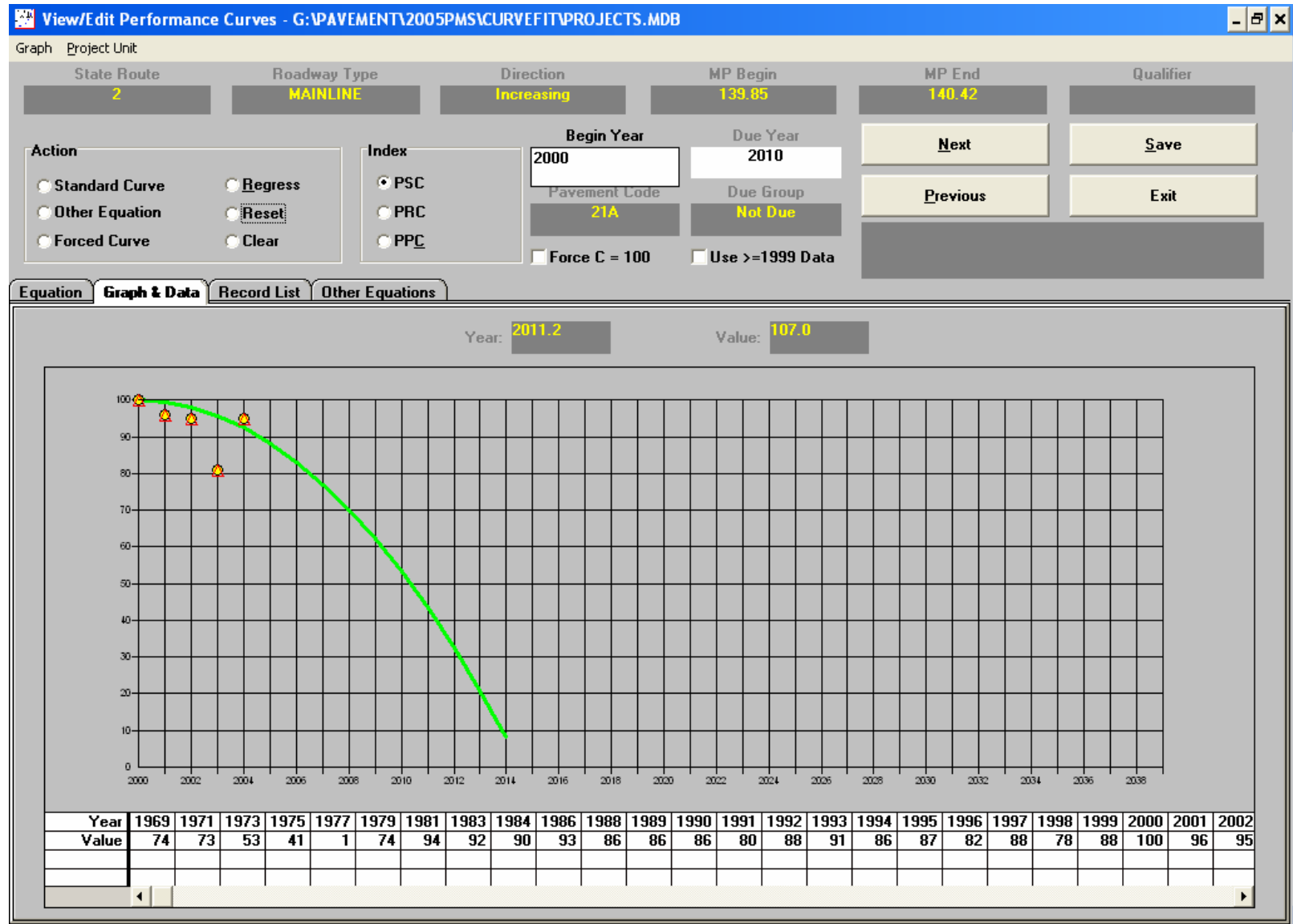
Force C = 100 Use >=1999 Data

Buttons: Next, Save, Previous, Exit

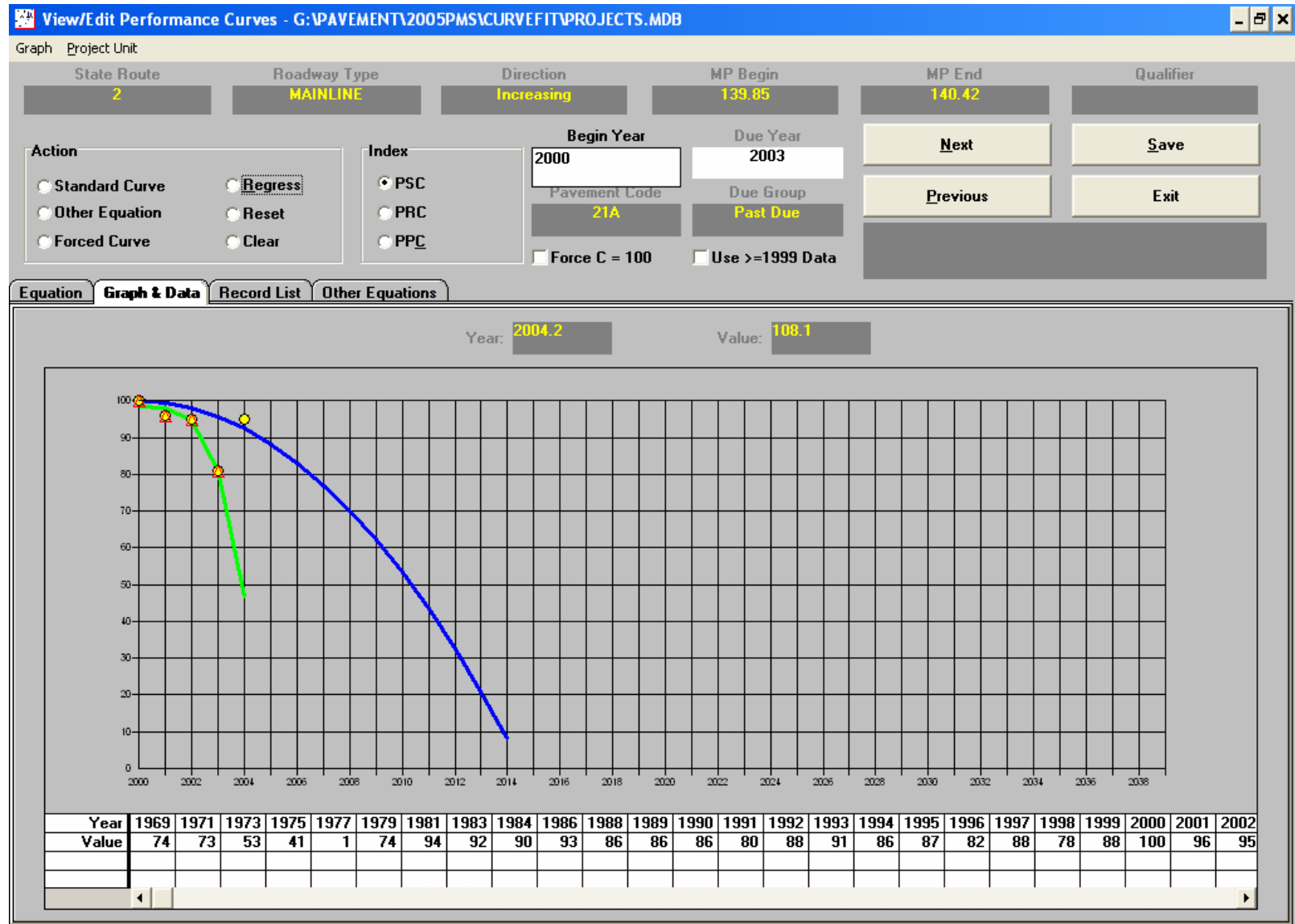
Equation Graph & Data Record List Other Equations

ID	SR	RRTtype	RRQual	Side	BARM	EARM	BSRMP	ESRMP	District	County
34	2				56.84	63.43	56.76	63.32	2	17
35	2				63.43	64.77	63.32	64.63	2	17
36	2				64.77	78.63	64.63	78.55	2	4
37	2				78.63	89.14	78.53	89.06	2	4
38	2				89.14	100.52	89.06	100.44	2	4
39	2				100.52	100.79	100.44	100.71	2	4
40	2				100.79	109.93	100.71	109.85	2	4
41	2				109.93	111.14	109.85	111.06	2	4
42	2				111.14	114.18	111.06	114.10	2	4
43	2				114.18	117.70	114.10	117.62	2	4
44	2				117.70	118.98	117.62	118.90	2	4
45	2				118.99	119.05	118.92	118.98	2	4
46	2				119.05	119.40	118.98	119.33	2	4
47	2				119.40	119.99	119.33	119.77	2	4
48	2				119.99	120.26	119.77	120.04	2	4
49	2				120.26	120.99	120.04	127.83	2	9
50	2				120.99	121.59	127.83	128.43	2	9
51	2				121.59	122.83	128.43	129.67	2	9
52	2				122.83	125.43	129.67	132.27	2	9
53	2				125.43	132.91	132.27	139.85	2	9
54	2				132.91	133.48	139.85	140.42	2	9
55	2				133.48	142.33	140.42	149.27	2	9
56	2				142.33	143.20	149.27	150.14	2	9
57	2				143.20	160.47	150.14	167.41	2	9
58	2				160.47	160.60	167.41	167.54	2	9
59	2				160.60	163.54	167.54	170.48	2	9
60	2				163.54	164.54	170.48	172.57	2	9
61	2				164.54	166.31	172.57	174.34	2	9
62	2				166.31	167.07	174.34	175.10	2	9
63	2				167.07	180.53	175.10	188.62	2	9
64	2				180.53	181.10	188.62	189.19	2	13
65	2				181.10	189.23	189.19	197.31	2	13

Performance Curves



Performance Curves



Performance Curves

View/Edit Performance Curves - G:\PAVEMENT\2005PMS\CURVEFIT\PROJECTS.MDB

Graph Project Unit

State Route	Roadway Type	Direction	MP Begin	MP End	Qualifier
2	MAINLINE	Increasing	139.85	140.42	

Action

Standard Curve Regress
 Other Equation Reset
 Forced Curve Clear

Index

PSC
 PRC
 PPC

Begin Year: 2000 Due Year: 2010

Pavement Code: 21A Due Group: Not Due

Force C = 100 Use >=1999 Data

Next Save
Previous Exit

Equation Graph & Data Record List Other Equations

Constant	Coefficient	Power
Fix Value? <input type="checkbox"/>	Fix Value? <input type="checkbox"/>	Fix Value? <input type="checkbox"/>
Value: 100	Value: -.468	Value: 2
Minimum: 0	Minimum: -1000	Minimum: 0
Maximum: 200	Maximum: -.0000001	Maximum: 10
Fit: 0	RMSE: 0	Due Year: 2010

Performance Curves

View/Edit Performance Curves - G:\PAVEMENT\2005PMS\CURVEFIT\PROJECTS.MDB

Graph Project Unit

State Route: 2 Roadway Type: MAINLINE Direction: Increasing MP Begin: 139.85 MP End: 140.42 Qualifier:

Action: Standard Curve Regress
 Other Equation Reset
 Forced Curve Clear

Index: PSC PRC PPC

Begin Year: 2000 Due Year: 2010
Pavement Code: 21A Due Group: Not Due

Force C = 100 Use >=1999 Data

Equation Graph & Data Record List **Other Equations**

PSC = X(1) + X(2)*AGE^X(3)*Exp(-X(4)*AGE)

Parameter Number	Initial Value	Minimum	Maximum	Fixed	Final Value
1	100.00	-1,000.00	1,000.00	<input checked="" type="radio"/> No <input type="radio"/> Yes	
2	2.00	-1,000.00	1,000.00	<input checked="" type="radio"/> No <input type="radio"/> Yes	
3	1.00	-10.00	10.00	<input checked="" type="radio"/> No <input type="radio"/> Yes	
4	0.50	-10.00	10.00	<input checked="" type="radio"/> No <input type="radio"/> Yes	

Fit: RMSE:

Region Acceptance

- List of projects are distributed to Regions
 - Verification of due year
 - Do you agree with the predicted due year?
 - In agreement with due year, but requested change for logistical reasons (combining adjacent projects for economy of scale, delaying for other work in the same area etc..)
 - Region reviews each project
 - 90 percent agreement rate between PMS and Region on project due year
- Over the last two biennium's
 - More than 90 percent of all projects reviewed by regions are in agreement with the WSPMS



Impacts of QC/QA Process

- Demonstrates the accuracy of the pavement condition rating process
- Verification of the prediction equations
- Quantifiable results and communication of the QC/QA process to Region staff has significantly improved the confidence of the WSPMS results

QUESTIONS?

