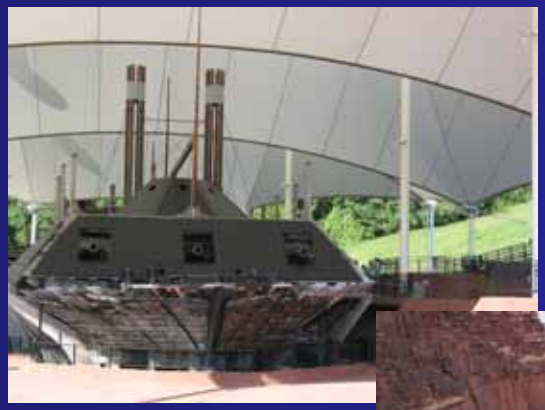
Are We There Yet?










PMS QA/QC for the National Park Service

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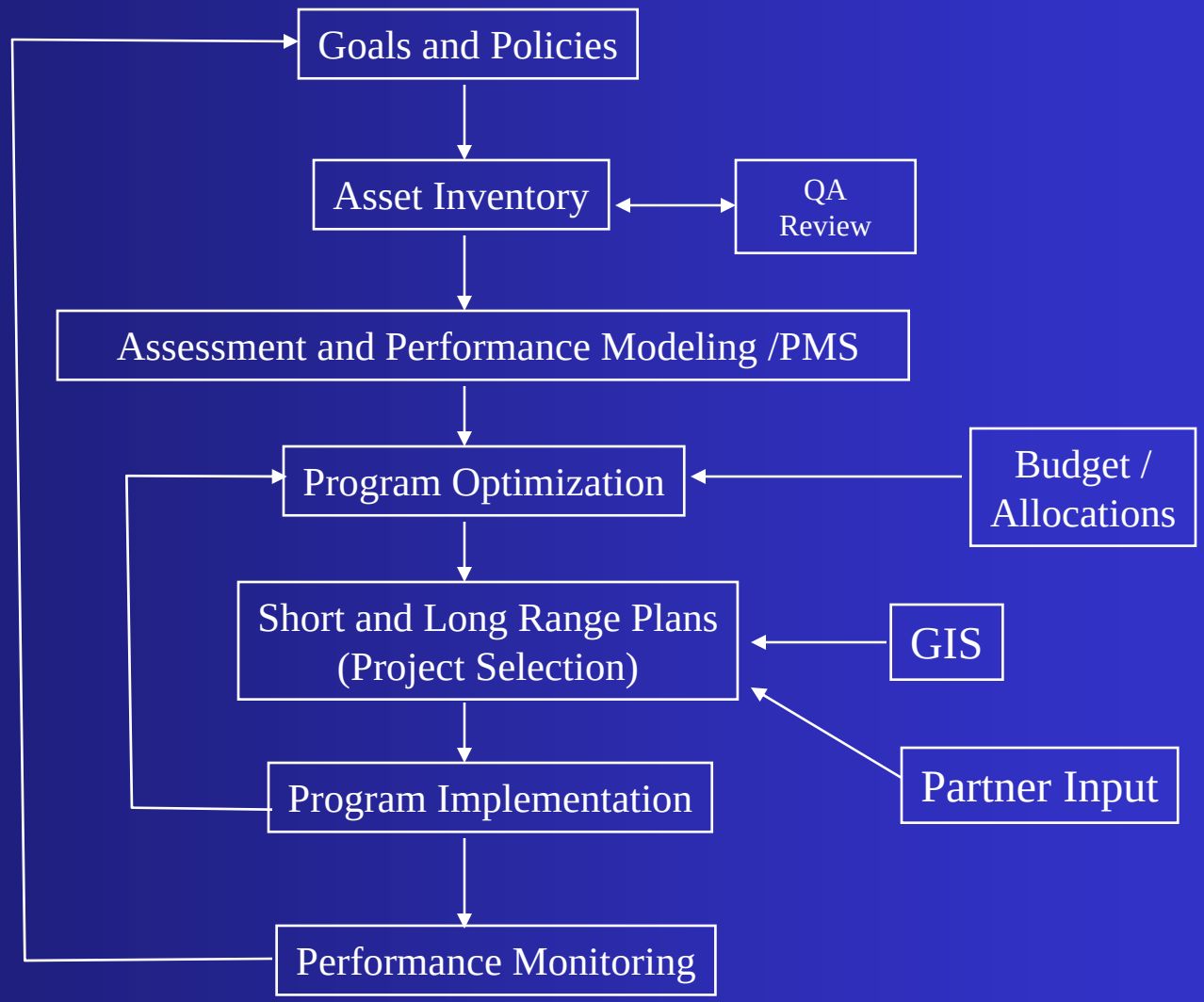
National Conference on Pavement Management
May 6-9, 2007
Norfolk, VA

Federal Lands Highway

U.S. Department of Transportation
Federal Highway Administration

FLH Asset Management System



Introduction & Background

- Park Roads & Parkways (PRP) Network (324 Parks)
  - Approximately 5500 miles of paved roads.
  - Mostly Low volume roads – except parkways around D.C.
  - No commercial traffic allowed
  - Administered jointly by FHWA & NPS through the FLHP.
  - Performance data collected in cycles
- In 2004, Federal Lands awarded contract to Stantec to develop and implement a PMS for the PRP network (FLH-PMS)

Data Collection

- Two data collection cycles for inventory & condition data completed
  - Cycle 1 (1997 – 2000) Cycle 2 (2001 – 2004)
  - Cycle 3 2006 Underway
- Pavement Condition Rating (PCR)
  - Roughness Condition Index (RCI) (40%)
  - Surface Condition Rating (Surface Distresses) (60%)
    - Alligator cracking …… AC Index
    - Longitudinal cracking …… LC Index
    - Transverse cracking …… TC Index
    - Patching …… Pat Index
    - Rutting …… Rut Index

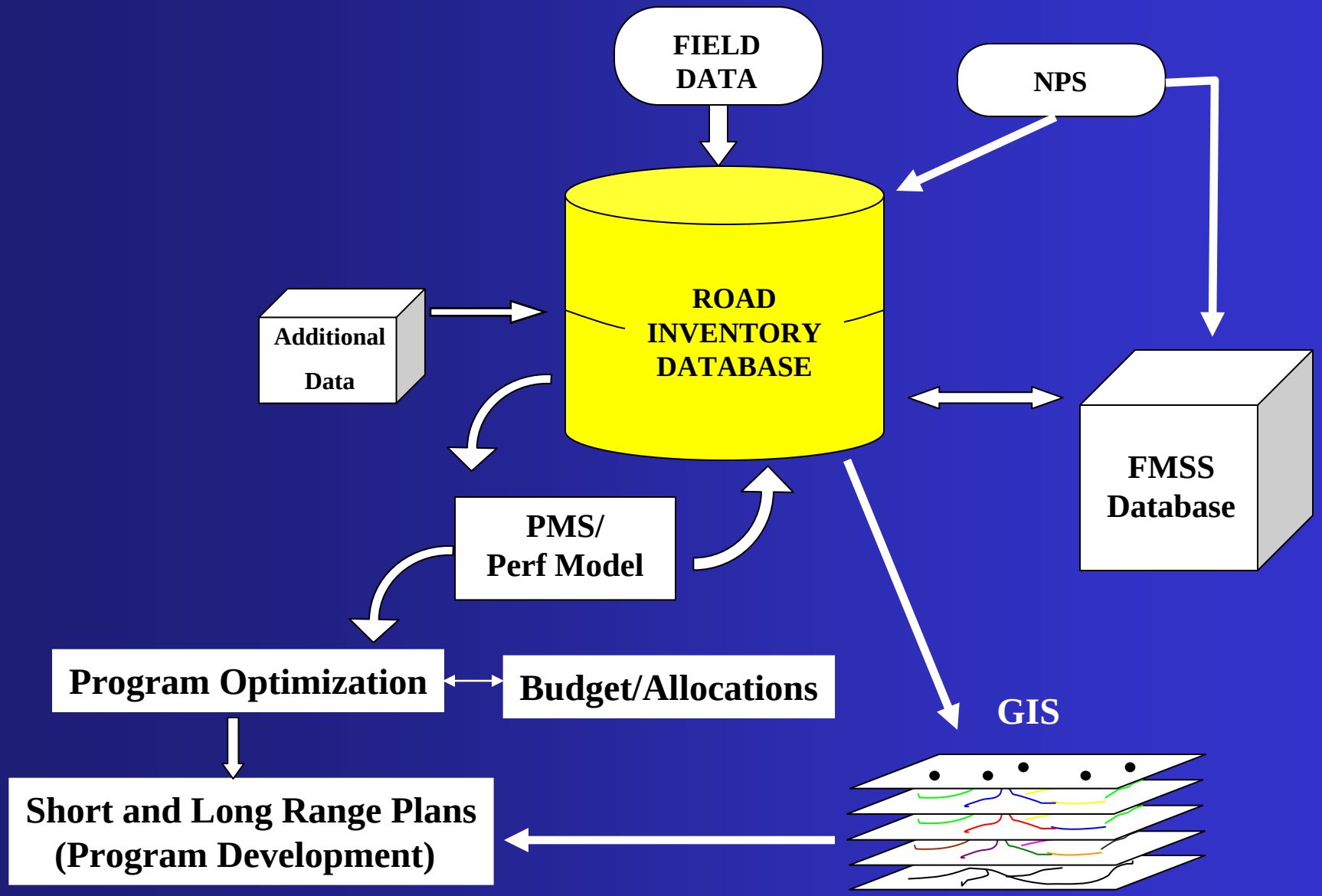
Data QA

- The Roadway Inventory Program (RIP) has a written manual for collection of the data including the following
  - Calibration of the data collection equipment
  - Operation of the equipment
  - What data is to be collected
  - Format of the data collected

Data QC

- A percentage of data is checked for comparison with supplied data (both in-house or contractor processed)
- Critical Data Items – Route ID, mileage, distresses, calculated indexes (100% comparison with 100% accuracy)
- Non-Critical Items – Drainage, culverts, signs, guardrails (10% comparison with 95% accuracy)

Pavement Management System Data Flow



PMS Project Milestones

	Date	Complete
▪ Review Pavement Management Needs and Existing Data	3/2004	100%
▪ Develop Database, Customize Software and Populate Database	9/2004	100%
▪ Develop Models		
Environmental Models	4/2004	100%
Generic Deterioration Models	12/2004	100%
Decision Trees	12/2004	100%

PMS Project Milestones (continued)

	Date	Complete
• Develop Models (continued)		
Maintenance & Reconstruction Costs-Nationally	12/2004	100%
• Run draft PMS Program w/ Output recommendations	3/2005	100%
• Conduct Ground Truthing of Outputs for Pilot Parks	4-7/2005	100%
• Functioning PMS System	1/2006	100%

PMS Analysis Tools

- Decision Trees for Pavement Type/Functional Class
  - Urban Parkways
  - Principle Park Roads, Connector Roads, City Streets
  - Special Park Roads, Primitive Roads, Administrative Roads
- Climatic Zones
  - Eight climatic models
  - Variations of Dry-Wet/Freeze- No Freeze-Super Freeze
- Dynamic Segmentation
- Segment Grouping
- Hard Wired Projects (4R Projects & Current Projects)
- Budget Scenarios
- Optimization Analyses

Development Challenges

Network Configuration

Not a Typical PMS Implementation …..

- National network configuration
- Environmental & geographical variations
- Regional practices
- Integration with Facility Management Software System
- Limited historic data

NPS Regional Practices

- PRP network is administered in 3 FLH Divisions & 7 NPS Regions
- Varying M&R practices e.g.
  - CIR used more in central and western regions
- Roads are spread across the entire country
  - Very different sub grade types
- Activities costs vary in different parks and regions
  - Location
  - Accessibility
  - Traffic levels

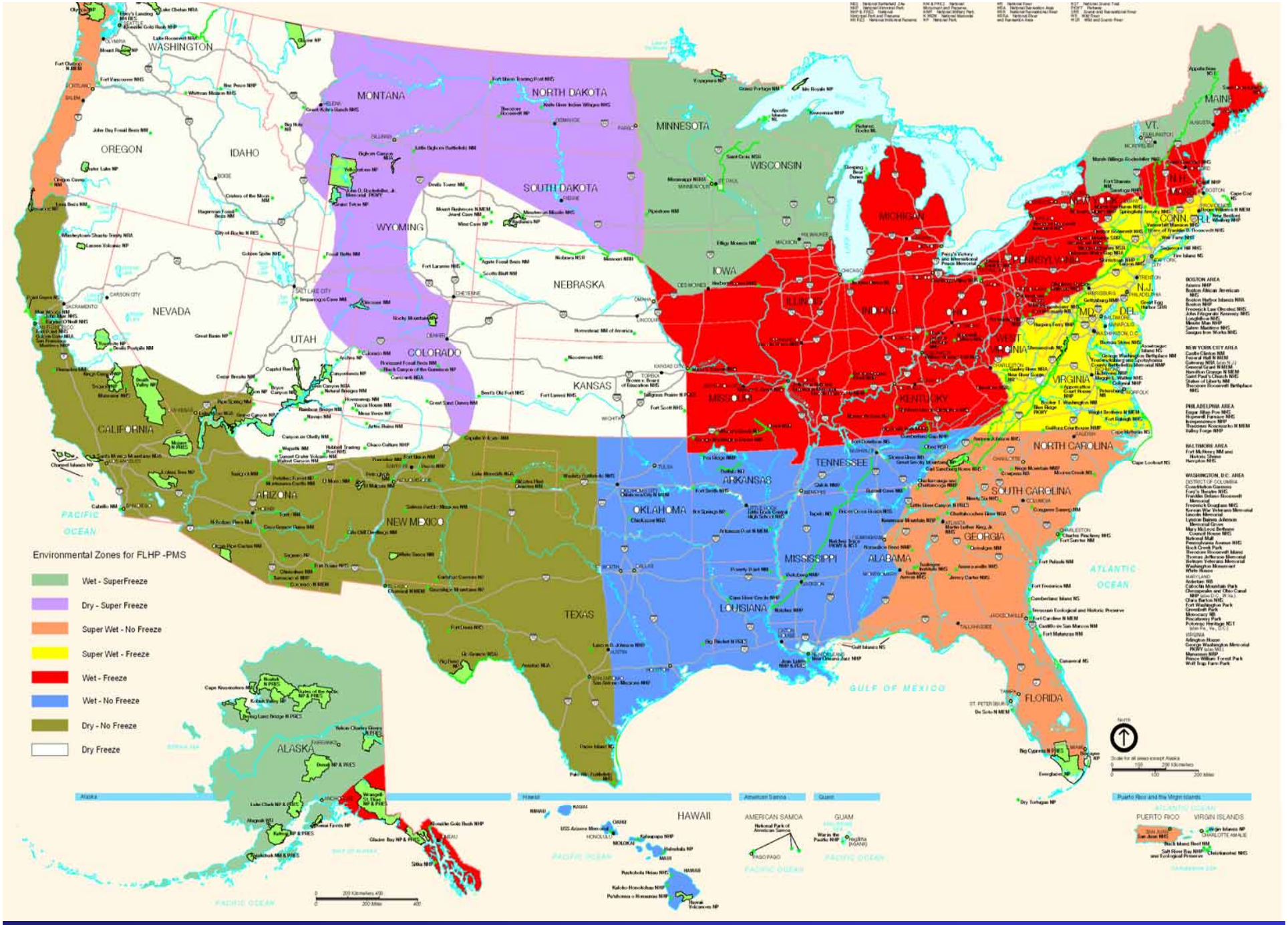
Limited Historical Data

- Construction Histories
- Traffic Data for selected parks only
- Pavement and Geotechnical data missing

Development of Analysis Models

FLH-PMS Environmental Zones

Dry – No Freeze	DNF
Dry – Freeze	DF
Dry – Super Freeze	DSF
Wet – No Freeze	WNF
Wet - Freeze	WF
Wet – Super Freeze	WSF
Super Wet – No Freeze	SWN
Super Wet - Freeze	SWF


Environmental Zones for FLHP -PMS
Wet - SuperFreeze
Dry - Super Freeze
Super Wet - No Freeze
Super Wet - Freeze
Wet - Freeze
Wet - No Freeze
Dry - No Freeze
Dry Freeze
WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
MINNESOTA
WISCONSIN
MICHIGAN
NEBRASKA
IOWA
NEVADA
UTAH
COLORADO
KANSAS
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
N.J.
MD.
DEL.
LOUISIANA
ARKANSAS
ALASKA
HAWAII
AMERICAN SAMOA
GUAM
PUERTO RICO
VIRGIN ISLANDS
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
BOSTON AREA
NEW YORK CITY AREA
PHILADELPHIA AREA
BALTIMORE AREA
WASHINGTON, D.C. AREA

Analysis Models

- Performance prediction models
- Decision trees
- Validation of analysis models – *Ground Truthing*
- M&R activities' unit costs

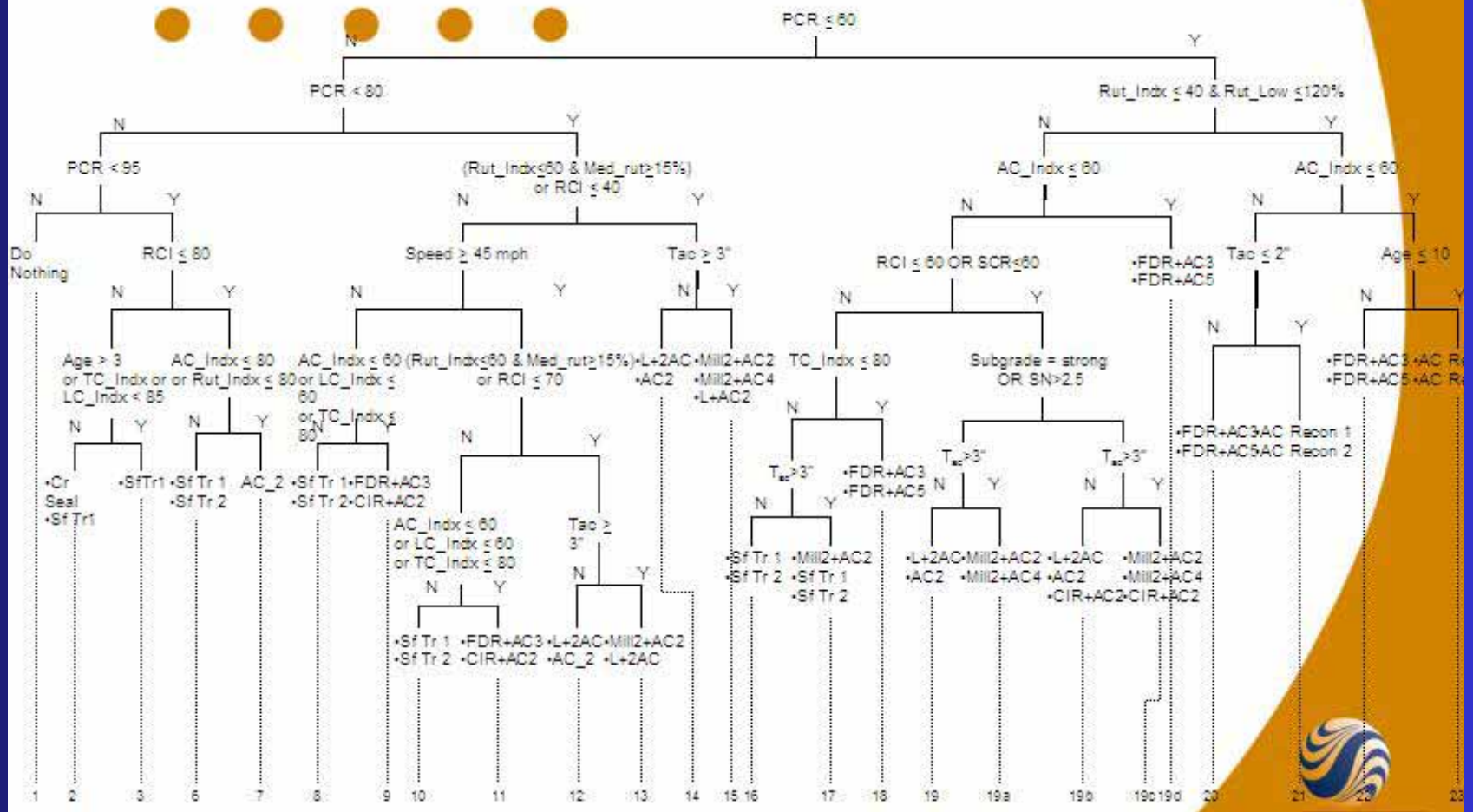
Performance Prediction Models

- Models required
  - RCI Models
  - Distress Indexes models
    - AC Index
    - LC Index
    - TC Index
    - Pat Index
    - Rut Index
- Performance Classes
  - Environmental zones (8 zones),
  - Rehabilitation activities (21 activities)
  - Pavement type (2 types)
  - Functional classification (3 categories)

Decision Trees

- Comprehensive pavement preservation approach
- Decision Trees combine both preventive maintenance activities and rehabilitation activities
- Separate decision trees for different functional classification / pavement type combination
- Data attributes considered include:
  - Pavement condition
  - Pavement distresses
  - Traffic levels
  - Age
  - Environmental conditions

AC Class B Roads – Final



Principals Parks (PP), Connectors Parks(CP) and City Street (CS)

Conditions of the Project Length were not applied to Decision Tree.

Stantec

Maintenance and Rehabilitation Treatments (Activities)

M&R Treatments	M&R Treatment Description	
Surface Treatments	1 – Crack Sealing 2 – Surface Treatment 1 (Chip Seal, Slurry) 3 – Surface Treatment 2 (1” Asp) 4 – AC Patching	
Light 3R Treatments	5 – 2” AC Overlay 6 – 4” AC Overlay 7 – Level + 2” AC Overlay 8 – Mill 2” Overlay 2”	
Heavy 3R Treatments	9 – Mill 4” Overlay 4” 10 – CIR + 2”AC 11 – CIR + 4” AC 12 – FDR + 3” AC 13 – FDR + 5” AC 14 – GEO + 2” AC	15 – GEO + 4” AC 16 - C/S + 2” AC 17 – C/S + 4” AC 18 – PCC JCR 19 – Recon 1/3” AC/6” Base 20 – Recon 2/5” AC/8” Base 21 – Recon /8” PCC/4” Base

M&R Activities Unit Costs

- Cost components in the system
  - Direct M&R activity unit cost
  - Incidental cost factors
  - Overhead engineering cost
  - Park escalation factors

- Cost defined by averaging a sample of historic project
  - Statistically significant sample
  - Scaling was used for activities with smaller samples

Ground Truth Selections

Ground Truthing Pilot Parks

No Freeze	Dry	Joshua Tree NP
	Wet	Chickasaw/Natchez Trace Pkwy
	Super Wet	Olympic NP
Freeze	Dry	Glacier NP
	Wet	Natchez Trace Pkwy
	Super Wet	Blue Ridge Pkwy
Super Freeze	Dry	Yellowstone NP
	Wet	Voyagers NP

Validation of Analysis Models – Ground Truthing

In total, approximately 800-miles of park roads and parkways were surveyed

- Sections selected based on
  - Environmental zone
  - Functional classification
  - Pavement types

Validation of Analysis Models – Ground Truthing

- The main objectives of these trips were to:
  - Validate and adjust decision trees.
  - Collect information to improve the performance prediction models.
  - Acquire additional information – interviews with parks' staff
  - Finalize the performance models and decision trees

Future Efforts

- **DATA MINING**
  - Sub-grade data
  - Core borings
  - Geotechnical Reports
  - Falling Weight Deflectometer (FWD)
  - Soil Classification
  - Construction Dates & History
  - As-Built Plans & Pavement Section
  - Final Construction Reports
- **EMERGING TECHNOLOGIES**
  - Rolling Wheel Deflectometer
  - Ground Penetrating Radar
- **ENHANCE COST ESTIMATING**

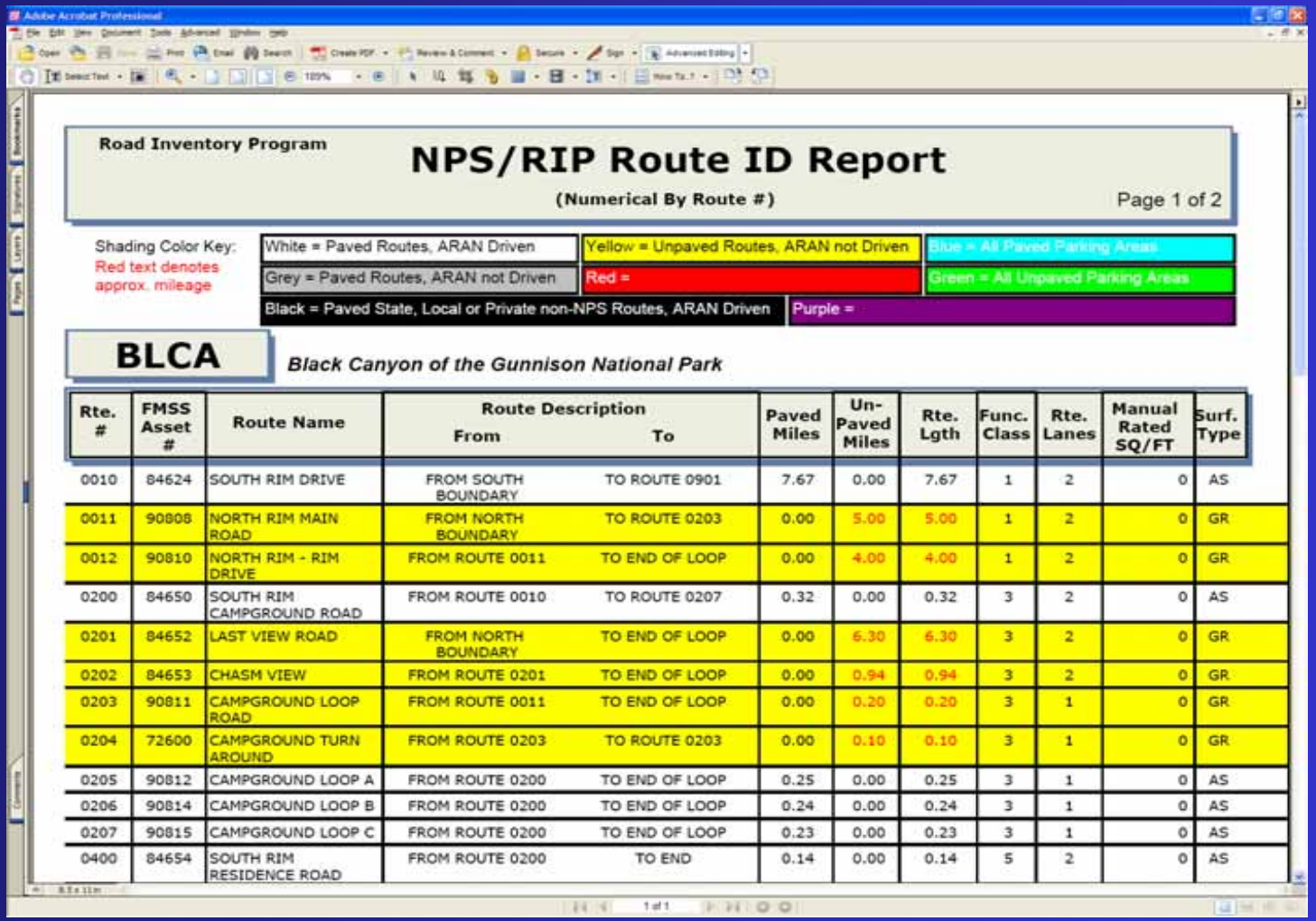
NPS Facility Management Software System (FMSS) Data Integration

- NPS and FHWA developing system to automatically integrate the Road Inventory data into the FMSS system
- FHWA Route ID lists unique Asset numbers for each Route in the parks
- Each Asset has associated pieces of equipment (i.e. road surface, culverts, guard rail, signs, etc.) that are attached to that specific asset.

FMSS Data Integration Continued

- NPS Pavement Management System generates work orders from list of 21 Pavement Maintenance and Rehabilitation activities
- National average costs developed with Park specific weighted factors for 21 activities
- Actual construction costs fed back into PMS to develop more accurate cost estimates

Park Route Identification/ Link to unique FMSS Asset Numbers



Road Inventory Program

NPS/RIP Route ID Report

(Numerical By Route #)

Page 1 of 2

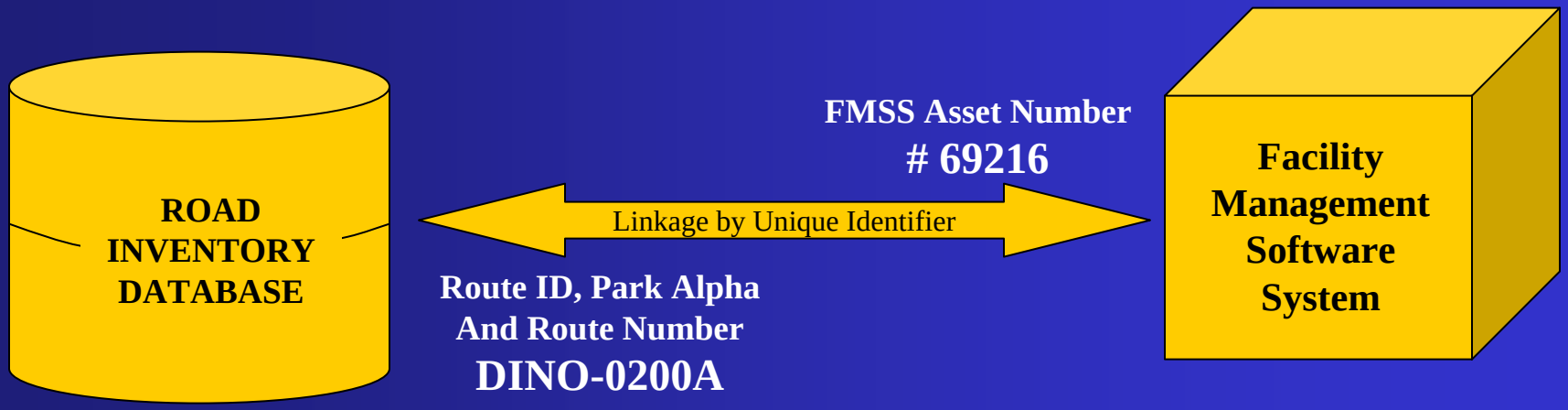
Shading Color Key:
Red text denotes approx. mileage

White = Paved Routes, ARAN Driven	Yellow = Unpaved Routes, ARAN not Driven	Blue = All Paved Parking Areas
Grey = Paved Routes, ARAN not Driven	Red =	Green = All Unpaved Parking Areas
Black = Paved State, Local or Private non-NPS Routes, ARAN Driven	Purple =	

BLCA *Black Canyon of the Gunnison National Park*

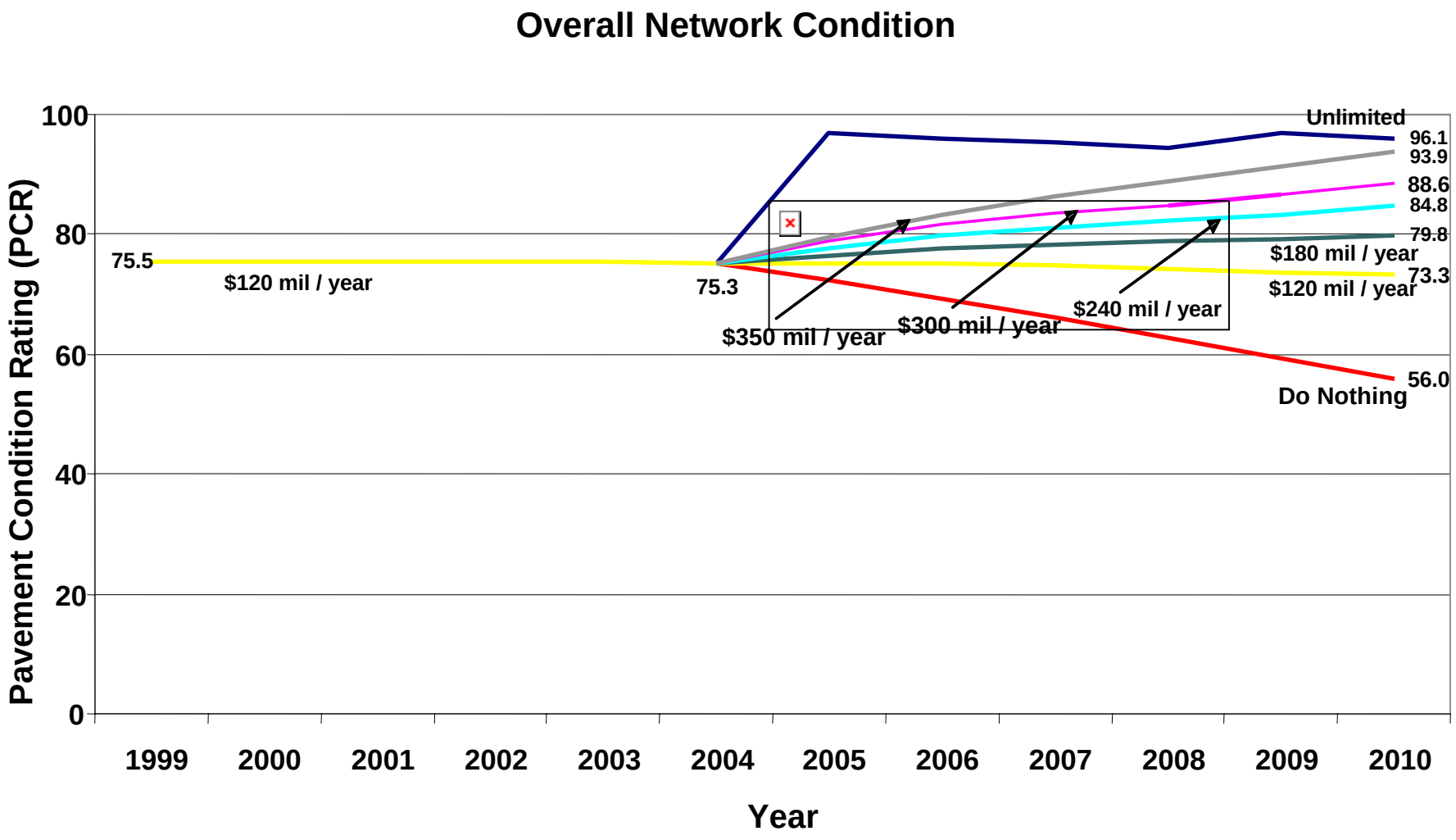
Rte. #	FMSS Asset #	Route Name	Route Description From	Route Description To	Paved Miles	Un-Paved Miles	Rte. Lgth	Func. Class	Rte. Lanes	Manual Rated SQ/FT	Surf. Type
0010	84624	SOUTH RIM DRIVE	FROM SOUTH BOUNDARY	TO ROUTE 0901	7.67	0.00	7.67	1	2	0	AS
0011	90808	NORTH RIM MAIN ROAD	FROM NORTH BOUNDARY	TO ROUTE 0203	0.00	5.00	5.00	1	2	0	GR
0012	90810	NORTH RIM - RIM DRIVE	FROM ROUTE 0011	TO END OF LOOP	0.00	4.00	4.00	1	2	0	GR
0200	84650	SOUTH RIM CAMPGROUND ROAD	FROM ROUTE 0010	TO ROUTE 0207	0.32	0.00	0.32	3	2	0	AS
0201	84652	LAST VIEW ROAD	FROM NORTH BOUNDARY	TO END OF LOOP	0.00	6.30	6.30	3	2	0	GR
0202	84653	CHASM VIEW	FROM ROUTE 0201	TO END OF LOOP	0.00	0.94	0.94	3	2	0	GR
0203	90811	CAMPGROUND LOOP ROAD	FROM ROUTE 0011	TO END OF LOOP	0.00	0.20	0.20	3	1	0	GR
0204	72600	CAMPGROUND TURN AROUND	FROM ROUTE 0203	TO ROUTE 0203	0.00	0.10	0.10	3	1	0	GR
0205	90812	CAMPGROUND LOOP A	FROM ROUTE 0200	TO END OF LOOP	0.25	0.00	0.25	3	1	0	AS
0206	90814	CAMPGROUND LOOP B	FROM ROUTE 0200	TO END OF LOOP	0.24	0.00	0.24	3	1	0	AS
0207	90815	CAMPGROUND LOOP C	FROM ROUTE 0200	TO END OF LOOP	0.23	0.00	0.23	3	1	0	AS
0400	84654	SOUTH RIM RESIDENCE ROAD	FROM ROUTE 0200	TO END	0.14	0.00	0.14	5	2	0	AS

Road Inventory Program and Facility Management Software System (FMSS)



NPS Funding Reauthorization Graph

PCR vs. NPS Funding Levels



Overall Network Condition