PennDOT's Pavement Asset Management System (PAMS)

Quality Assurance Workshop
Hershey, PA
February 8th, 2017

Halley Cole P.E.

What is Asset Management?

- Strategic framework for managing transportation infrastructure, aligning resource allocation to maintain and/or improve the system to a specific level
- Predictive, not reactive (making informed decisions)
- Principals:
  - o Policy Driven (Strategic)
  - o Performance Based
  - o Option Oriented
  - o Data Driven
  - o Transparent – Getting public's trust

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Pennsylvania Assets

- PA maintains the Nation's:
  - 5th largest roadway network
  - 4th largest number of interstate miles

- Four Business Plan Networks (BPNs):
  - Interstates
  - National Highway System (NHS) Non-Interstate
  - Non-NHS (> 2,000 ADT)
  - Non-NHS (< 2,000 ADT)

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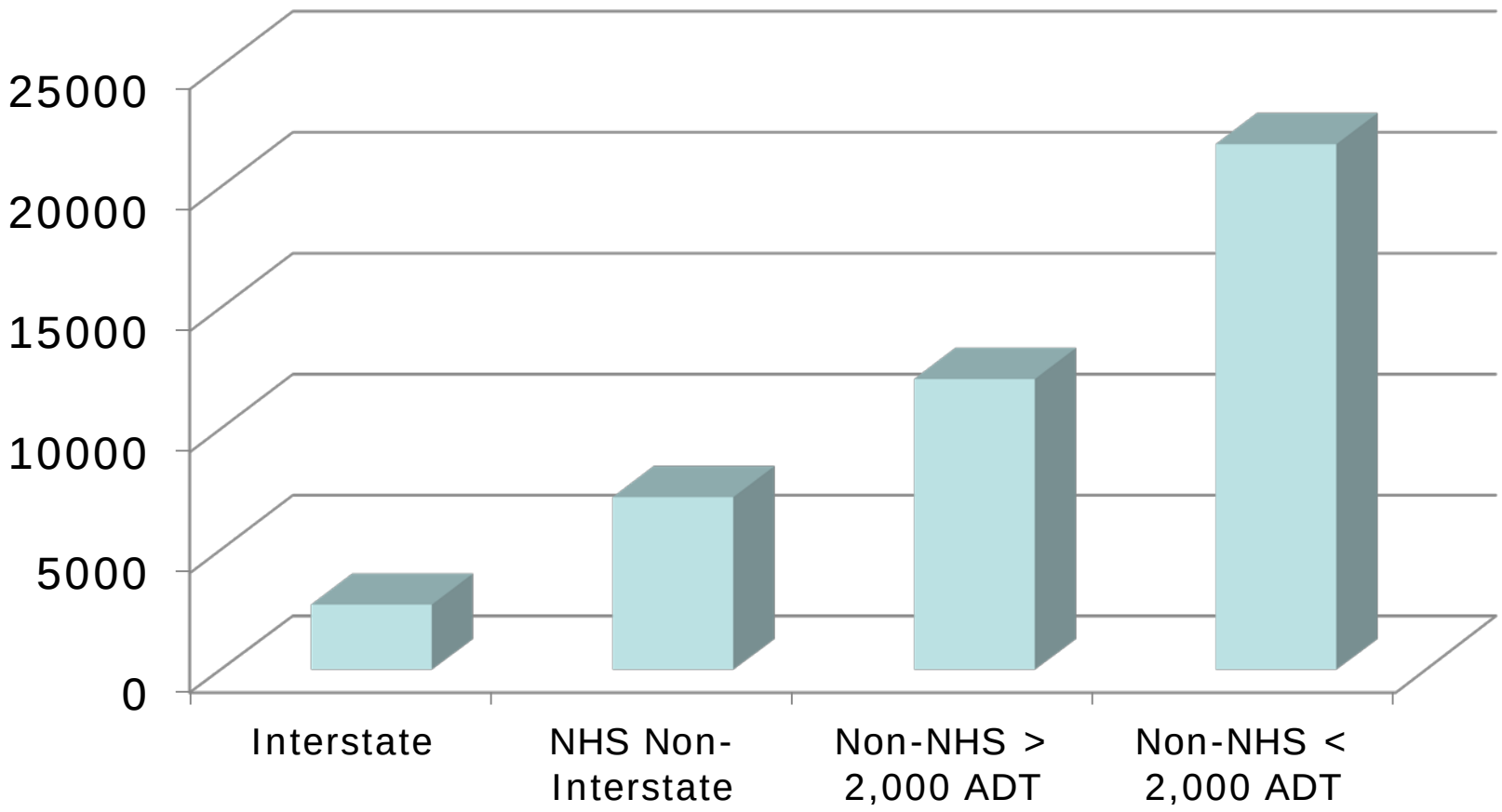
Pennsylvania's Roadway Network



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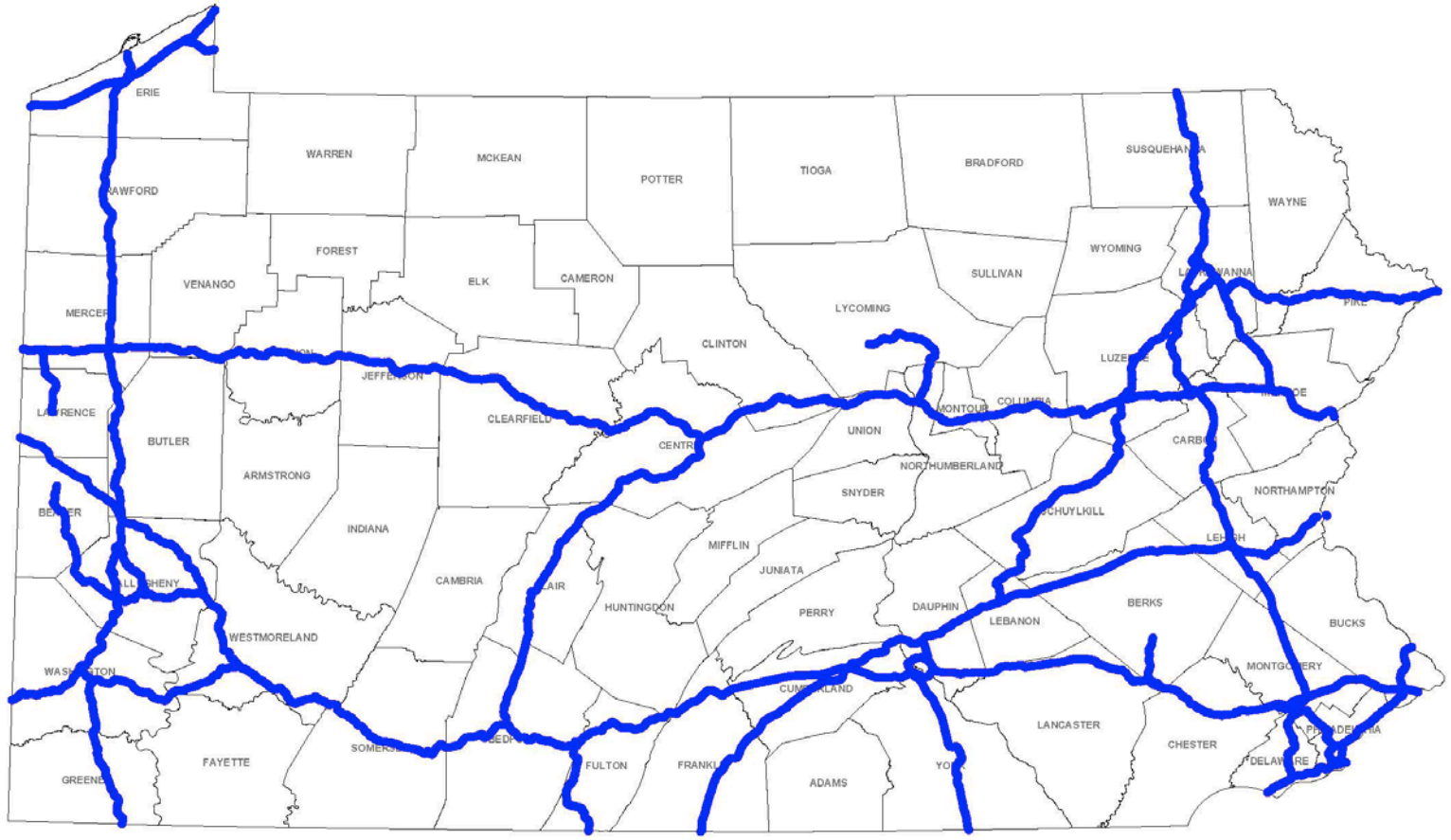
Pennsylvania's Roadway Network

Interstate



Interstate

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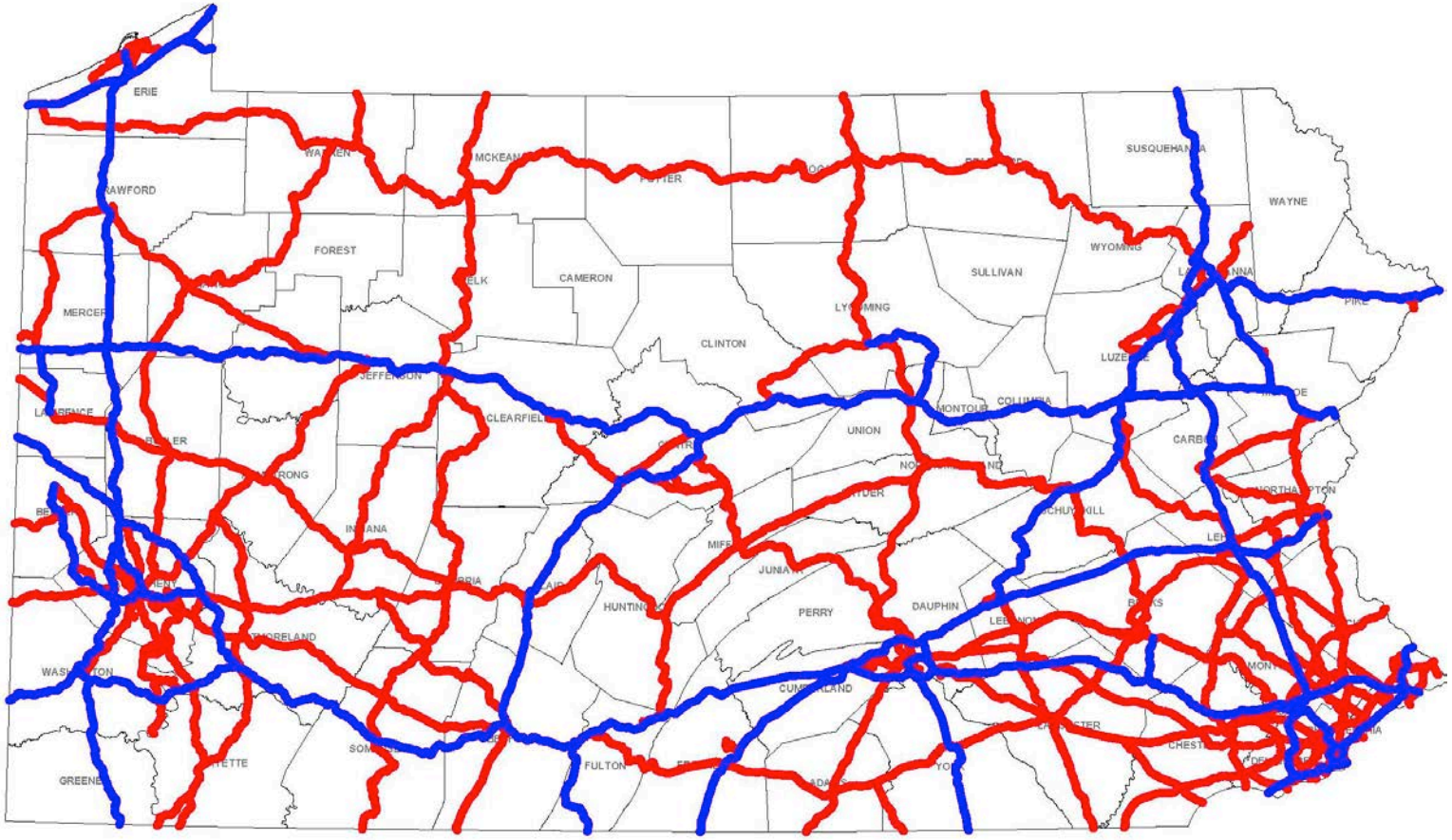
Note: Local Roads Not Shown

Pennsylvania's Roadway Network

Interstate & NHS



Interstate

NHS

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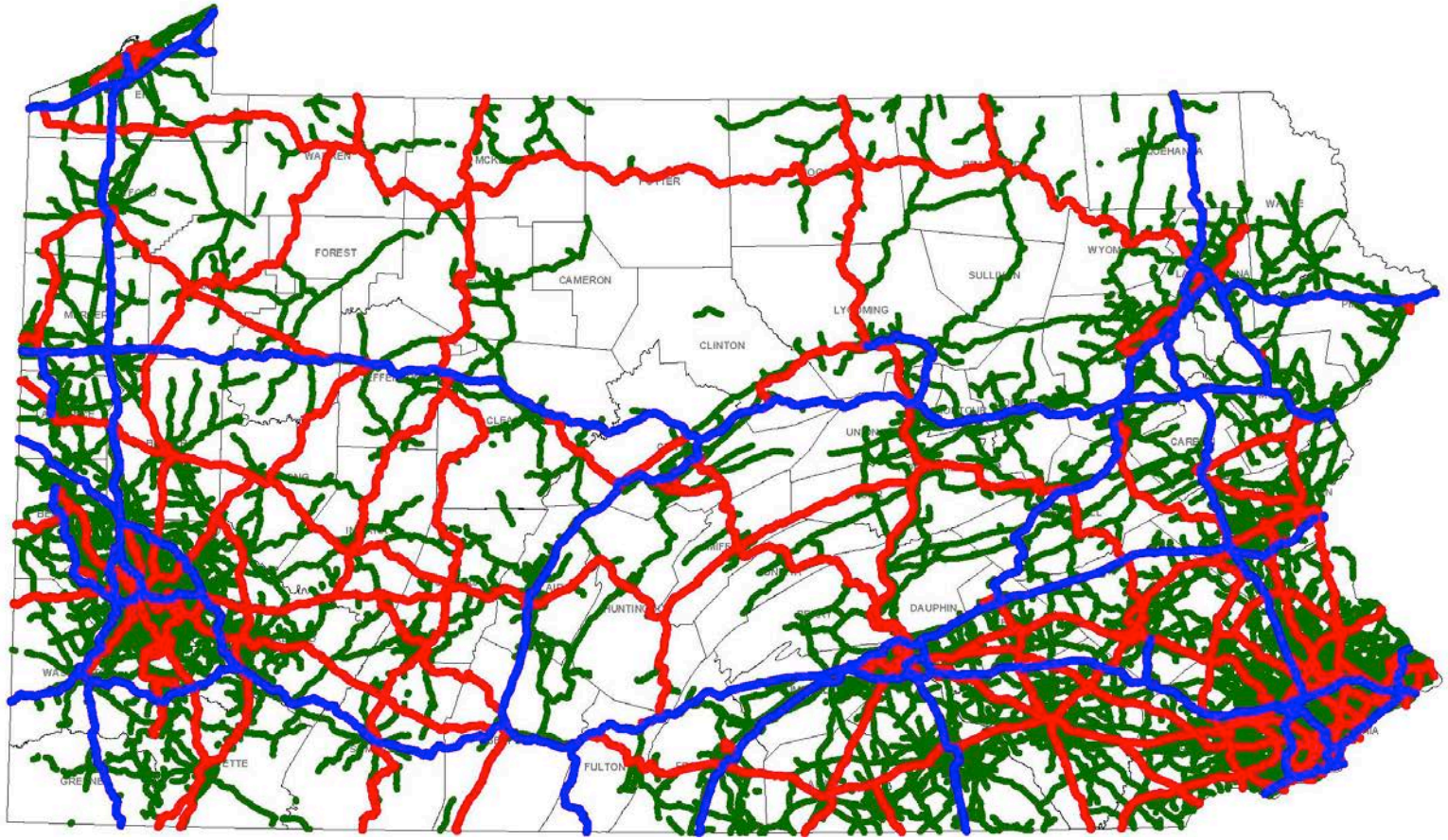
Note: Local Roads Not Shown

Pennsylvania's Roadway Network

Interstate, NHS, and Non-NHS (>2000ADT)



Interstate **Non-NHS (> 2000 ADT)**

NHS

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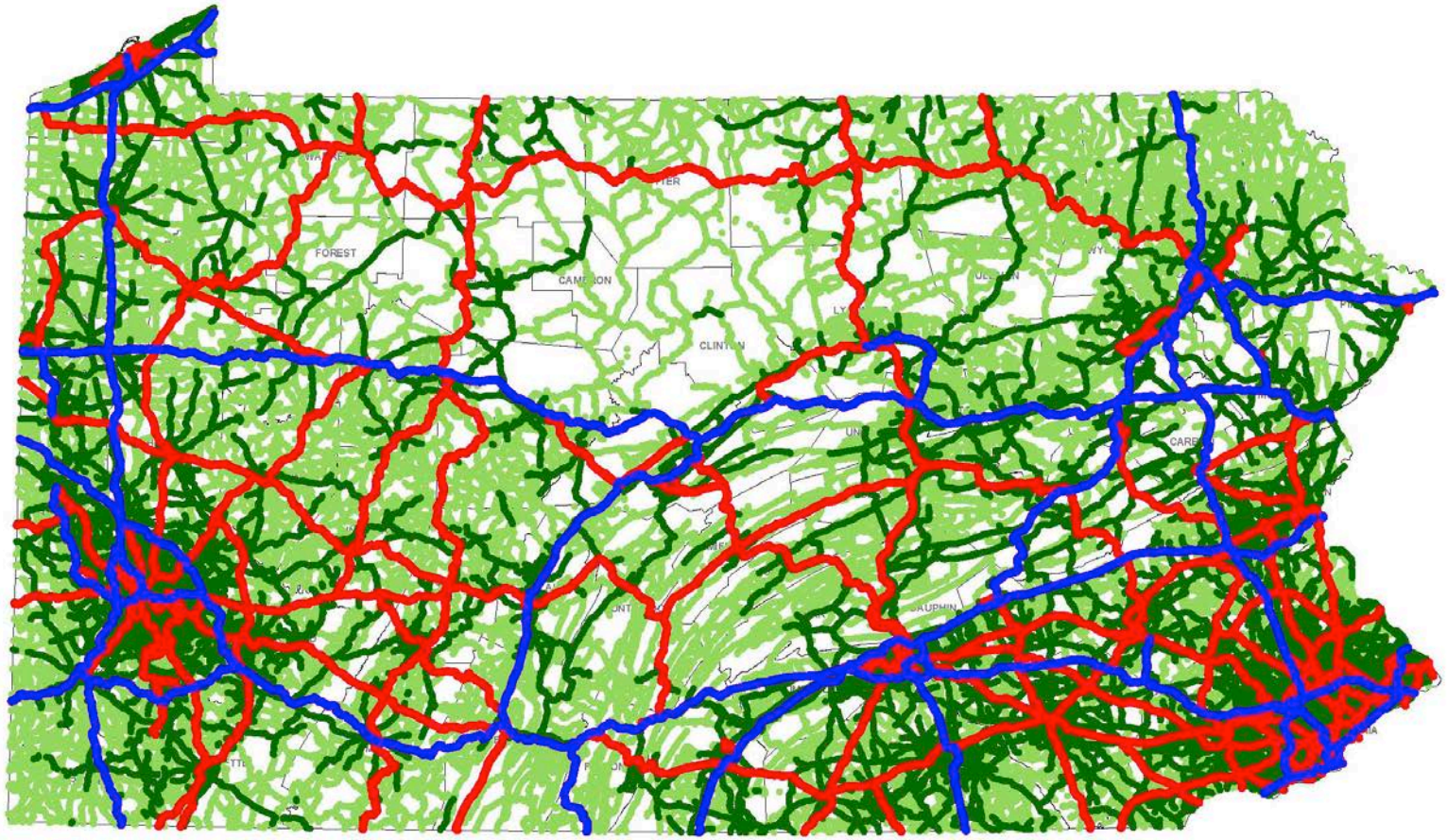
Pennsylvania's Roadway Network

Interstate, NHS, and Non-NHS



Interstate		**Non-NHS (> 2000 ADT)**	
NHS		**Non-NHS (< 2000 ADT)**	

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Note: Local Roads Not Shown

Why PAMS at PennDOT

- Data for more than 43,000 segment miles of state roadways stored in Roadway Management System (RMS) & analyzed in spreadsheets to manage the data for reporting and decision making

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Why PAMS at PennDOT

- No consistent forecasting means
- Lack of communication between systems
- No funding optimization
- No standard project selection process
- No easy way to determine cost estimates

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Why PAMS at PennDOT

- No Means of modeling a section of pavement for deterioration
- Political influence and personnel preference outweigh data driven decisions
- Not centered around long term goals
- Determine if treatment selection was cost effective

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MAP 21 and FAST Act

- Establish performance targets for pavement condition based on specific measures like IRI, rutting, cracking and faulting
- Submit biennial performance reports
- Meet minimum condition levels
- Make significant progress toward meeting the state established targets

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PAMS Targets

- Project optimization based on funding
- Future prediction of deterioration and benefits from proposed projects
- Bring together data from multiple systems for analysis and reporting

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Selecting a Pavement Management System

- Roadway Data Management Study (2010)
  - COTS (Consumer off the shelf solution)
- Request for Proposal (2013)
- Selected Deighton's dTIMs Product

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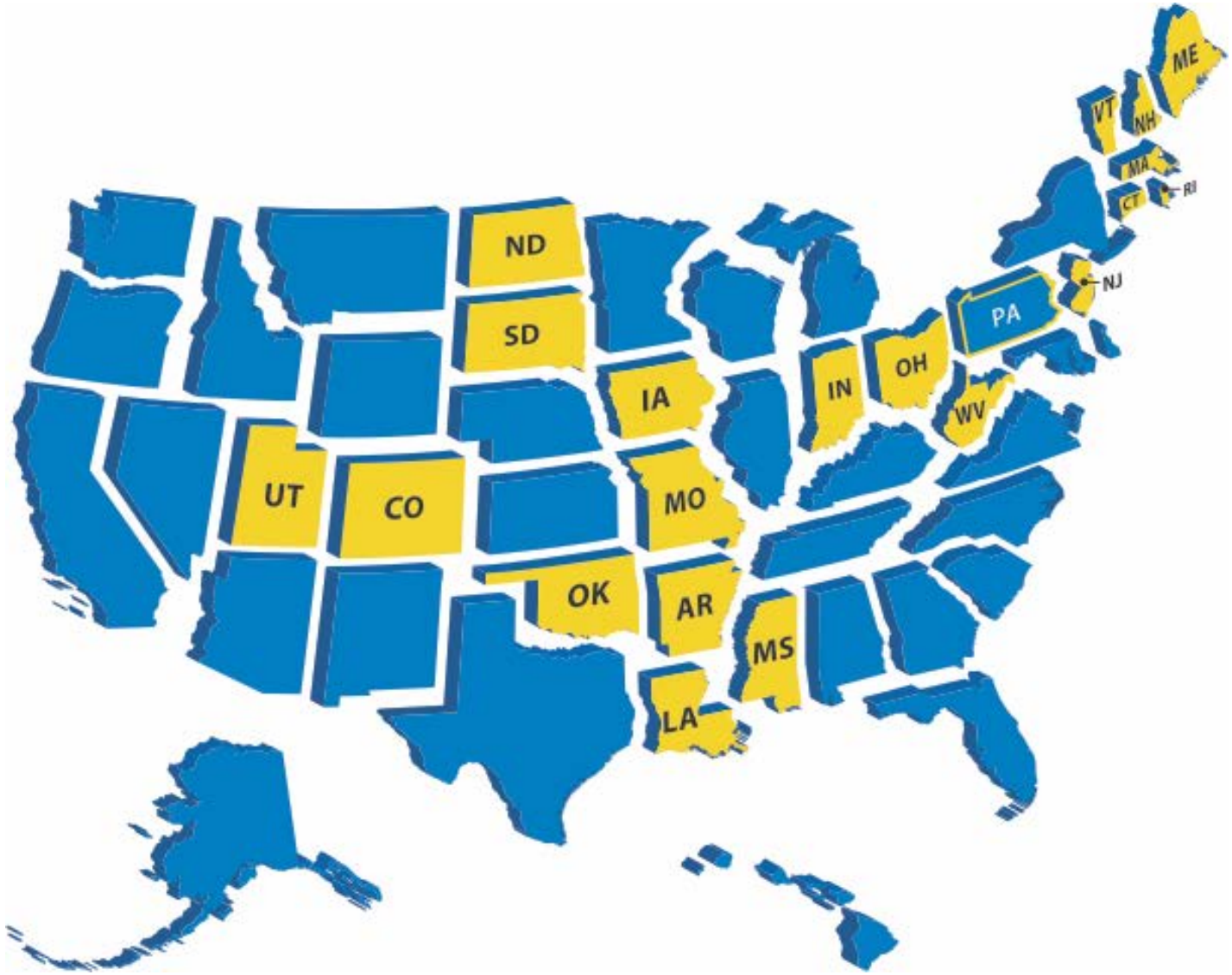
Deighton



- Deighton has been producing asset management solutions since 1986
- Pennsylvania is Deighton's 20th state in order to implement dTIMS
- Configuration is user driven not application driven

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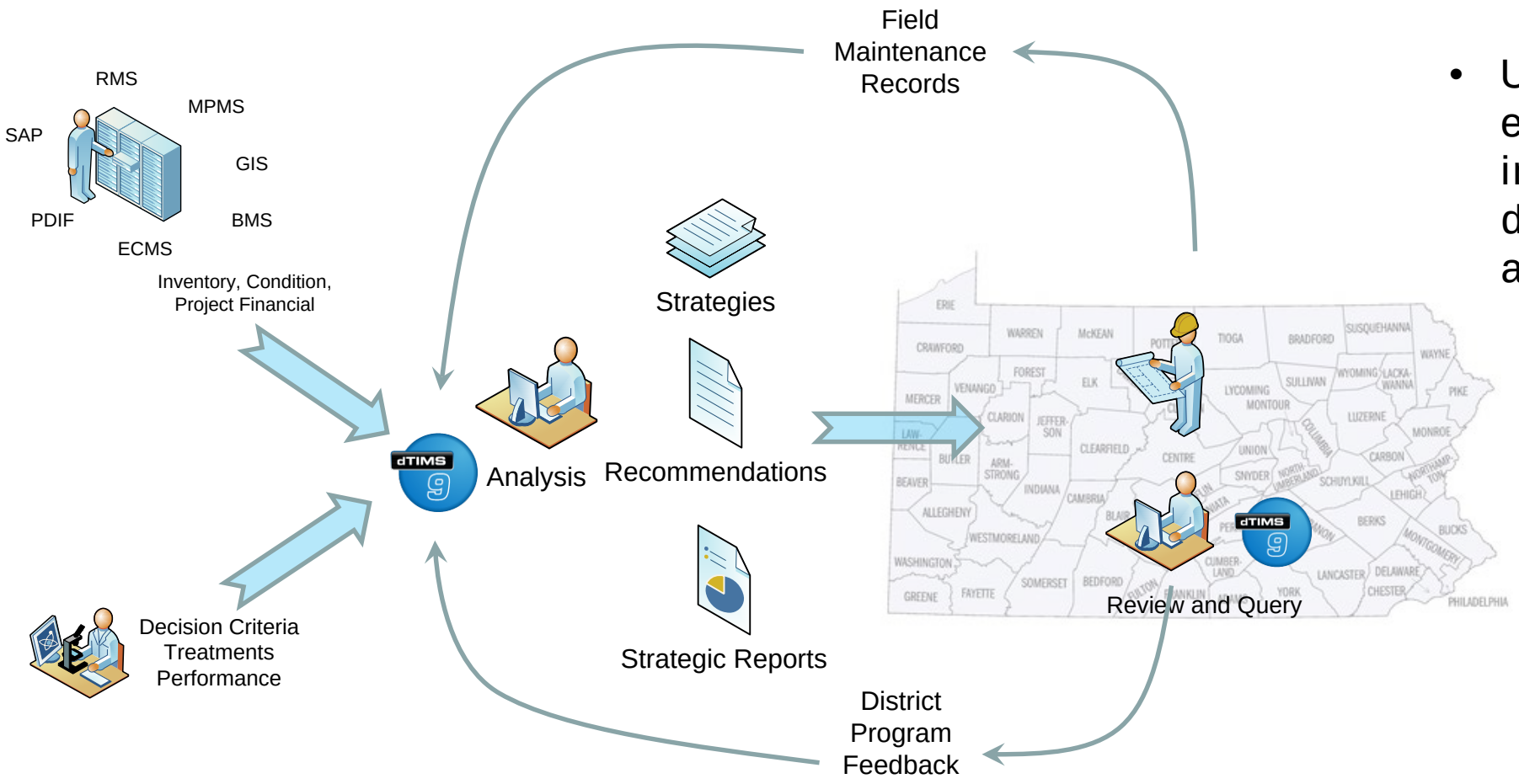
Pavement Asset Management System



- Utilizes information from existing systems – including treatments and decision criteria already agreed upon in RMS

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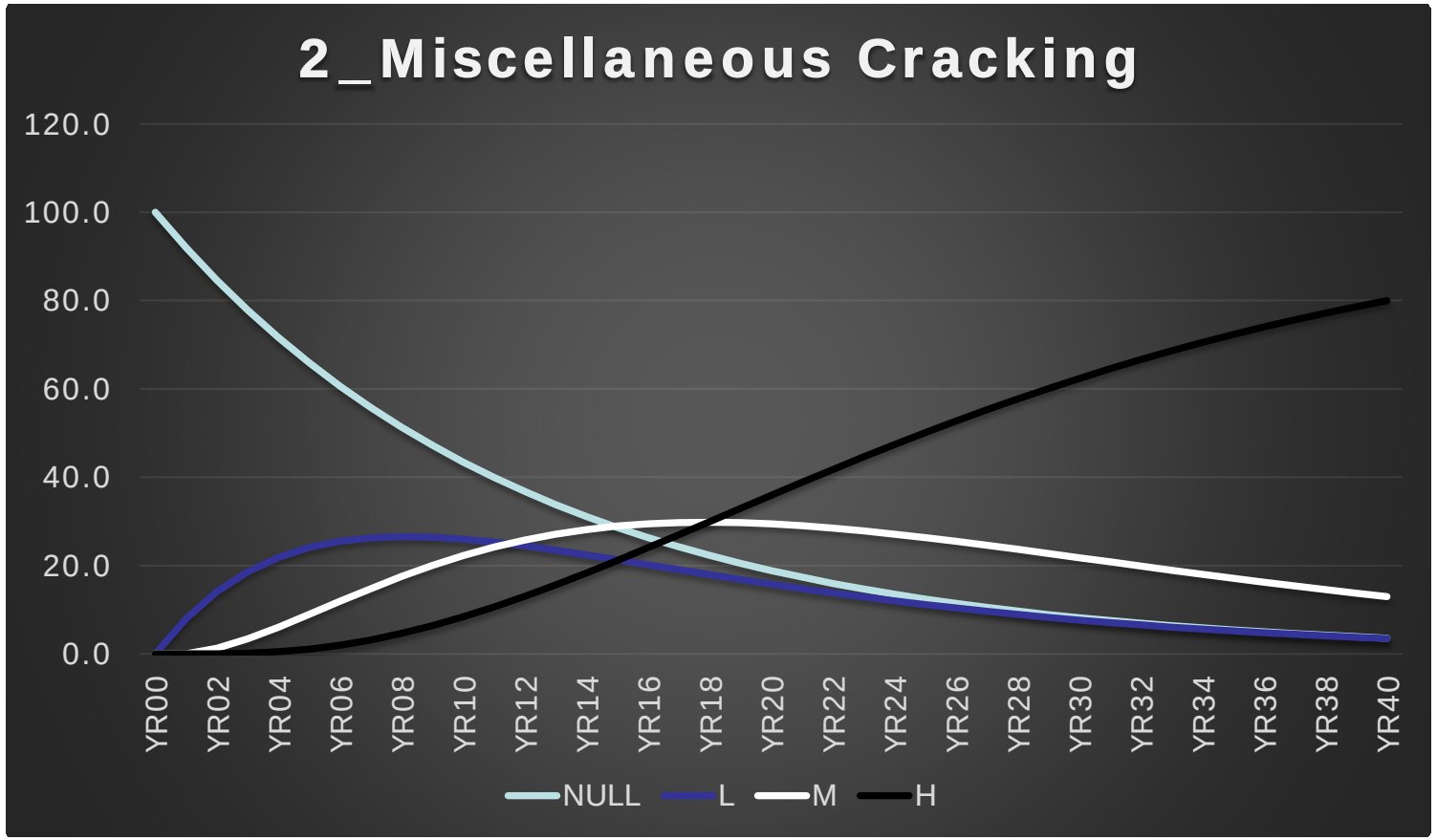
Deterioration Models

- 54 Model Families
- Deterministic Models for IRI and OPI
- Transition Probability Matrices
  - all other distresses i.e. Fatigue cracking, raveling, Left edge joint deterioration



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Performance models

- Overall Pavement Index (OPI)- Pavement Performance Models from data available in PennDOT's Roadway Management System (RMS) to simulate future changes
- 54 Pavement families made by combinations of categories including pavement type, route class, location and traffic level

PPM Process

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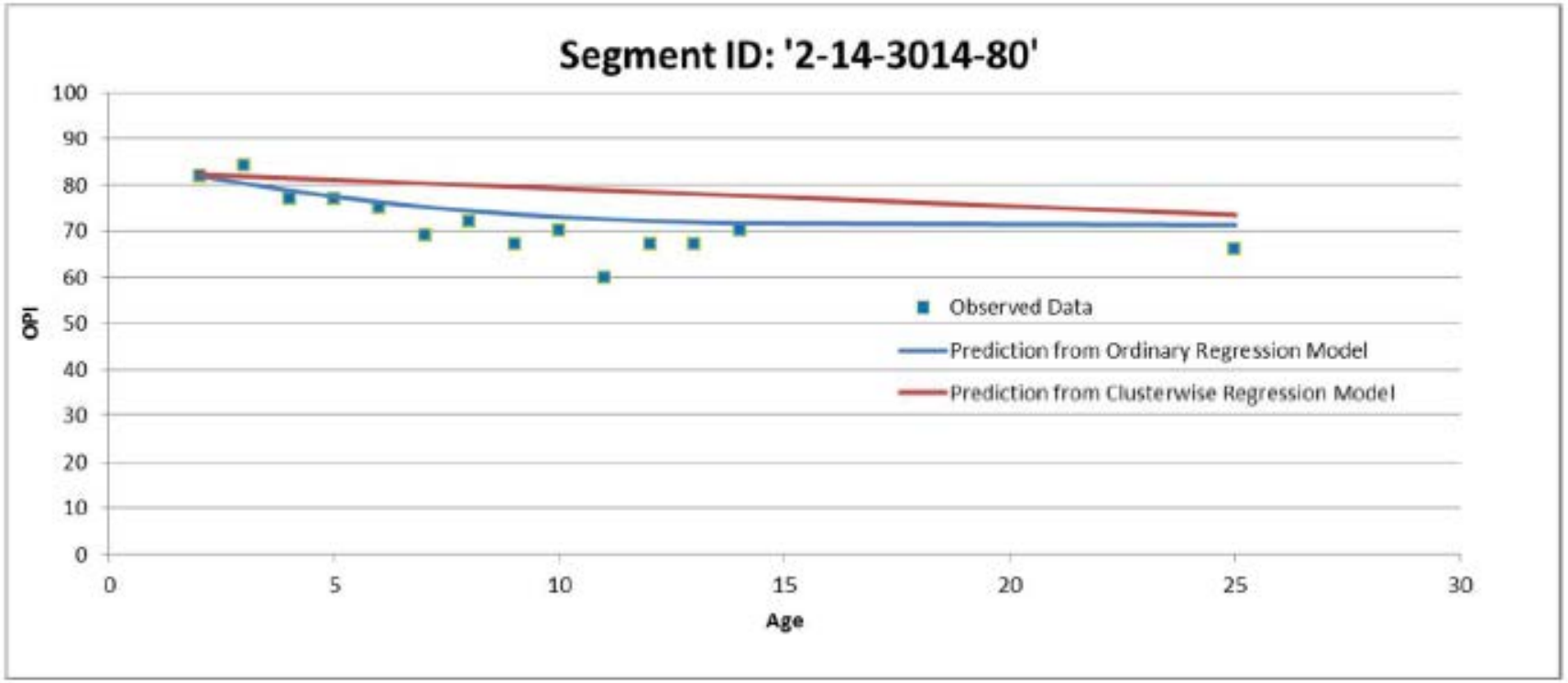
Performance models

- Example of a segment from HMA pavement family



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Pavement Performance Model for Roughness

- Deighton developed roughness models for PennDOT implementation of dTIMS using historic roughness data
- Roughness models against the independent variable of pavement age
- 54 model families evaluated
- Trend lines were fitted through each of the pavement family datasets with exponential and polynomial 2nd and 3rd order forms of the equation

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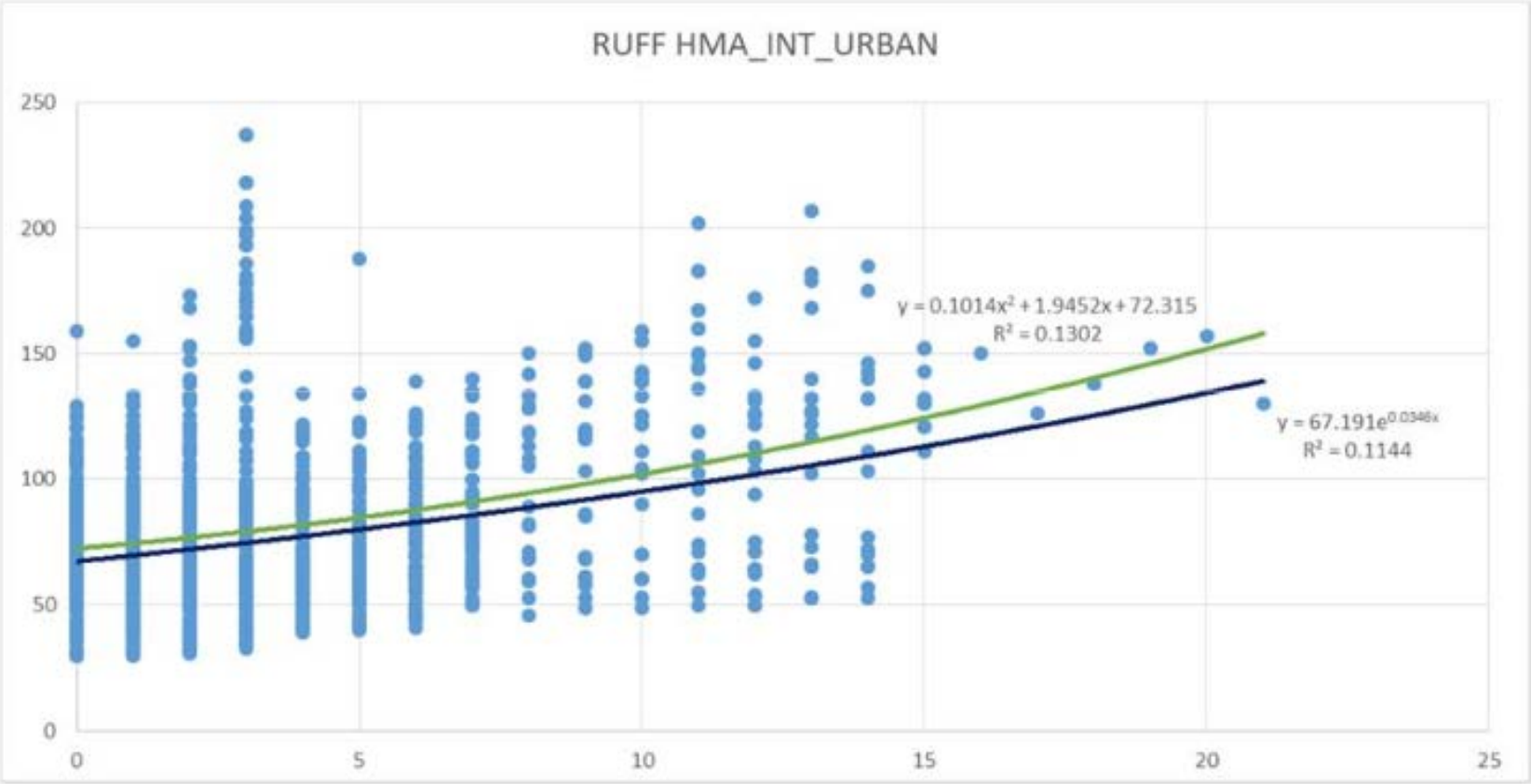
Pavement Performance Model for Roughness

- Example HMA interstate

HMA Interstate



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Deterioration Models

- Transition Probability Matrices (TPM's)
  - Condition data in RMS (based on extent and severity)
  - 54 Model Families
  - 350 TPM's

Transition Probability Matrix				
Severity	NULL	L	M	H
NULL	0.9500	0.0500	0.0000	0.0000
L	0.0000	0.8200	0.1800	0.0000
M	0.0000	0.0000	0.9800	0.0200
H	0.0000	0.0000	0.0000	1.0000

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Deterioration Models

- Modeling individual distresses
  - HMA
    - Fatigue Cracking
    - Transverse Cracking
    - Miscellaneous Cracking
    - Edge Deterioration
    - Raveling/ Weathering
    - Left Edge Joint Deterioration
    - Rut depth
    - Roughness
    - Bituminous patch (not modeled)

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Deterioration Models

- Modeling individual distresses
  - Composite
    - Fatigue Cracking
    - Transverse Cracking
    - Miscellaneous Cracking
    - Edge Deterioration
    - Raveling/ Weathering
    - Left Edge Joint Deterioration
    - Rut depth
    - Roughness
    - Bituminous patch (not modeled)

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Deterioration Models

- Modeling individual distresses
  - Jointed concrete pavement
    - Faulted joints
    - Broken Slabs
    - Transverse Joint Spalling
    - Transverse Cracking
    - Longitudinal Cracking
    - Longitudinal Joint Spalling
    - Bituminous Patch (not modeled)
    - Concrete Patch (not modeled)
    - Rut Depth
    - Roughness

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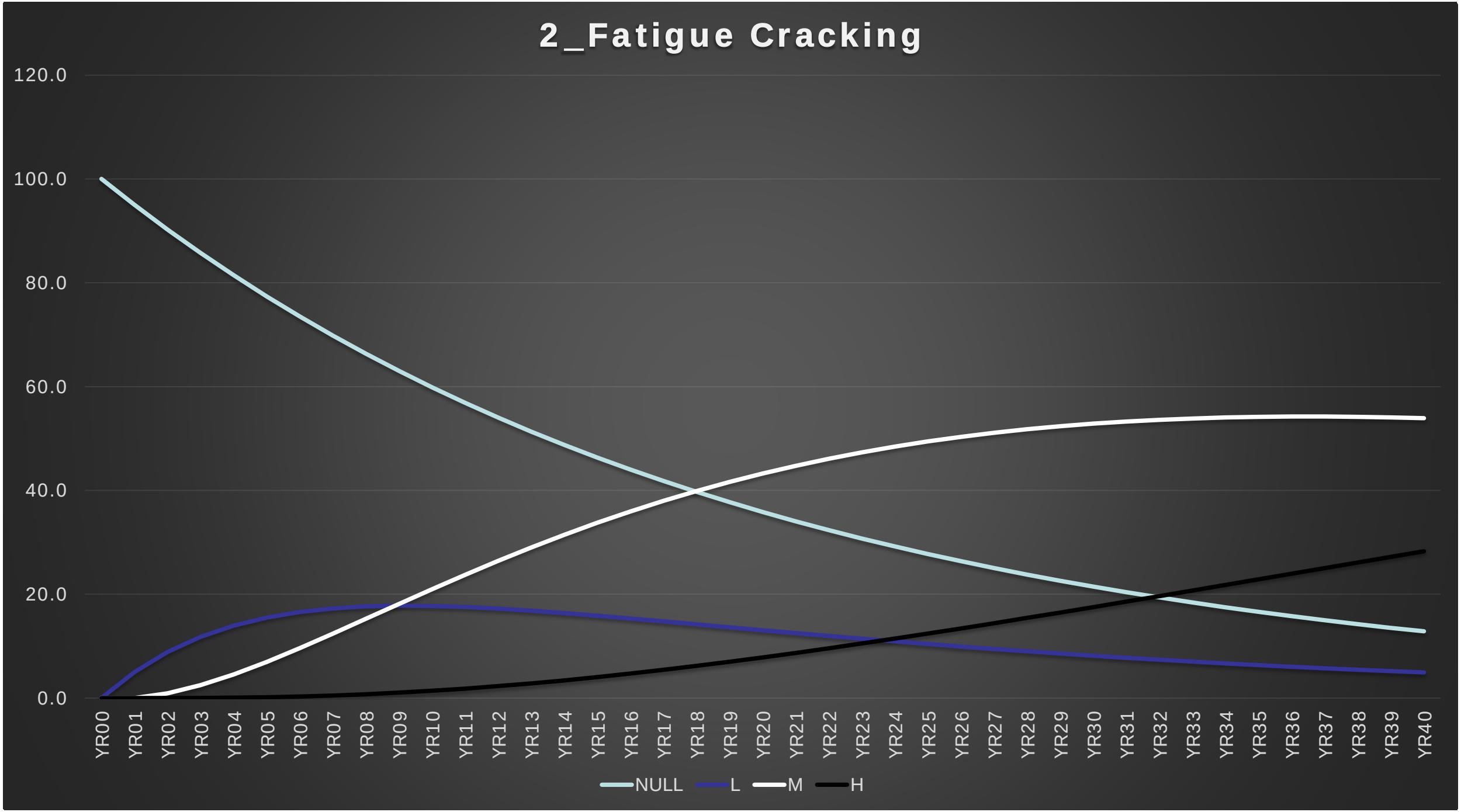
2_Fatigue Cracking
120.0
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80.0
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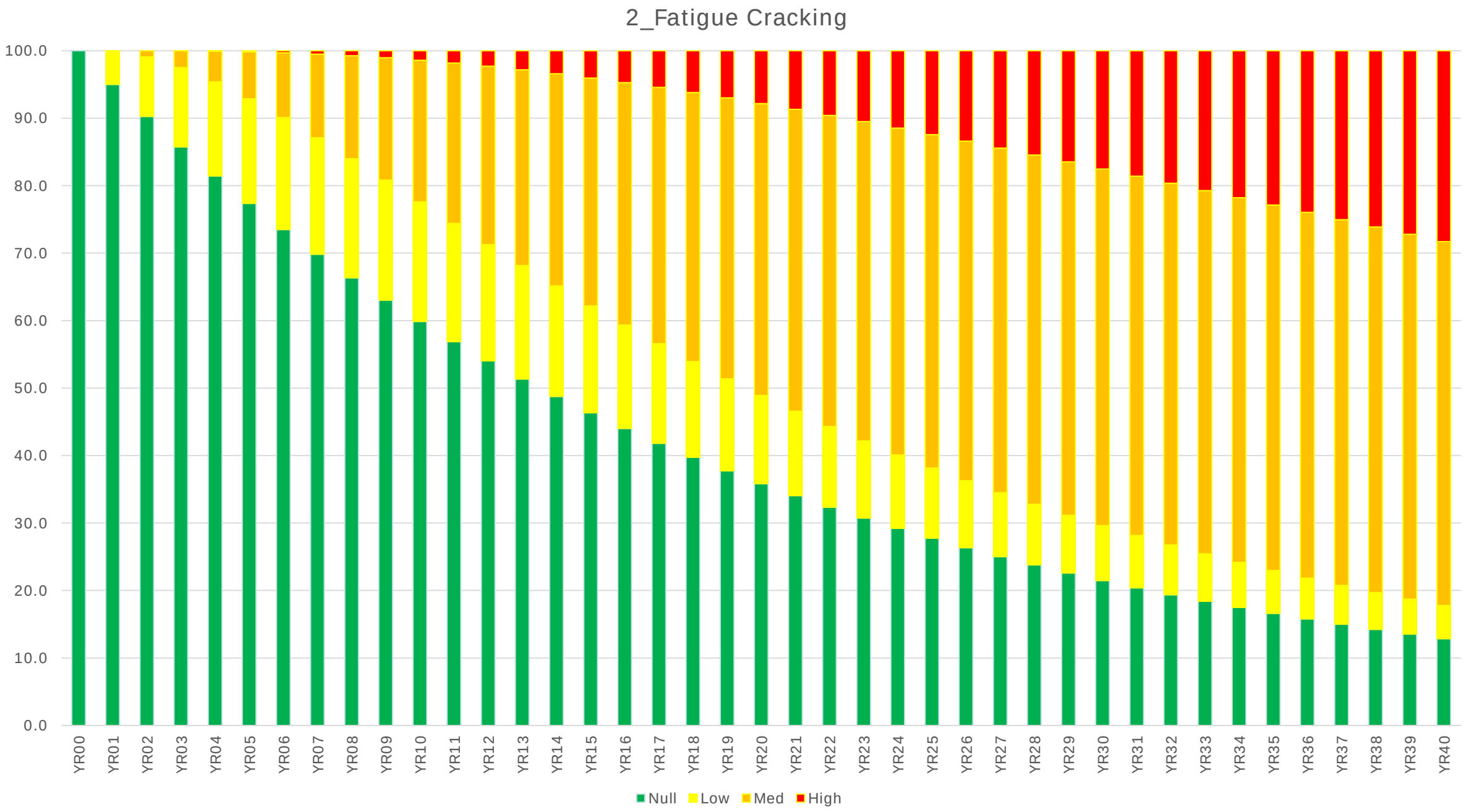
2_Fatigue Cracking
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Med
High

PAMS Sectioning

- Many District's sectioned projects themselves in RMS

- PAMS will section the roadways not already grouped
  - Business Plan Network must be the same
  - County must be the same
  - District must be the same
  - OPI condition must be within 10
  - Year Resurfacing must be within 5 years
  - Surface Types must be similar
  - Minimum length = 0
  - Maximum length = 10 miles

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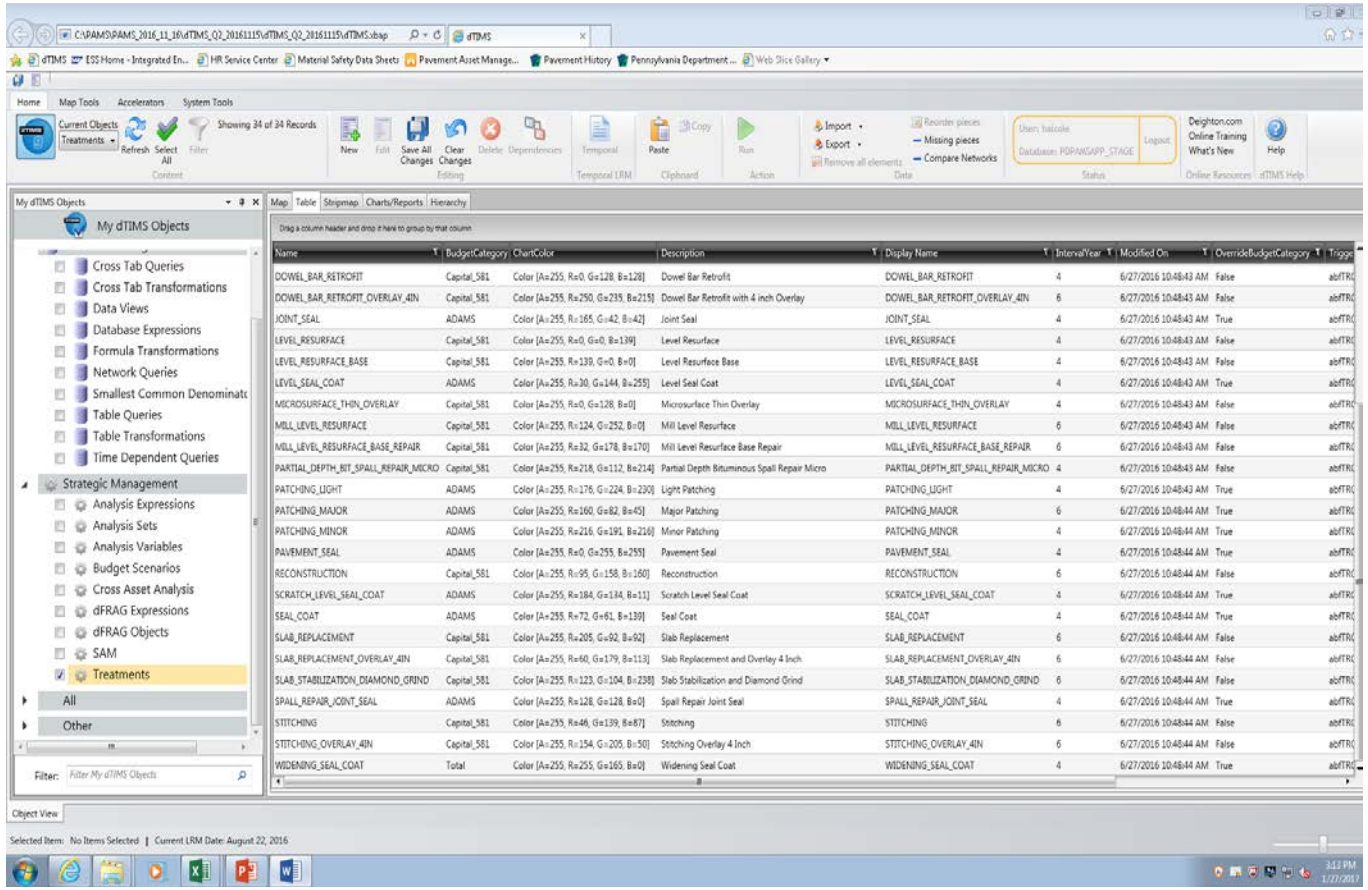
PAMS Treatments

- 34 Pavement treatments
- Pavement treatment Determination
  - Pavement treatment matrices based on roadway type and condition
  - Cost benefit



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PAMS Treatment Selection

dTIMS MM

Select Strategy | Reset Strategy | Reset All Strategies | Add a Strategy | Modifications Report | Export Strategies | Import Strategies

Elements | Strategies

Drag a column header and drop it here to group by that column

RoadName	From	From_Description	To	To_Description	Name	Length	COM_COST	COM_TRT	COM_YEAR	DIS_OPI	DIS_ROUGAVE	INV_AADT	INV_BPN	INV_COUNTY	INV_DIS_IND	INV_FAMILY	INV_FUNC_CLASS	INV_LANES	INV_NHS_IN
54-0011-N	0.000000		1.451000		23141	1.451000	-1			94.703652	80	6603	2 - NHS NON-INTERSTATE	54 - SNYDER		29	02	2	S - STRATEG
54-0011-N	1.451000		4.206000		23142	7.544000	-1			96.467391	50	7653	2 - NHS NON-INTERSTATE	54 - SNYDER		11	02	2	S - STRATEG
54-0011-N	4.207000		6.093000		23142	7.544000	-1			96.467391	50	7653	2 - NHS NON-INTERSTATE	54 - SNYDER		11	02	2	S - STRATEG
54-0011-N	6.094000		8.997000		23142	7.544000	-1			96.467391	50	7653	2 - NHS NON-INTERSTATE	54 - SNYDER		11	02	2	S - STRATEG
54-0011-N	8.997000		10.120000		23143	1.123000	-1			94.054318	48	8118	2 - NHS NON-INTERSTATE	54 - SNYDER		47	02	2	S - STRATEG
54-0011-N	10.120000		10.276000		23144	0.156000	-1			94	40	8118	2 - NHS NON-INTERSTATE	54 - SNYDER		11	02	2	S - STRATEG
54-0011-N	10.276000		10.776000		1136	3.960000	-1	MICROSURFACE_THIN_OVERLAY	5	93.596362	63	8932	2 - NHS NON-INTERSTATE	54 - SNYDER		44	12	2	S - STRATEG
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54-0011-N	14.237000		14.865000		1137	0.628000	-1	LEVEL_RESURFACE	2	81.312101	91	19099	2 - NHS NON-INTERSTATE	54 - SNYDER		44	14	2	S - STRATEG
54-0011-N	14.865000		15.105000		23145	0.240000	-1			78	96	18830	2 - NHS NON-INTERSTATE	54 - SNYDER		44	14	2	S - STRATEG
54-0011-N	15.106000		17.352000		23146	2.246000	-1			92.037845	65	17223	2 - NHS NON-INTERSTATE	54 - SNYDER		44	14	2	S - STRATEG
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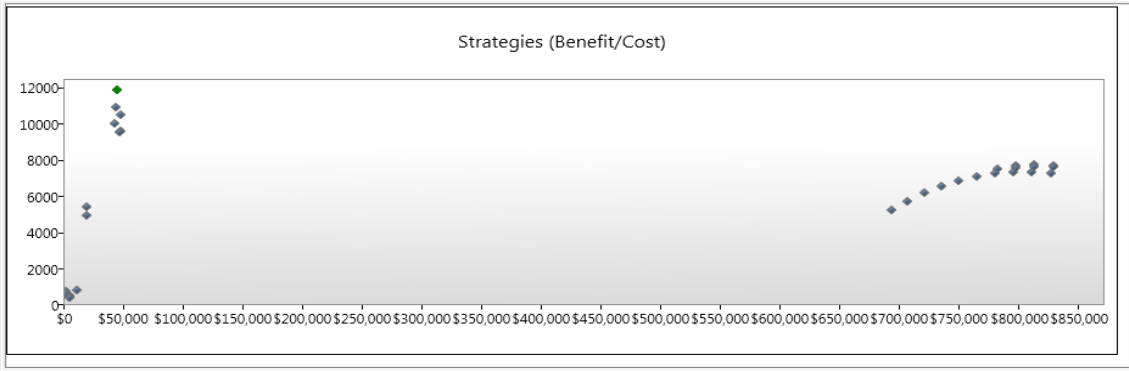
54-0011-N	17.807000		18.274000		23148	0.467000	-1			88.134903	92	17433	2 - NHS NON-INTERSTATE	54 - SNYDER		47	02	2	Y - NATIONA
54-0011-N	18.274000		18.528000		23149	0.254000	-1			92	83	17433	2 - NHS NON-INTERSTATE	54 - SNYDER		12	02	3	Y - NATIONA

Strategy Treatments | Original Strategy Treatments | Budgets

NYEAR	Treatment	Type	Budget Category	Financial Cost	Economic Cost
2022	PATCHING_MAJOR	Major	SNYDER	$52,978.43	$0.00

Efficiency Chart | Analysis Variables | Analysis Variables Chart | Strategies Chart | Budget Chart



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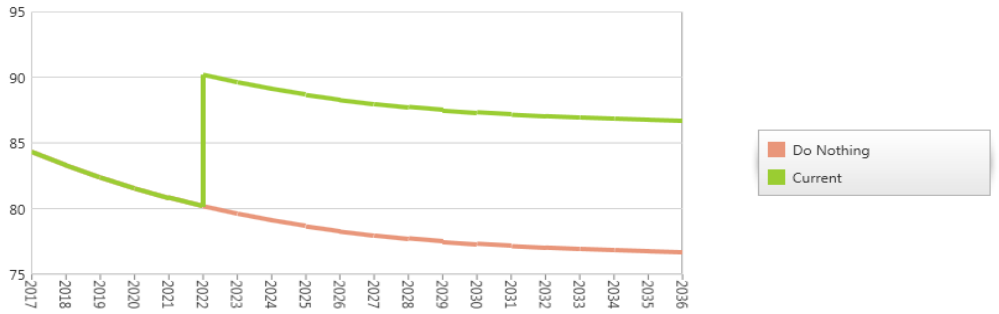
Analysis Variable: nAAV_CND_OPI



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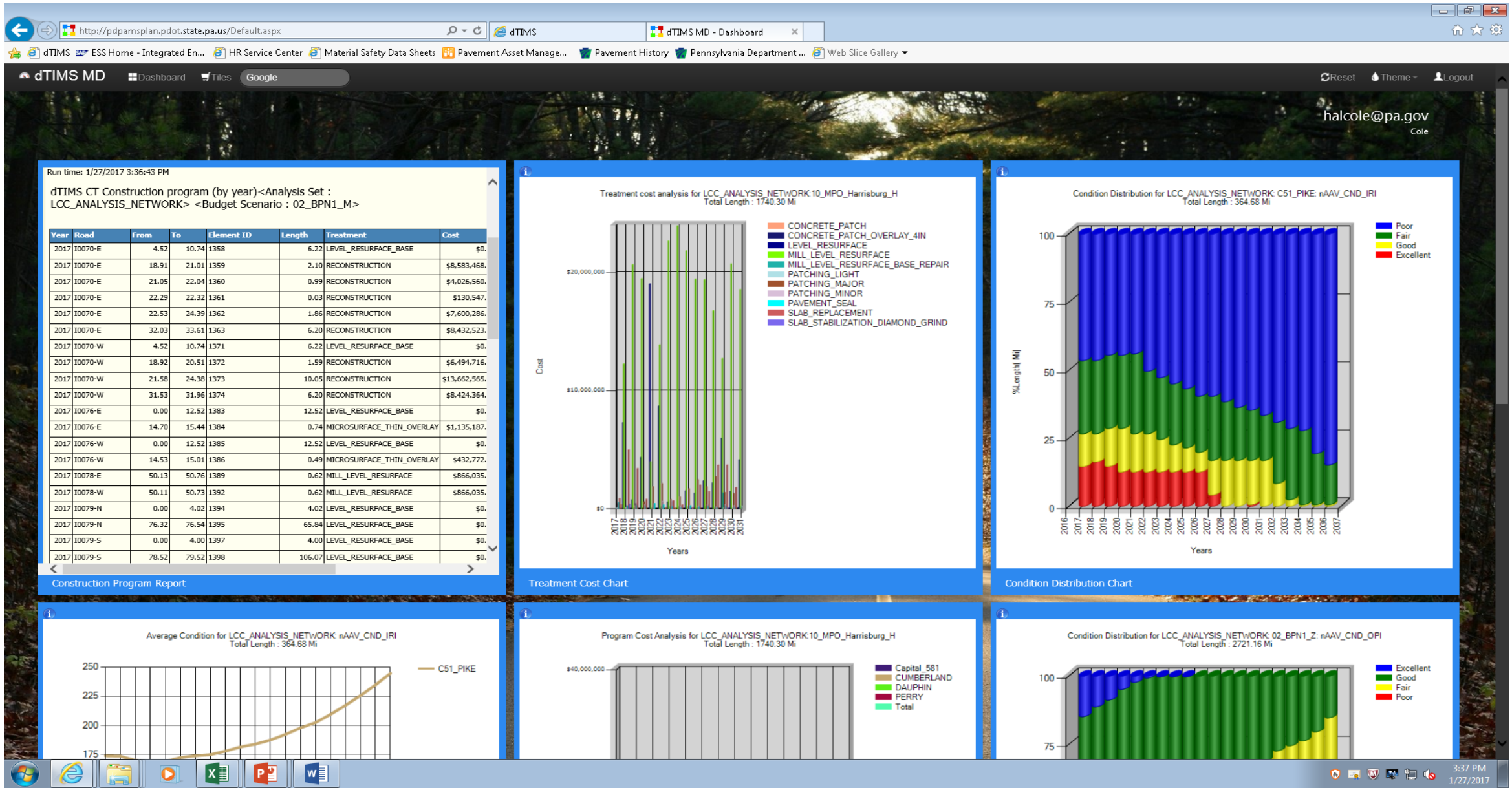
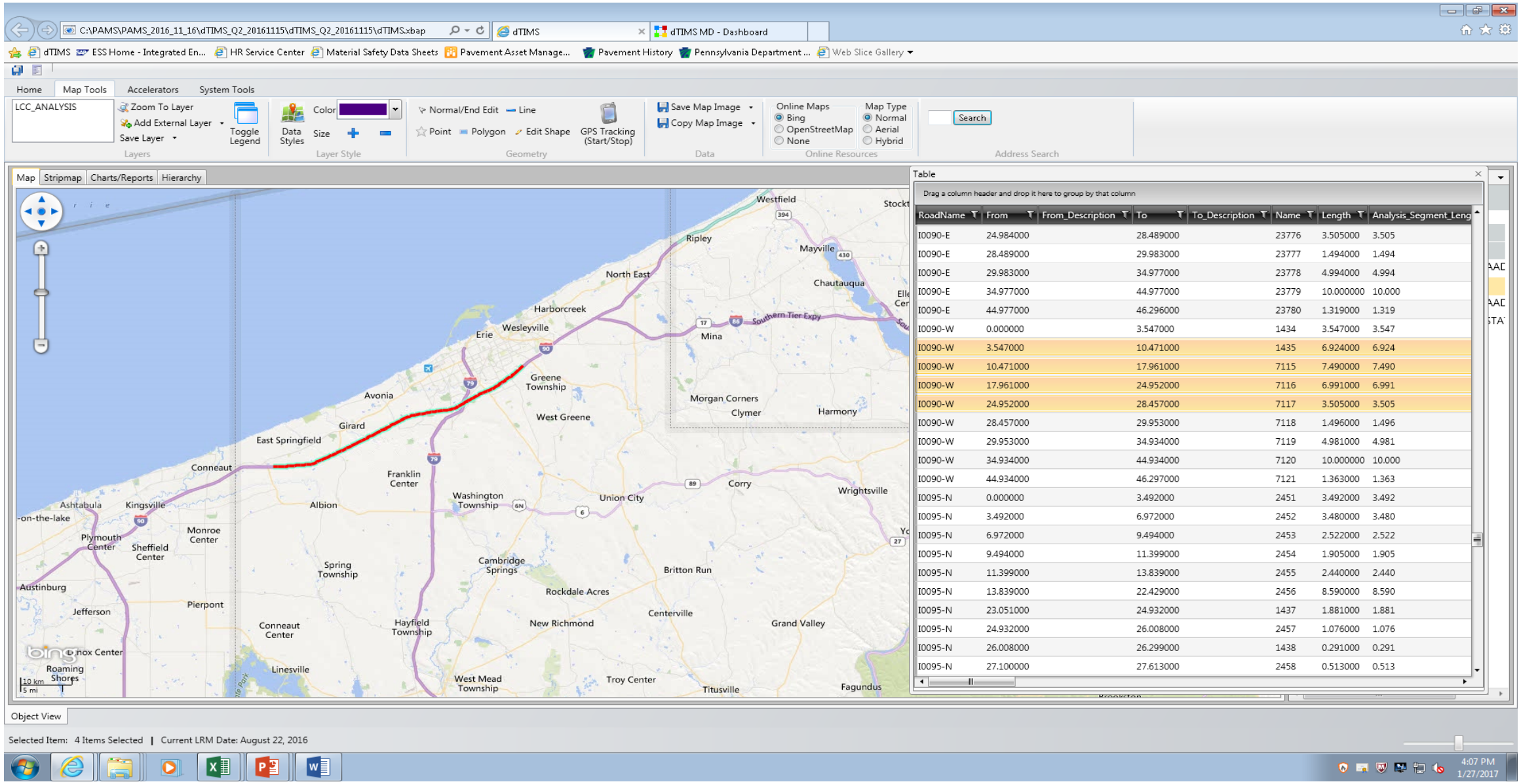
PAMS Management Dashboard



PAMS Mapping



RoadName	From	From_Description	To	To_Description	Name	Length	Analysis_Segment_Leng
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I0090-E	28.489000		29.983000		23777	1.494000	1.494
I0090-E	29.983000		34.977000		23778	4.994000	4.994
I0090-E	34.977000		44.977000		23779	10.000000	10.000
I0090-E	44.977000		46.296000		23780	1.319000	1.319
I0090-W	0.000000		3.547000		1434	3.547000	3.547
I0090-W	3.547000		10.471000		1435	6.924000	6.924
I0090-W	10.471000		17.961000		7115	7.490000	7.490
I0090-W	17.961000		24.952000		7116	6.991000	6.991
I0090-W	24.952000		28.457000		7117	3.505000	3.505
I0090-W	28.457000		29.953000		7118	1.496000	1.496
I0090-W	29.953000		34.934000		7119	4.981000	4.981
I0090-W	34.934000		44.934000		7120	10.000000	10.000
I0090-W	44.934000		46.297000		7121	1.363000	1.363
I0095-N	0.000000		3.492000		2451	3.492000	3.492
I0095-N	3.492000		6.972000		2452	3.480000	3.480
I0095-N	6.972000		9.494000		2453	2.522000	2.522
I0095-N	9.494000		11.399000		2454	1.905000	1.905
I0095-N	11.399000		13.839000		2455	2.440000	2.440
I0095-N	13.839000		22.429000		2456	8.590000	8.590
I0095-N	23.051000		24.932000		1437	1.881000	1.881
I0095-N	24.932000		26.008000		2457	1.076000	1.076
I0095-N	26.008000		26.299000		1438	0.291000	0.291
I0095-N	27.100000		27.613000		2458	0.513000	0.513

Questions

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DEPARTMENT OF TRANSPORTATION