New Jersey Thin-Lay Experience – High Performance Thin Overlay -

Mid-Atlantic Quality Assurance Workshop 2017
Hershey, PA

Overview

- Brief History
- NJDOT HPTO Specification Review
- Examples of Field Projects
- Updated HPTO Spec for 2017
- Open Discussion

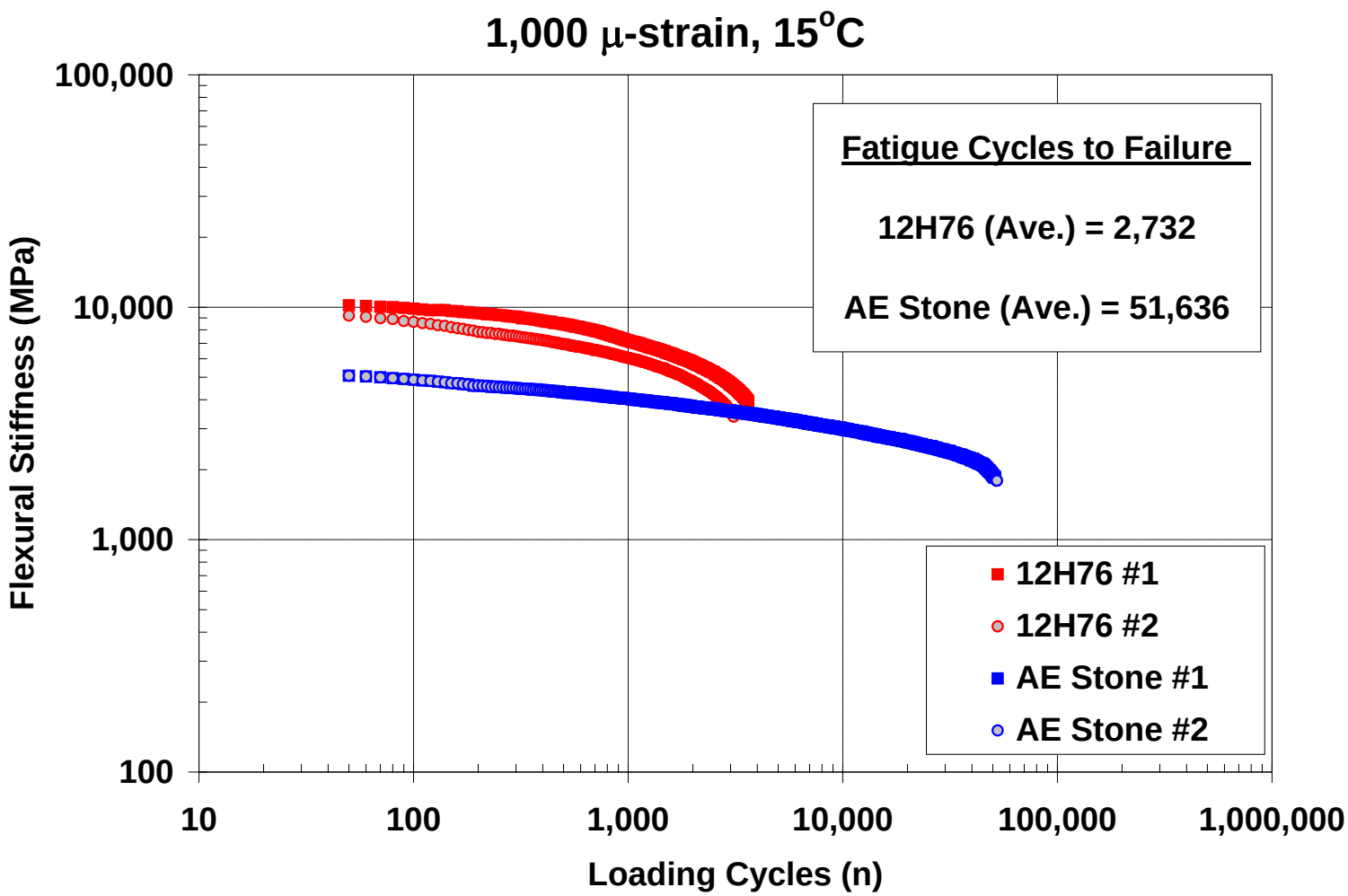
Background

- In 2005, Rutgers began working on a thin-lift mixture to be used for low volume applications
  - In collaboration with Citgo Asphalt
    - Citgo recommending for towns/municipalities
    - Sold under the name "FlexGard"
  - Meant for improving smoothness, structure, and "sealing" existing pavement
  - Modeled after NYSDOT 6F mixture
    - NYSDOT frequently uses ¼" stone
    - Neat binder

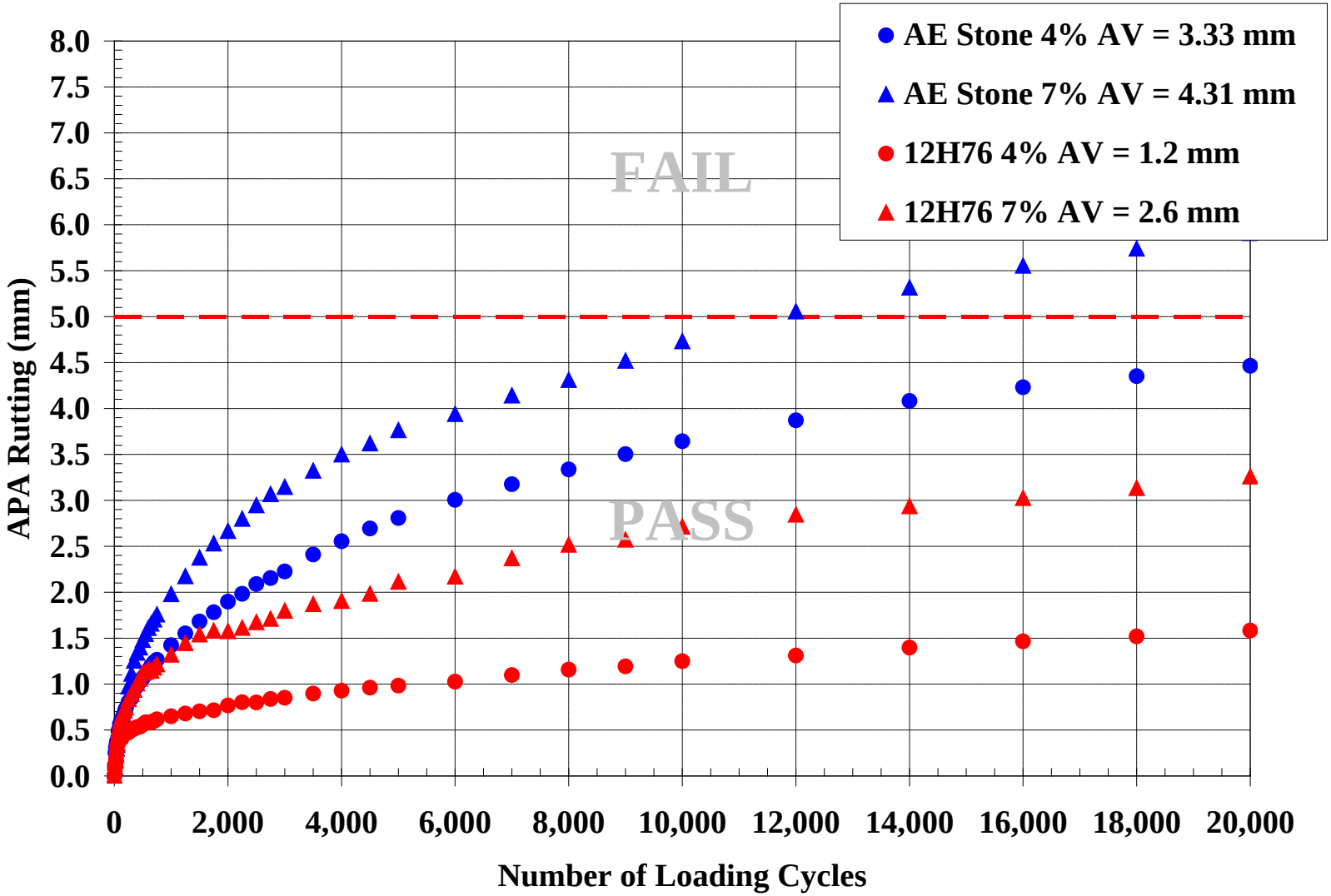
Background - continued

- In 2006, South Jersey asphalt supplier began recommending a high performance fine aggregate mix for heavy duty parking lots and for the south Jersey municipalities roads and AC Expressway
  - Based on Superpave 4.75 mm NMAS (very fine 9.5 mm NMAS)
  - PG76-22, no RAP
- No specification at time – placed for a few clients

Flexural Fatigue Comparisons



Rutting Stability – Asphalt Pavement Analyzer



Background - Continued

- March 2006 – Draft Specification developed based on early laboratory test results
- Citgo Refinery Trials
  - Using preliminary NJDOT "spec", Citgo Asphalt installed approximately 1,000 tons of HPTO on refinery road
    - Heavy tanker truck traffic
    - Existing thin pavement section showing extensive cracking
    - No milling prior to placement, just tack
- Conducted forensic analysis
  - Mixture testing
    - Loose mix and field cores

Citgo Refinery – June, 2006

Citgo Refinery – June, 2006

Citgo Refinery – June, 2006

Citgo Refinery – June, 2007

- One year after placement, visual distress survey and field cores taken
- Minimal cracking (reflective from previous cracking)
  - Thin application area
- HPTO "sealed" existing cracks
  - Proper thickness

NJDOT HPTO Specification

Background - continued

- HPTO Final Specification – 2007
  - 1st spec in NJ to require performance testing
    - Added performance testing during design and production
  - Mixture targeted for pavement preservation type applications
    - Found to also be a "superior" leveling course in areas where extended staged construction was needed

High Performance Thin-Overlay

Job Mix Formula Requirements	
Sieve Size	Percent Passing
3/8"	100
#4	65 - 85
#8	33 - 55
#16	20 - 35
#30	15 - 30
#50	10 - 20
#100	5 - 15
#200	5 - 8
Min. % Binder	7.0

FAA > 45% (AASHTO T304)
Fine aggregate from stone sand (no natural sands)

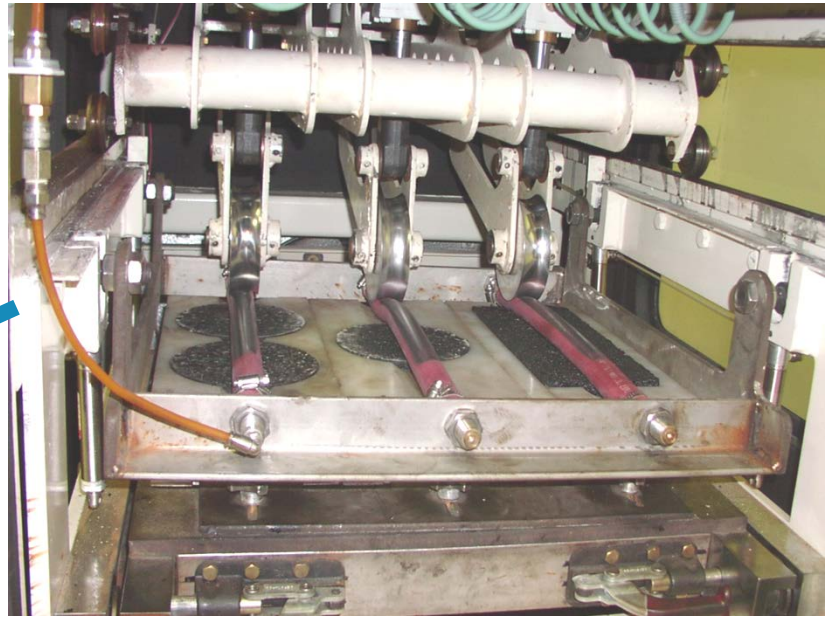
Sand Equivalency > 45% (AASHTO T176)

Volumetric Requirements for Design and Control of HPTO					
Requirements	Required Density (% of Max. Sp. Gr.)		Voids in Mineral Aggregate (VMA)	Dust to Binder Ratio	Draindown, AASHTO T305
	Ndes (50 Gyrations)	Ndes (100 Gyrations)			
Design	96.5	< 99.0	> 18.0%	0.6 - 1.2	< 0.1 %
Control	95.5 - 97.5	< 99.0	> 18.0%	0.6 - 1.2	< 0.1 %

High Performance Thin-Overlay

- Asphalt Binder
  - Polymer-modified binder
    - Originally PG76-22 (now PG64E meeting % Recovery curve)
    - RTFO Elastic Recovery > 65% @ 25°C (AASHTO T301)
- Performance Specification
  - Utilize the Asphalt Pavement Analyzer (AASHTO T340) for stability check
    - Mix design verification and production control (1st Lot and every other Lot after)

Asphalt Pavement Analyzer



- AASHTO T340
- 100 lb wheel load; 100 psi hose pressure
- Tested at 64°C for 8,000 loading cycles
- Samples at 5 +/- 0.5% air voids
- APA Rutting
    - < 4 mm to PASS for Design
    - < 5 mm to PASS for Production

Examples NJDOT HPTO Projects

1st HPTO Project – I295

2nd NJDOT HPTO: Route I-287 SB

- MP 30.2 to 35.5
- 44 million ESAL
- Full depth Bituminous Concrete Pavement
- Three 12 foot lanes with 12 foot outside shoulder and 4 foot inside shoulder.
- Previous Resurfacing approximately 8 years old.
- Pavement Management Data (right lane)
  - Average IRI = 91 inches/mile
  - Average Rut Depth = 0.2 inches
  - Average SDI = 1.7 (Rating 1 to 5)*

    * **Fatigue cracking was major issue**

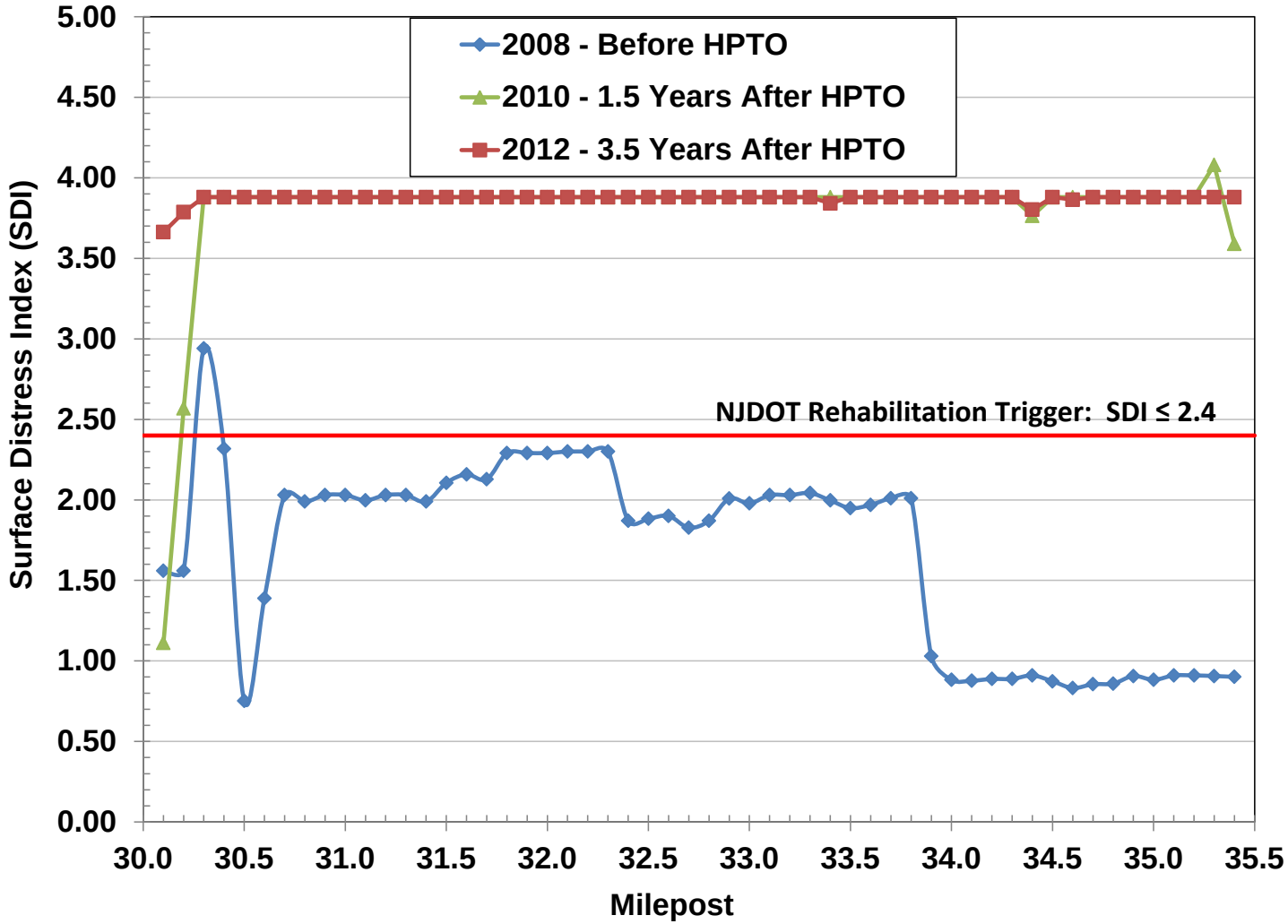
Route I-287 Project Scope

- Mill 1" depth – in areas with extensive cracking to remove crack sealer and in transition areas.
- Tack using PG 64-22.
- Pave 1" HPTO.
- No treatment on the outside shoulder except for replacing the rumble strip.

Route I-287 in 2012 (3.5 Years)

- Average Air Voids = 5.8% (based on field cores)
- Skid Resistance (SN40) = 51
  - Recommended minimum skid number for 65 mph roadway is 43.
- IRI = 87 inches/mile
- Rut Depth = 0.1 inches
- Average SDI = 3.9 (Rating 1 to 5)

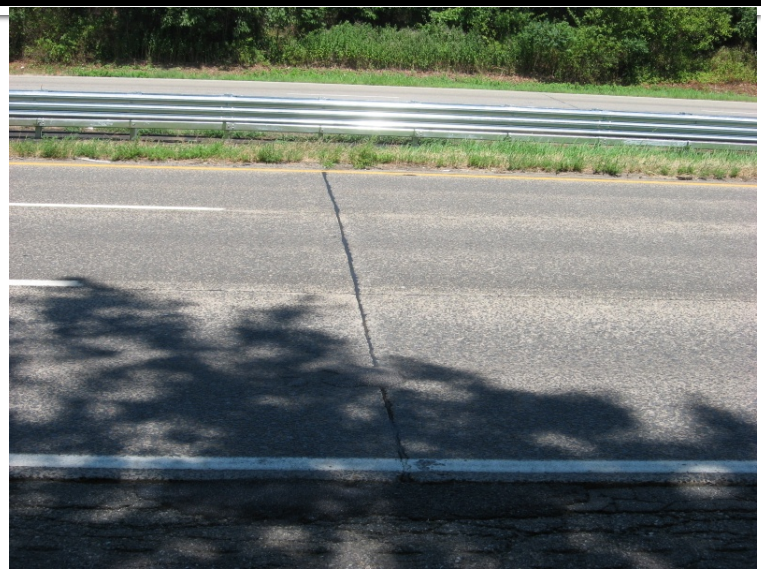
Surface Distress Index (SDI)



Route I-287 in 2013

NJ I-280 Conditions

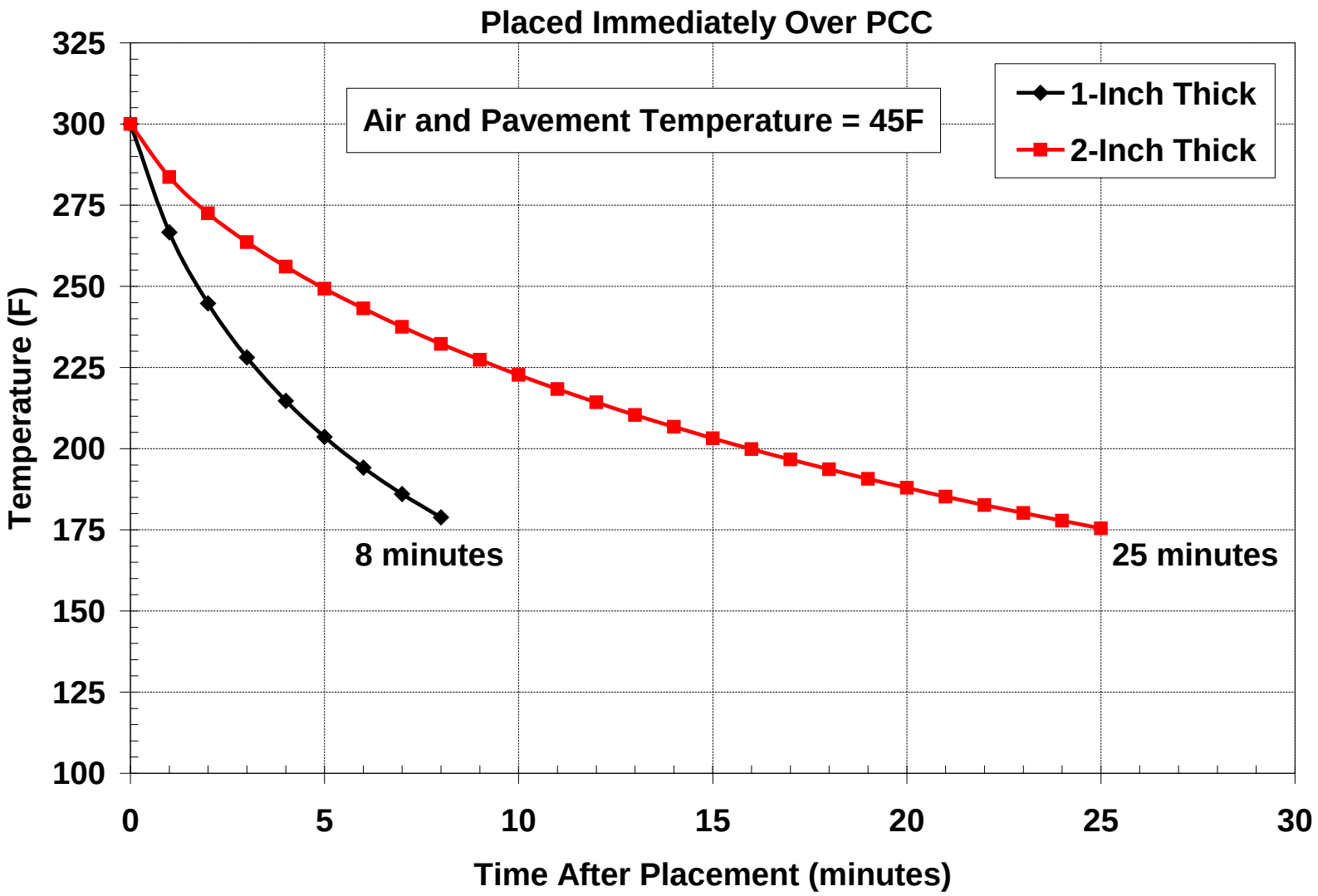
- Deteriorating PCC pavement
- High vertical deflections at joints
- Heavy traffic volume
- HPTO used as a "superior" leveling course over faulted PCC
  - Staged construction would require it left open to traffic for 8 months
    - 11/2009 to 7/2010



Incorporation of WMA into HPTO

- I280 Schedule
  - Issues with undersealing (severe upheaval at PCC joints – too much grout!)
  - All joint area required diamond grinding
  - Pushed HPTO paving schedule to start in November, 2009
- Addition of WMA additive was used for
  - Improved workability and compactability
  - PCC Patch and Joint Material

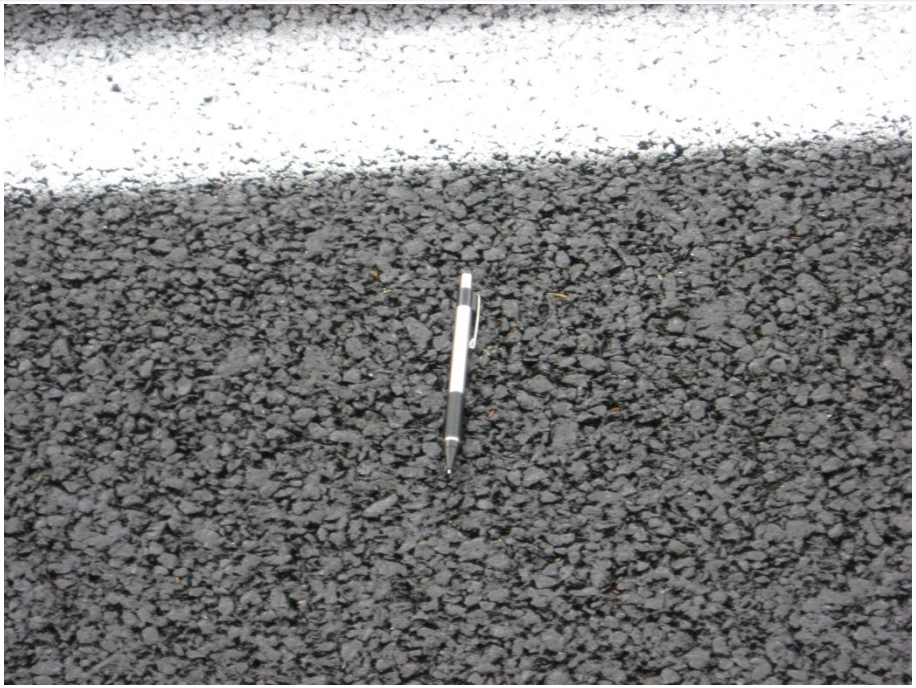
General Thin-Lift HMA Cooling (MultiCool 3.0)



Swelling Areas on NJ I-280

HPTO left open to traffic from November 2009 to July 2010

NJ I-280 – Completed September, 2010



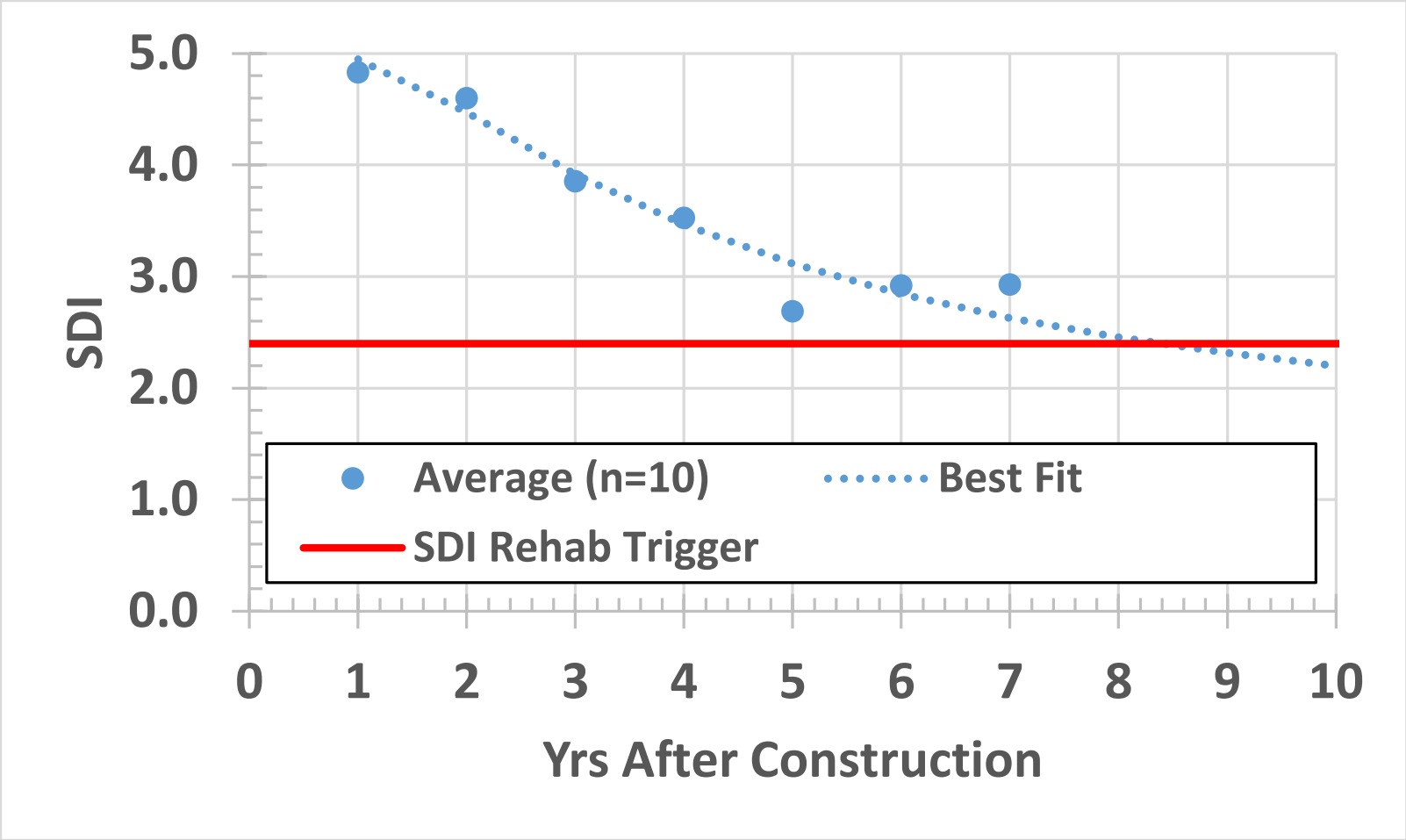
NJDOT HPTO

- Since 2008, 19 different pavement locations with HPTO
  - To date, generally good performance when compared to conventional HMA
  - Since used primarily as Pavement Preservation treatment, important to consider existing pavement condition prior to placement.

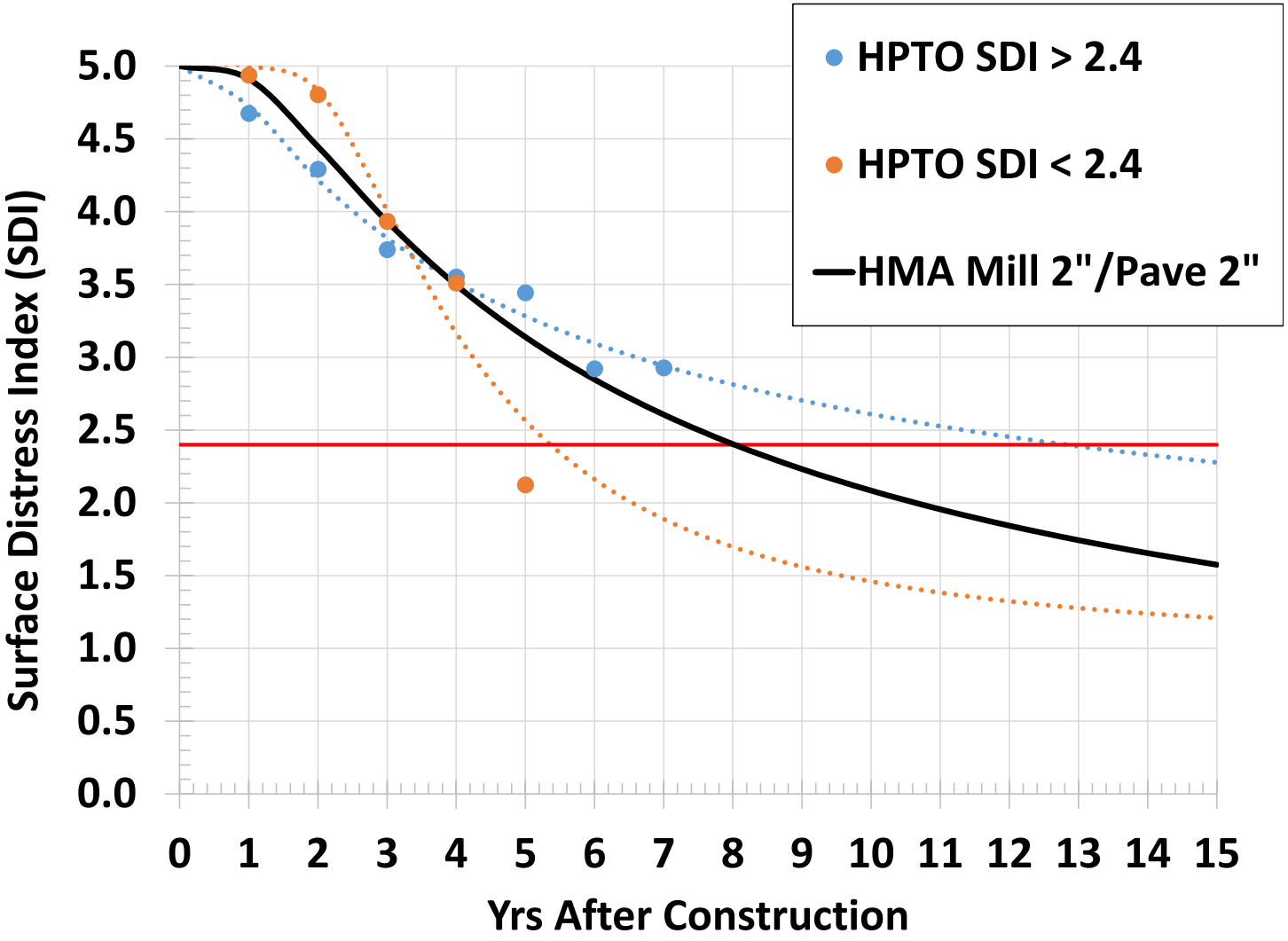
HPTO PMS Analysis

- HPTO placed on 19 different pavement sections since 2008
- Evaluated changes in SDI to evaluate performance of HPTO on New Jersey pavement sections
- Compared performance life for different scenarios
  - All data averaged
  - Where HPTO was placed on pavement with pre-existing SDI > 2.4
  - Where HPTO was placed on pavement with pre-existing SDI < 2.4
  - Comparison of typical Mill 2"/Pave 2"
  - An SDI value of 2.4 is a trigger for rehabilitation

All HPTO Sections (Averaged)



HPTO Sections for Pre-existing Pavement SDI (Averaged)

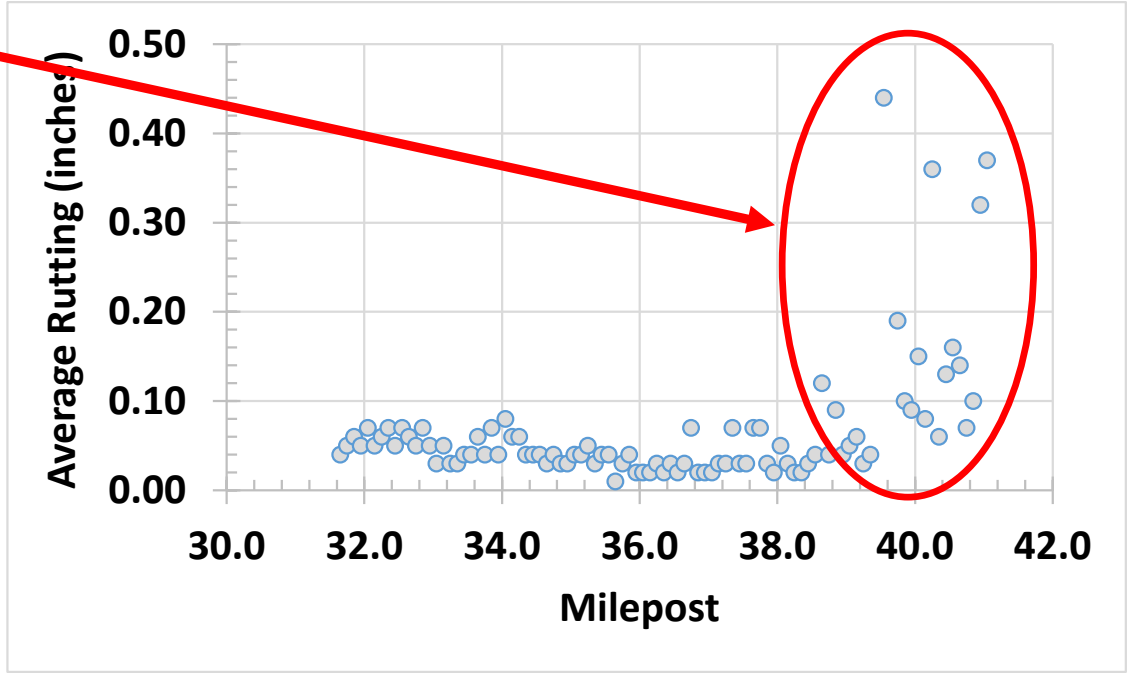


2017 HPTO Update

2016 PMS Data (August, 2016)

- Example: New Jersey HPTO – AASHTO T340

Date	APA (mm)
5/27/2015	6.56
5/28/2015	6.23
5/29/2015	6.5
6/3/2015	6.84
6/4/2015	3.66
6/5/2015	3.87
6/9/2015	3.92
6/10/2015	4.32
6/11/2015	3.98
6/12/2015	3.73
6/17/2015	3.83
6/18/2015	2.94
6/19/2015	2.73
6/24/2015	3.99

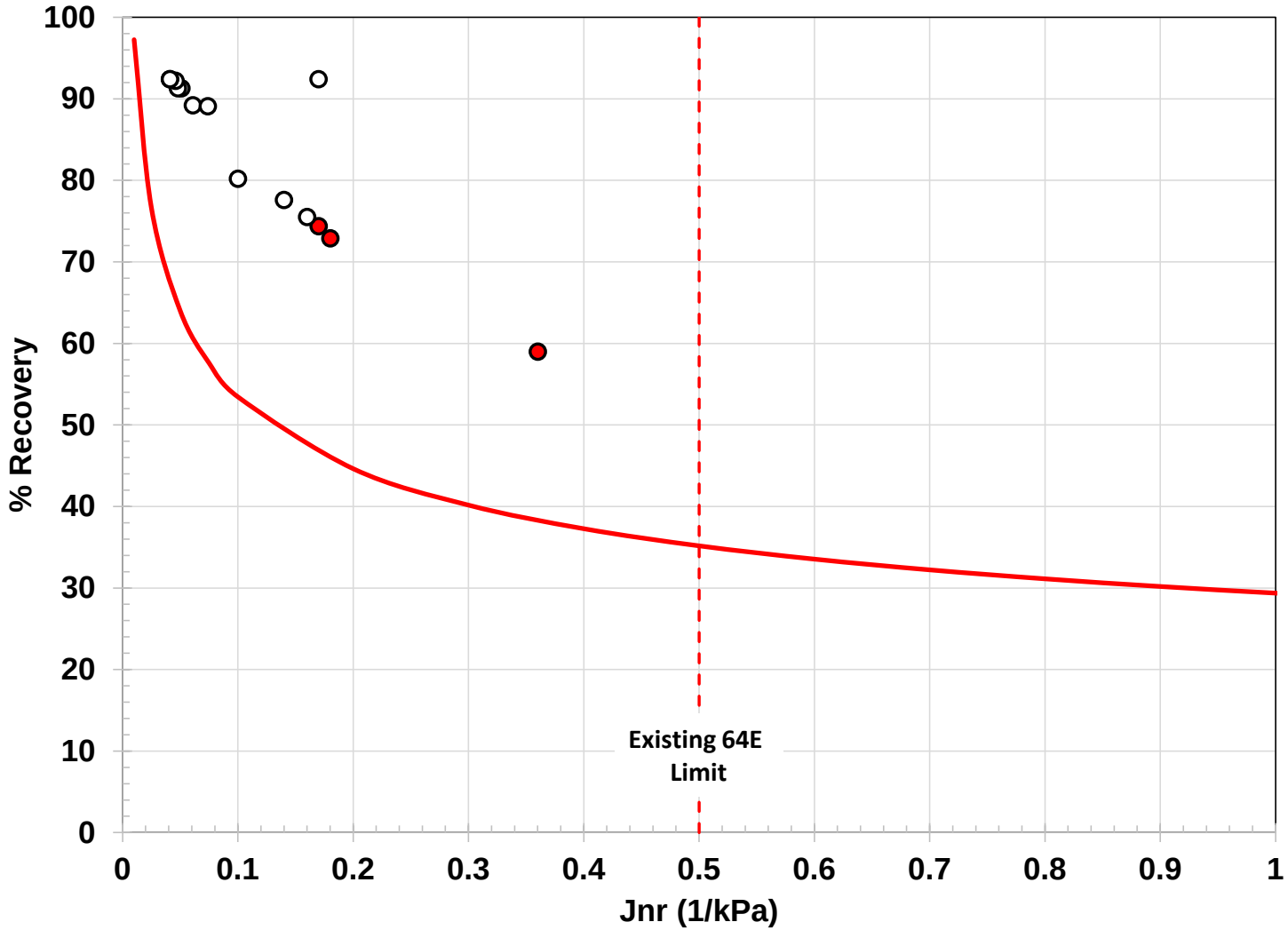


2015 Failing HPTO Binder Testing

- Some issues in 2015 regarding failing HPTO mixtures specified using PG64E-22 asphalt binder
  - Minimal previous issues prior to PG64E use (i.e. – AASHTO M320)

Date	Original	RTFO	PG Grade	Jnr (1/kPa)	% Rec	MSCR Grade	δ @ 76C (Orig)	δ @ 76C (RTFO)	APA (mm)
5/27/2015	77	76.6	PG76	0.36	59	PG64E	73.6	68.3	6.56
5/28/2015	78.8	78.8	PG76	0.18	72.9	PG64E	69.5	64.5	6.23
5/29/2015	79.6	79.6	PG76	0.17	74.4	PG64E	69.9	64.5	6.5
6/3/2015	78.3	78.7	PG76	0.16	75.5	PG64E	69.6	63.5	6.84
6/4/2015	86.5	79	PG76	0.17	92.4	PG64E	58.9	58.4	3.66
6/5/2015	84.2	78.6	PG76	0.14	77.6	PG64E	65.4	64.8	3.87
6/9/2015	87	81.1	PG76	0.061	89.2	PG64E	60.7	60.1	3.92
6/10/2015	83.7	81.7	PG76	0.1	80.2	PG64E	66	61.8	4.32
6/11/2015	86.3	80.9	PG76	0.051	91.3	PG64E	60.8	58.4	3.98
6/12/2015	82.4	81.2	PG76	0.048	91.3	PG64E	66.8	60.4	3.73
6/17/2015	87.5	81.8	PG76	0.046	92.2	PG64E	60.6	57.9	3.83
6/18/2015	87.6	82.6	PG82	0.041	92.4	PG64E	61.2	59.2 @ 82C	2.94
6/19/2015	86.5	82.3	PG82	0.041	92.4	PG64E	59.2	59.2 @ 82C	2.73
6/24/2015	83.8	79.5	PG76	0.074	89.1	PG64E	62	59.7	3.99

2015 Failing HPTO Binders



NJDOT HPTO Spec Revisions

- Asphalt Binder Grade – no longer specifying a PG grade
  - Use polymer modified asphalt binder that is specially formulated for meeting the mix performance criteria in this specification. Consult with the asphalt binder supplier to obtain the appropriate material for the specific mix design. Submit a certificate of analysis (COA) showing the PG continuous grading (AASHTO R 29) for the asphalt binder used in the mix design.

NJDOT HPTO Spec Revisions

- Asphalt Binder Grade – continued
  - For QA testing of the asphalt binder, the ME may sample the asphalt binder during production of the mix and compare the results with the COA submitted at the time of mix design. If the high and low temperature test results are within 5% of the results from the same temperature on the COA, then the ME will consider the asphalt binder comparable to the binder used during mix design.

NJDOT HPTO Spec Revisions

- Asphalt Mixture Testing – Addition of the Overlay Tester
  - The ME will approve the JMF if the average rut depth for the 6 specimens in the asphalt pavement analyzer testing is not more than 4 mm in 8,000 loading cycles and <u>the average number of cycles to failure in the Overlay Tester is greater than 750.</u> If the JMF does not meet the APA and Overlay Tester criteria, redesign the HPTO mix and submit for retesting.

NJDOT HPTO Spec Revisions

- Pay Adjustment

Table 902.08.03-1 Performance Testing Pay Adjustments for HPTO			
Test	**Requirement**	**Test Result**	**PPA**
APA @ 8,000 loading cycles, mm (AASHTO T 340)	5.0 maximum	$t \leq 5.0$ $5.0 < t \leq 12.0$ $t > 12.0$	0 -50(t-5)/7 -100 or Remove & Replace
Overlay Tester, cycles (NJDOT B-10)	750 minimum	$t \geq 750$ $750 > t \geq 450$ $t < 450$	0 -(750-t)/6 -100 or Remove & Replace

Thank you for your time!
Questions?

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