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NJDOT Experience with Specialty Mixes

Nusrat S. Morshed, P.E.
Supervising Engineer
Pavement Design & Technology, NJDOT

Acknowledgement

- Robert Blight
  Senior Executive Manager,
  Pavement & Drainage Management & Technology, NJDOT

- Kevin Sereni
  Administrative Analyst 4,
  Pavement Management Unit, NJDOT

Outline

- Definition of Specialty Paving Mixes
- Reason for using Specialty Paving Mixes
- NJDOT Specialty Paving Mixes
- Conclusion

Definition of Specialty Paving Mixes

Specialty Mixes

- Specialty paving mixes are engineered asphalt formulations designed for unique environmental conditions.
- Specific performance goals, that go beyond the capabilities of standard dense-graded HMA.

Specialty Mixes

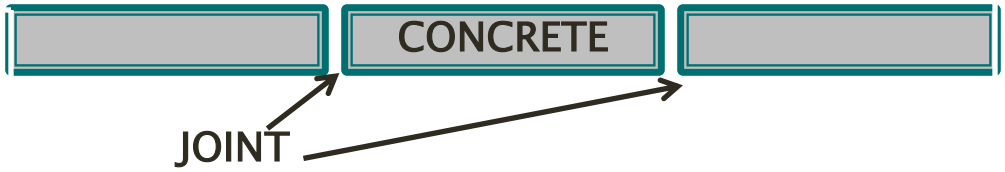
- Specialty paving mixes often incorporate modified binders (such as polymers, rubber, or fibers).
- Specific aggregate gradations to improve durability, reduce noise, handle extreme heavy loading, or manage stormwater.

Reason for using Specialty Paving Mixes

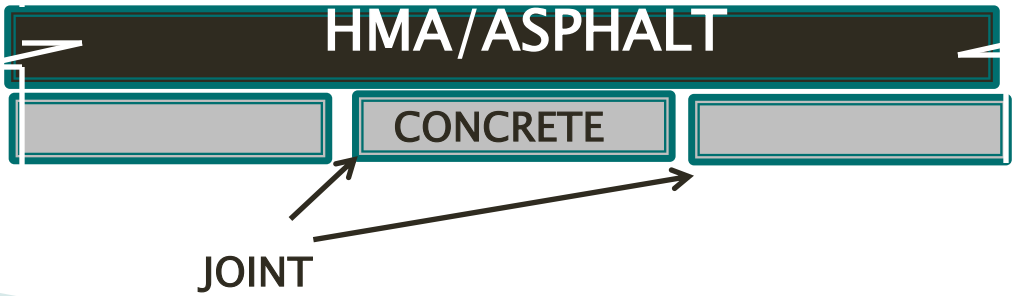
TYPES OF PAVEMENT

FLEXIBLE PAVEMENT

CONCRETE PAVEMENT



COMPOSITE PAVEMENT



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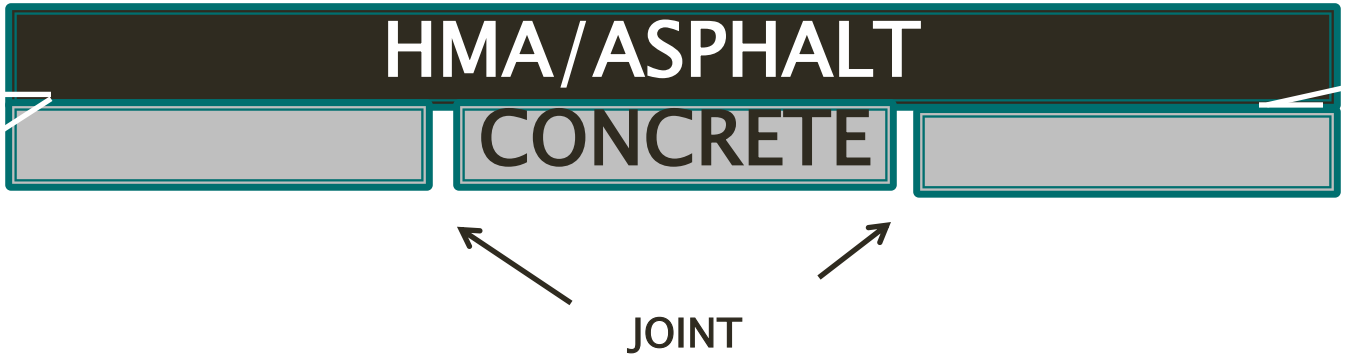
THE STATE OF NEW JERSEY

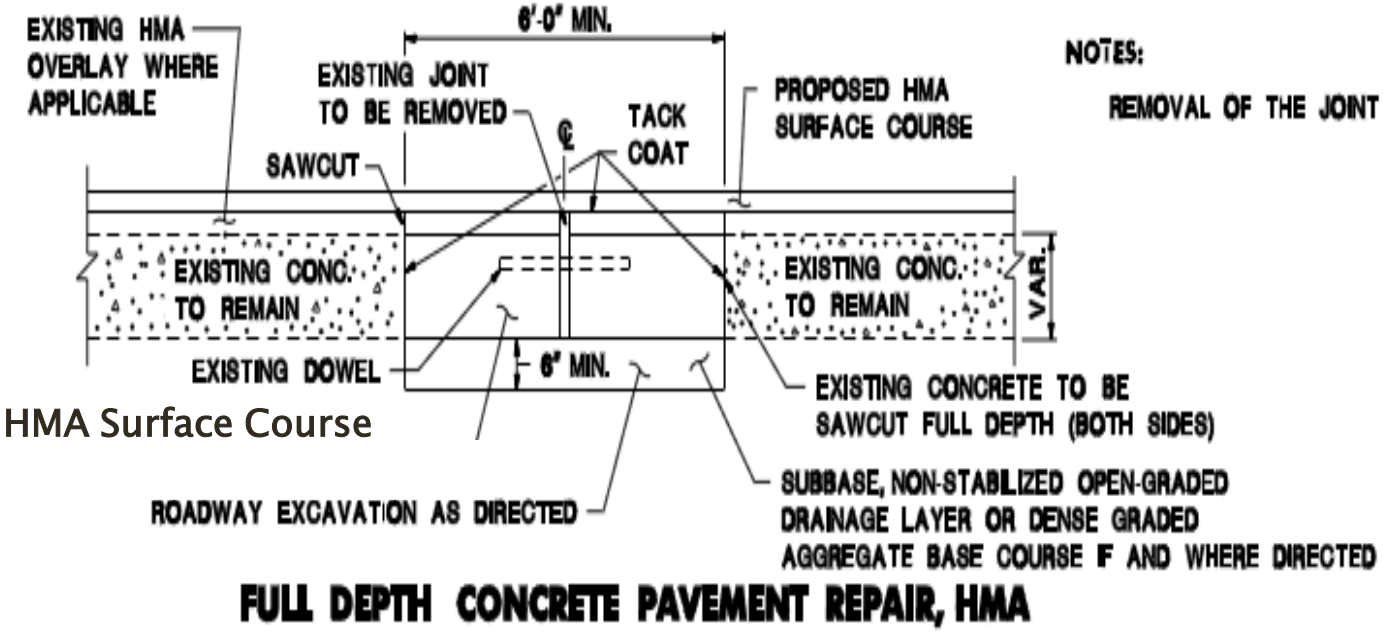
Challenges of composite pavement analysis:

Total NJDOT Lane Miles: 8500 approximately

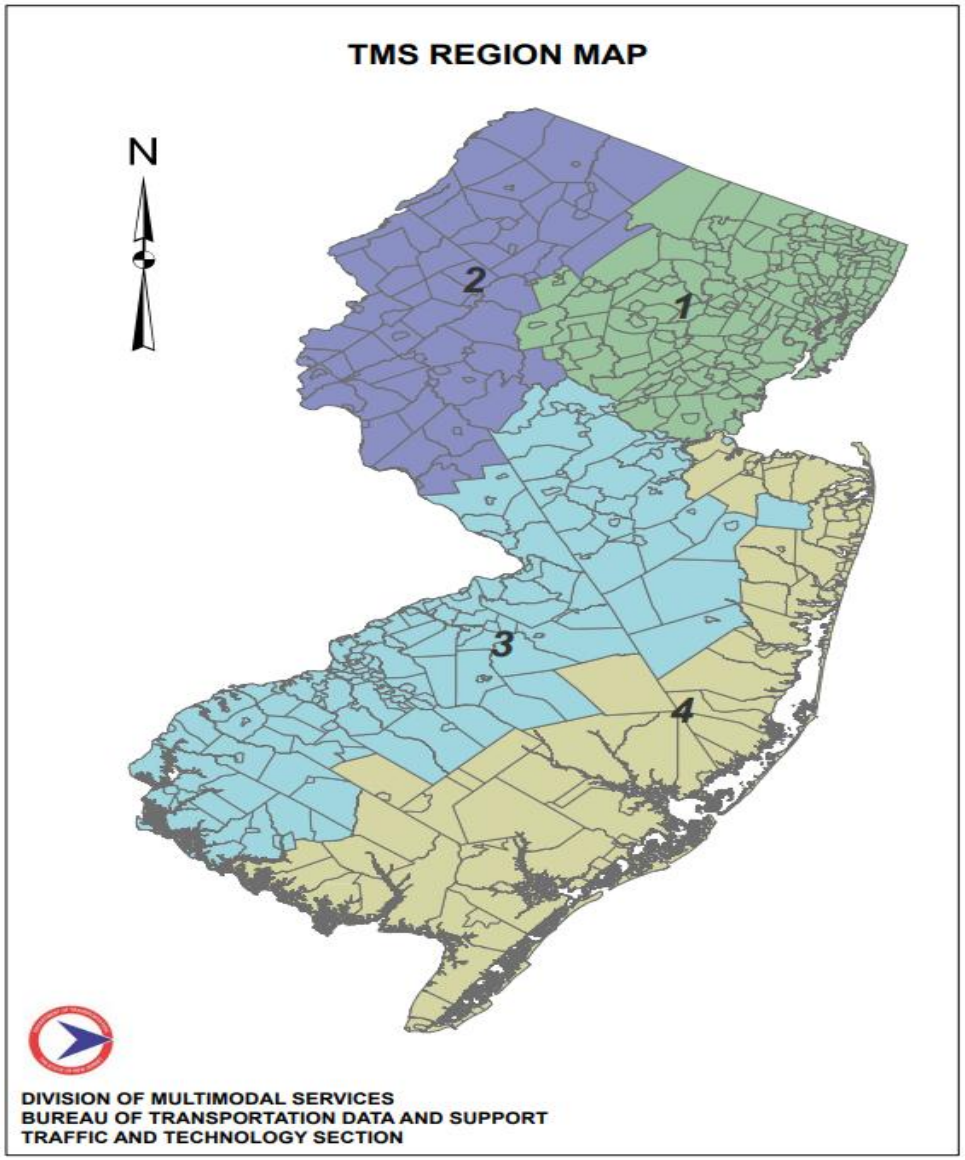
NJDOT Composite Pavement = Approximately 60% or more



Full Depth Repair with HMA (typically before milling)



Challenges of design due to the High ESAL



Challenges of Removing HMA Overlay:

Pavement Recommendation:
Mill 3” and Pave with 3” SMA 12.5 MM Surface Course
Core Information: Lane 2
Core information was not available during design.

Challenges of Removing HMA Overlay:

Core Information:

Lane 1 Core information was 5.25” to 7.75” HMA over PCC.

Lane 2 Core information was not available during design.

Lane 3 Core information was 3.5” to 19.5” HMA over PCC.

NJDOT Specialty Paving Mixes

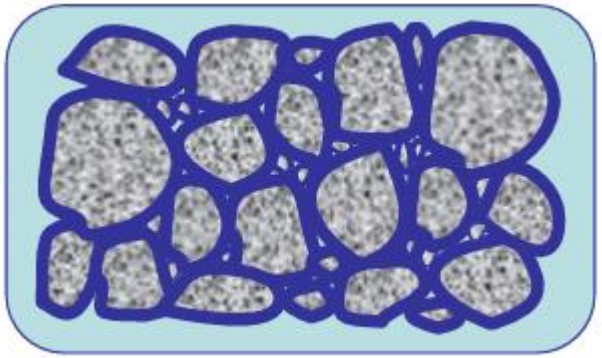
NJDOT Specialty Paving Mixes

- Stone Matrix Asphalt (SMA)
- Binder Rich Intermediate Course (BRIC)
- Bottom Rich Base Course (BRBC)
- High Performance Thin Overlay (HPTO)
- Ultra High Performance Thin Overlay (Ultra HPTO)
- Ultra Thin Friction Course (UTFC)
- High Surface Friction Treatment (HFST)
- HMA High RAP MIX

Stone Matrix Asphalt (SMA)

Stone Matrix Asphalt (SMA)

- Gap- Graded Mix
- The composition of the SMA Mixture
  - Coarse Aggregate
  - Fine Aggregate
  - Mineral Filler
  - Mineral Fibers or Cellulose Fibers
  - Polymer Modified Asphalt Binder
  - May include a WMA additive



- 7% Max Air Void
- Asphalt Binder is PG 64E-22
- May be used in combination with BRIC

Stone Matrix Asphalt

- Binder Rich Intermediate Course (BRIC)

Binder Rich Intermediate Course (BRIC)

- 4.75 MM Intermediate Course
- No Reclaimed Asphalt Pavement (RAP), Crushed Recycled Container Glass (CRCG), Ground Bituminous Shingle Material (GBSM).
- Air Voids 0% to 6%
- Performance Testing is required
  - Overlay Tester (Cracking)
  - APA testing (Rutting)
- Intended to reduce Reflective Cracking on Composite Pavements

Design Consideration for BRIC

- Performance of BRIC material highly dependent on the Surface Course overlaying the BRIC.
- BRIC is typically recommended with SMA.
- Presence of high severity reflection cracks in composite pavement.

Case Example1: SMA over BRIC

- Limit of the project:
  MP 72.68 to MP 74.12
  MP 76.03 to MP 80.97
  MP 81.59 to MP 83.58
- Total Lane Miles of the project: 33.56
- Letting Date: June 23, 2015
- Project Completed: June 17, 2016

Case Example1: SMA over BRIC (Constructed 2016)

- Visual Survey of Composite Pavement
- Cores performed to establish proper milling depth
- Full Depth Repair areas identified by visual survey during final design
- Calculated approximately 20 million ESAL's
- Overlay Design consisted of milling 3" depth and resurfacing with:
  - 2" Stone Matrix Asphalt 12.5 MM Surface Course
  - 1" Binder Rich Intermediate Course, 4.75 MM

Case Example 1:SMA over BRIC

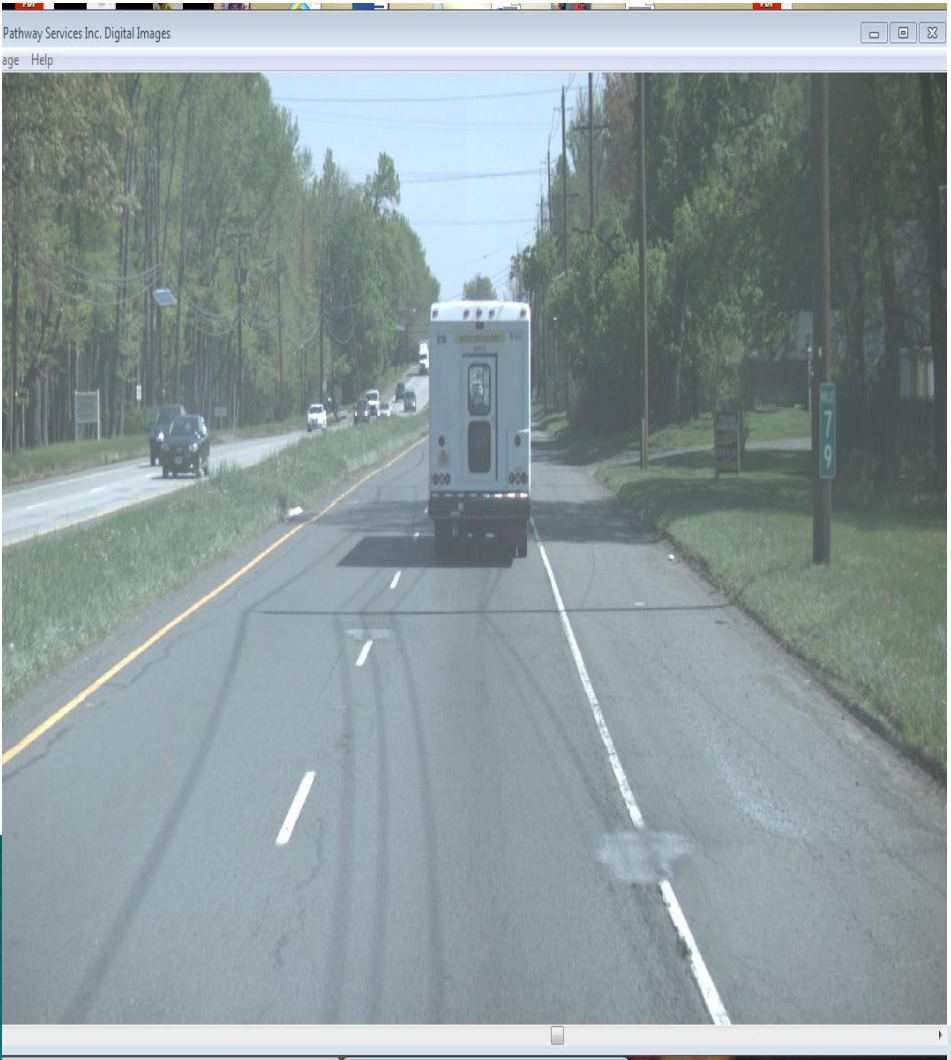
Before Rehab

- SDI = 2.4
- Ride Quality IRI = 178

After Rehab

- SDI = 5
- Ride Quality IRI = 65

Case Example 1:SMA over BRIC in 2016



Bottom Rich Base Course (BRBC)

Bottom Rich Base Course (BRBC)

- 19 MM Base Course mix with higher percentage of modified binder.
- Increased Fatigue Resistance.
- Air Voids 1% to 8%
- Mix Performance Testing is required for Design and Production:
  - Flexural Fatigue Testing (AASHTO T321)
  - Asphalt Pavement Analyzer (APA, AASHTO T340)
- Used on RT 295 and Rt 70 Rubblization Projects to decrease the overall pavement thickness.

Case Example 2: SMA and BRBC over Rubblized Concrete in 2020

Existing Pavement (Majority portion):

3 to 4” Asphalt Concrete
8” Portland Cement Concrete (PCC)
12” Subbase

Proposed Pavement Treatment:

- 2” Stone Matrix Asphalt (SMA)
- Minimum 3” & Var. Bottom Rich Base Course (BRBC)
- 8” Rubblized PCC
- 12” Subbase

Case Example 2:

Picture is taken in 2018 after 3 years of Resurfacing

Case Example 2:
After milling of Existing asphalt concrete

Case Example 2:
After Rubblization

Case Example 2:
After application of Tack coat over rubblized concrete

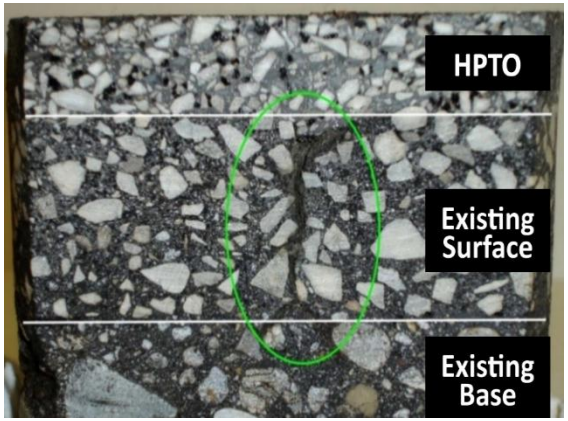
Case Example 2: After Construction

High Performance Thin Overlay (HPTO)

High Performance Thin Overlay (HPTO)

- 1” Thickness
- 4.75 mm mix NMA Size

- Requires performance testing of the mix
  - APA Test (Rutting)
  - Overlay Tester (Cracking)
- Continued use as pavement preservation treatment or mill and overlay treatment
- Use of an Ultra-Thin Paver (Spray Paver) is mandated on some projects



Benefits of HPTO:

- Improves ride quality
  - 70% improvement on some projects
- Seals out water
- Renew road surface
- Quick open to traffic
- Placed with a Conventional Paver or spray paver

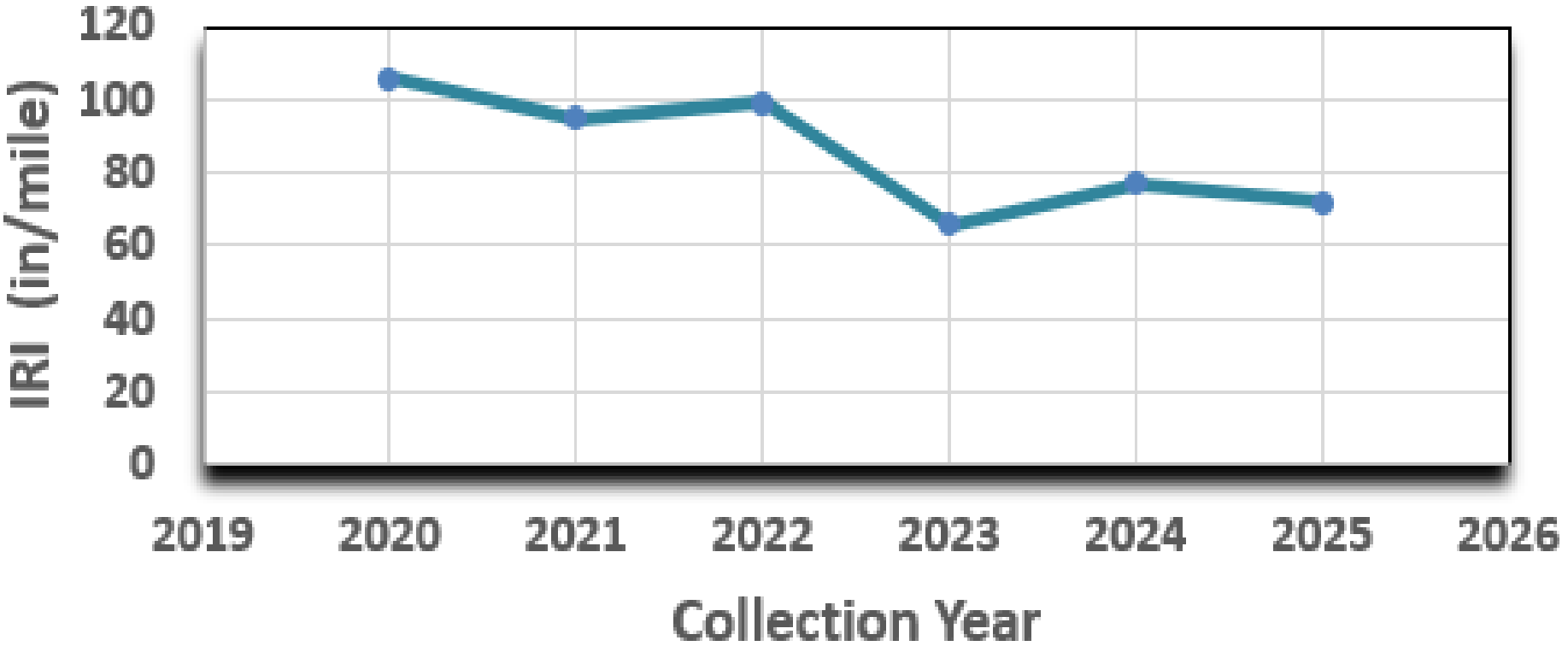
Case Example 3:HPTO after Concrete Pavement Repair (CPR)

Existing Concrete 2020

After CPR 2021

After HPTO 2022

Case Example 3:
HPTO after CPR



Ultra High Performance Thin Overlay (Ultra HPTO)

Ultra-High Performance Thin Overlay (Ultra HPTO)

- 1” Thickness
- 4.75 mm mix NMA Size

- Requires performance testing of the mix
  - APA (RUT Test)
  - Overlay Tester (Cracking Test)
- Two projects were constructed
- One project is in construction
- Few projects are in design phase.
- Use of an Ultra-Thin Paver (Spray Paver) is mandated on some projects

Ultra-High Performance Thin Overlay (Ultra HPTO)

- Ultra Thin Friction Course (UTFC)

Ultra-Thin Friction Course (UTFC)

- ¾ inch thick Thin Bonded Hot Mix Asphalt (HMA) Overlay
  - Like Novachip (but not proprietary)
- 4.9 – 6.0 % polymer modified (PG 64E-22) asphalt binder
- Volumetric Mix Design Requirements
- 9.5 mm nominal maximum size high quality aggregate
  - Gap/open graded HMA
  - Flakiness Index (cubicle aggregate)

Ultra-Thin Friction Course (UTFC)

- Aggregate shape and gradation is **critical** to success
  - Improper aggregate = premature failure
  - Aggregate crushing operation is critical
  - Refined specification to more clearly indicate mix design requirements
- Tack coat bond is critical
  - Under application or poor coverage = premature failure
  - Improper tack coat material = premature failure

Ultra-Thin Friction Course (UTFC)

Benefits:

- Improvement in ride quality
- Improves wet weather skid resistance/spray
- Seals out water
- Renew road surface
- Quick open to traffic

Experience of Ultra Thin Friction Course:

- **Route 195: Supplier could not produce the mix as per specification.**
- **Route 80: This project was completed successfully by using Ultra Thin friction Course in 2016.**
- NJDOT has been using UTFC successfully as a pavement preservation over 10 years.

High Friction Surface Treatment (HFST)

High Friction Surface Treatment (HFST)

- HFST is pavement treatment that dramatically and immediately reduce crashes, injuries, and fatalities associated with friction demand issues, such as:
  - A reduction in pavement friction during wet conditions, and/or
  - A high friction demand due to vehicle speed and/or roadway geometrics

HFST-2016

HFST-2025 with updated Spec

Hot Mix Asphalt (HMA) High RAP

HMA High RAP

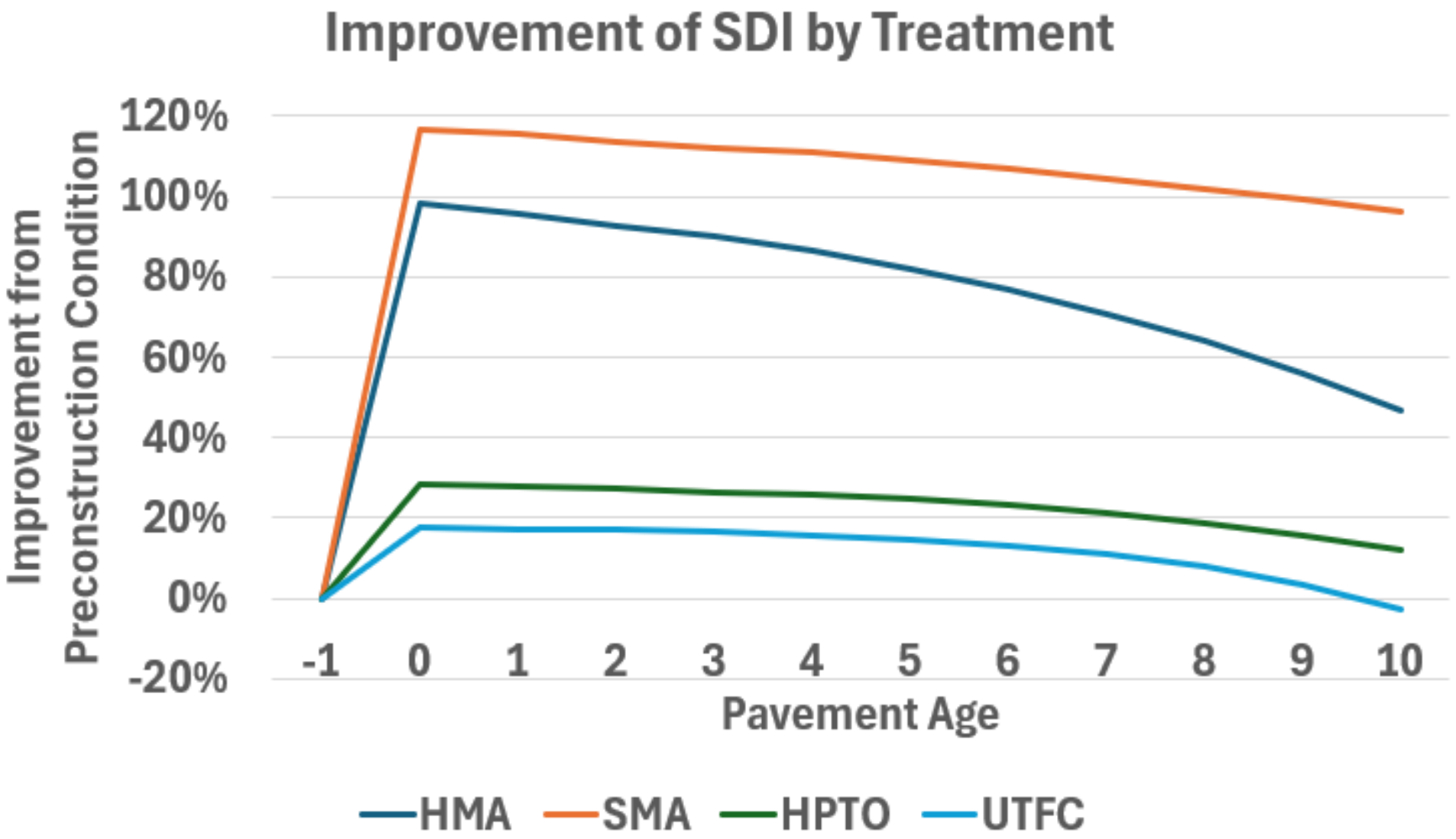
- Few projects were constructed
- Few projects are in construction and design
- Requires performance testing of the mix
  - APA (RUT Test)
  - Overlay Tester (Cracking Test)

Table 902.13.03-2 Performance Testing Requirements for HMA HIGH RAP Design				
Test	Requirement			
	Surface Course		Intermediate and Base Course	
	PG 64S-22	PG 64E-22	PG 64S-22	PG 64E-22
APA @ 8,000 loading cycles (AASHTO T 340)	≤ 7 mm	≤ 4 mm	≤ 7 mm	≤ 4 mm
Overlay Tester (NJDOT B-10)	≥ 200 cycles	≥ 275 cycles	≥ 100 cycles	≥ 150 cycles

HMA HIGH RAP- Completed 2024

Conclusion

Conclusion


Improvement of SDI by Treatment
Improvement from Preconstruction Condition
120%
100%
80%
60%
40%
20%
0%
-20%
-1
0
1
2
3
4
5
6
7
8
9
10
Pavement Age
HMA
SMA
HPTO
UTFC

Thank You

Contact:
Nusrat.Morshed@dot.nj.gov