Use Of Local Aggregates In SMA

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Illinois Tollway

About The Illinois Tollway

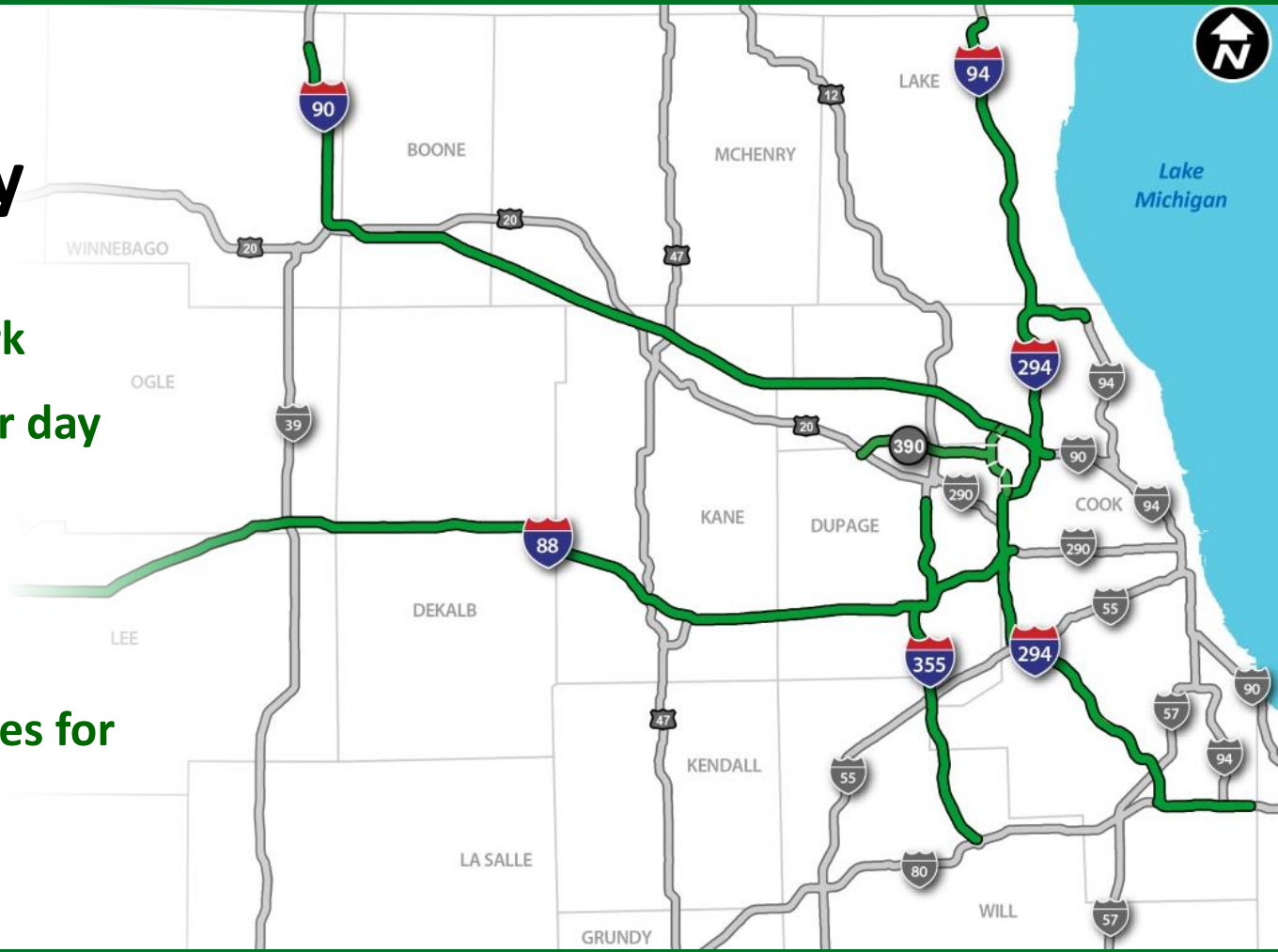
Dynamic 294-mile transportation network

1.6 million vehicles per day

88 percent pay electronically

User-fee system

No state or federal taxes for maintenance and operations



Tollway SMA

- Stone-matrix asphalt (SMA) used for all mainline overlays
- 2008 to 2009 – Full-depth asphalt on the Jane Addams Memorial Tollway (I-90) in Rockford area
- 2015 – Reagan Memorial Tollway (I-88) rehabilitation
- 2018 – Veterans Memorial Tollway (I-355) overlay
- 2018 – I-88 rehabilitation

327,000 tons of SMA, six producers

Illinois Tollway

Coarse Aggregates For Tollway SMA

Friction Surface SMA

- High traffic pavements and curves
- Coarse aggregate: quartzite, granite, diabase/trap rock, crushed steel slag

Binder SMA and Surface SMA

- Coarse aggregate: typically crushed gravel (also surface aggregates)
- 2008 friction evaluation – acceptable for tangents

Coarse Aggregates For Tollway SMA

- Friction aggregates – Non-Illinois sources
- Crushed gravel – Southern Wisconsin
- 2015 – Evaluated local crushed gravel and dolomite sources
- 2018 – Implemented aggregate testing, including coarse FRAP

Local Aggregates For Tollway SMA

2015 evaluation approach

- Identify potential sources
- Aggregate breakdown
  - Micro-Deval testing
  - Gyratory compaction to N_{max}

Aggregate Sources – 2015

Control

- Rock Road Companies Inc., Janesville, Wis.: Lathers crushed gravel (1/2” and 3/8”)
- Michels Corp., Brownsville, Wis.: quartzite (1/2”)

Crushed Gravel

- Beverly Materials LLC, Elgin, Ill. (1/2” and 3/8”)
- Lafarge Aggregates, Elburn, Ill. (1/2” and 3/8”)
- Meyer Material Co., Algonquin, Ill. (3/8” and 3/4”- scalped)
- Thelen Materials LLC, Antioch, Ill. (3/8” and 3/4”- scalped)

Aggregate Sources – 2015

Dolomite

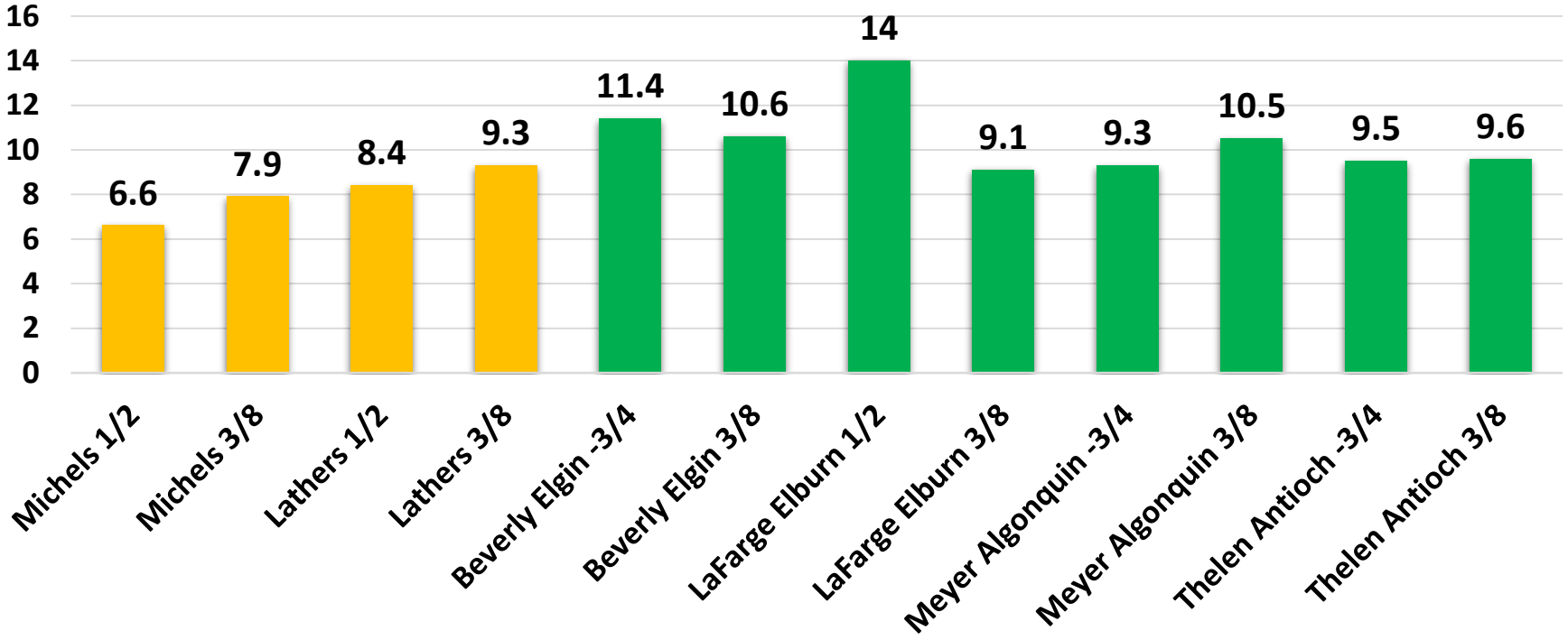
- Vulcan Materials Co., Sycamore, Ill. (3/8” and 3/4”- scalped)
- Lafarge Aggregates Fox River Quarry, South Elgin, Ill. (3/8” and 3/4”- scalped)
- RiverStone Group Inc., Osborn, Ill. (3/4”-scalped)
- RiverStone Group Inc., Milan, Ill. (3/8”)
- Macklin Inc., Rochelle, Ill. (3/8” and 3/4”- scalped)
- Hanson Aggregates, Thornton, Ill. (3/8” and 3/4”- scalped)

Micro-Deval Of Coarse Aggregates

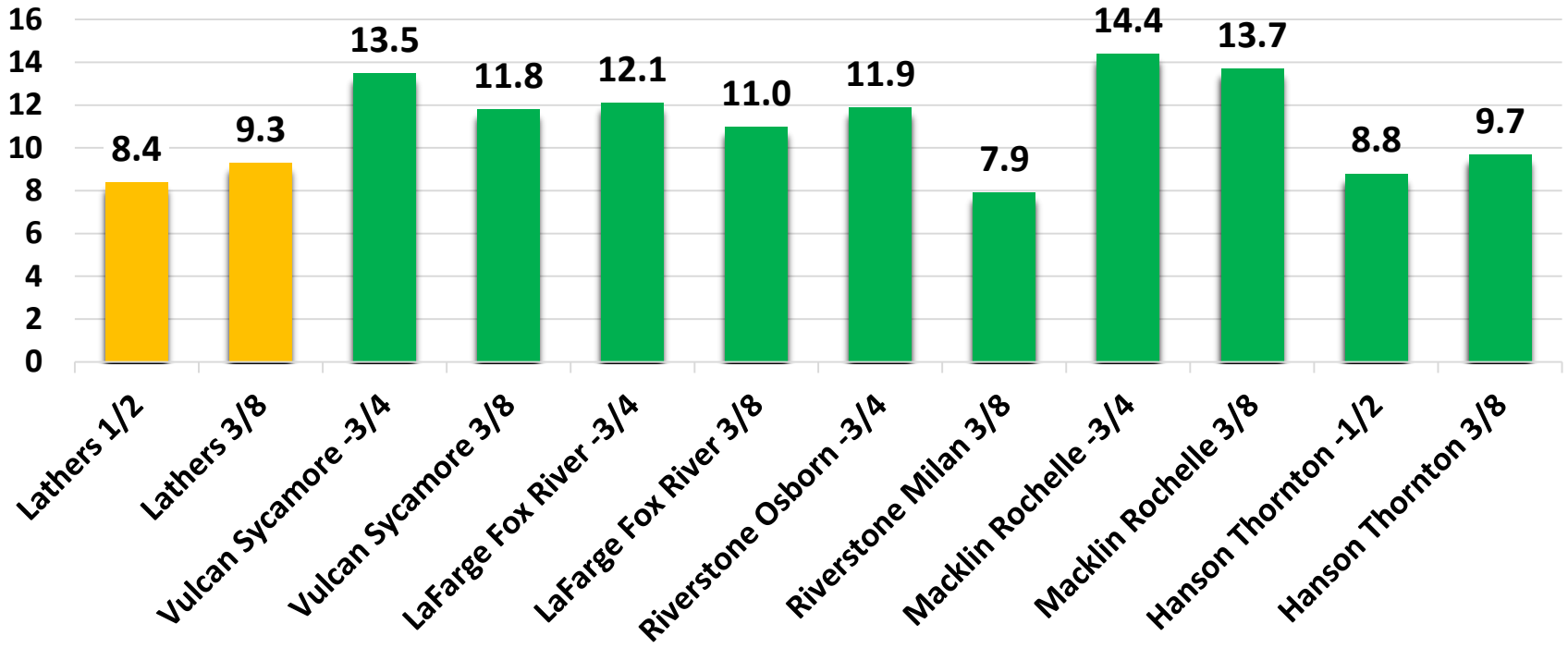
AASHTO T327

- Aggregate breakdown (percent loss) in presence of water
- Good identifier of pavement performance
- “Mini” L.A. Abrasion
- Repeatable test
- Some agencies use in lieu of soundness

Micro-Deval Loss – Crushed Gravel



Micro-Deval Loss – Dolomite



Degradation Evaluation

- Aggregate substituted into an existing mix design at optimum asphalt content
- Samples gyrated to N_{max} = 225 gyrations
- Voids analysis
- Extraction gradation
- Hamburg of N_{225} samples - 20,000 cycles

Degradation Evaluation

Control Aggregates		
	Michels Quartzite	Lathers Crushed Gravel
N_{80} Voids (Design)	3.5	3.8
N_{225} Voids (Max)	2.2	2.0
% Passing 200, Loose	8.1	7.7
% Passing 200 @ N_{80}	9.3	9.2
% Passing 200 @ N_{225}	9.5	9.1

Degradation Evaluation

Crushed Gravel			
	Beverly Elgin	**Meyer Algonquin**	**Thelen Antioch**
N_{80} Voids (Design)	3.6	3.1	3.2
N_{225} Voids (Max)	1.8	1.8	1.6
% Passing 200, Loose	8.1	7.7	7.8
% Passing 200 @ N_{80}	9.1	8.9	8.7
% Passing 200 @ N_{225}	9.4	9.4	9.1

Degradation Evaluation

Dolomite

	Riverstone	Macklin Rochelle	Vulcan Sycamore	Hanson Thornton
N_{80} Voids (Design)	3.6	3.8	3.7	3.8
N_{225} Voids (Max)	1.2	1.5	1.4	1.6
% Passing 200, Loose	8.1	8.1	8.1	8.1
% Passing 200 @ N_{80}	8.0	9.5	9.9	9.9
% Passing 200 @ N_{225}	9.4	10.8	10.0	10.6

Degradation Evaluation

- Samples gyrated to N_{max} = 225 gyrations
- Hamburg of N_{225} samples – 20,000 cycles
- Inconclusive results – all mixes (quartzite, crushed gravel, dolomite) had rut depths between 2.5 and 3.2 mm (6 mm max)

Specification – Coarse Aggregate For SMA

L.A. Abrasion – Less than 28 percent loss

Micro-Deval loss

- Single source: less than 12.0 percent
- Coarse aggregates: design weighted average < 9.5 percent (includes coarse FRAP) – A-OK, proceed with mix design
- If design weighted average is 9.5 to 12.0 percent
  - Conduct mix design – optimum AC at 3.5 percent Air Voids
  - Air voids at optimum AC and $N_{225} \geq 2.0$ percent

How Does This Compare?

NCHRP 557 (aggregate tests for HMA)

- Micro-Deval: Max loss of 15 recommended

AASHTO T327 (Micro-Deval for coarse aggregate)

- 17-18 for HMA surface course (Max 21 for lower courses)

AASHTO M325 (standard for SMA)

- Max L.A. Abrasion = 30
- Higher values have been successful

2018 SMA Mix Designs

4 contracts, 6 producers, 327,000 tons of SMA

5 “local” sources used: MicroDeval = 7.7 to 11.6

17 of 18 SMA designs used coarse FRAP

- MicroDeval = 6.8 to 9.0

Additional Performance Testing

2018

- 18 SMA mix designs (all types)
- Hamburg wheel testing @ 20,000 passes
  - 1.8 to 5.9 mm (less than 6 mm required)
- DC(T) – Fracture energy
  - 642 to 1217 J/m^2 (minimum 600-650 required)

Why SMA?

THANK YOU

Illinois Tollway