National Pavement Advancements
MnROAD/NCAT Partnership

Safer, Smarter, Sustainable Pavements through Innovative Research

Ben Worel

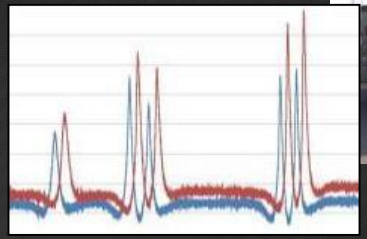
October 13, 2016

History of MnROAD

- **MnROAD Owned and Operated by Minnesota DOT**
  - Mainline and Low Volume Road
- **22-Years of Long Term Customer Service**
  - Minnesota Department of Transportation
  - Minnesota Local Road Research Board
  - Pooled Funds Efforts (States) / Industry
  - SHRP II / FHWA
  - National Road Research Alliance (NRRA)
- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (Currently Planning → NRRA Directed)

MnROAD Operations

- **Research Development**
- **Construction**
- **Performance Monitoring**
  - Cracking / Rutting / Ride
  - Deflection (FWD), …..
- **Sensors**
  - Static (Environmental)
  - Dynamic (Traffic Loading)
- **MnROAD Database**
- **Technology Transfer/Samples**
- **Traffic Loadings**


MnROAD Project Benefits

- **Phase-1**
  - **9:1** B/C Ratio

  Highlights → Seasonal Load Restrictions; Low Temp Cracking

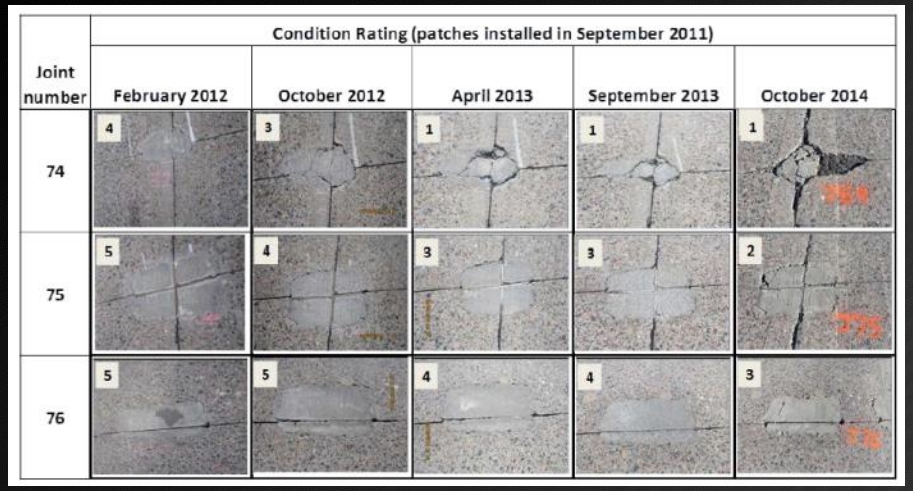
- **Phase-2**
  - **5:1** B/C Ratio

  Highlights → Surface Characteristics (HMA/PCC), Pervious Pavements, Implements Husbandry, Stabilized Full Depth Reclaimation, Lightly Surface Roadways, Chip Seal Video, Whitetopping, Thin PCC, Optimal Timing of Preventive Maintenance, Low Temperature Cracking II, Quiet Rumble Strips, Drainable/Stabile Bases

MnROAD Pavement Preservation Benefits

- Crack Sealing
- Chip Seals
- Microsurfacing
- Transverse Crack Repairs

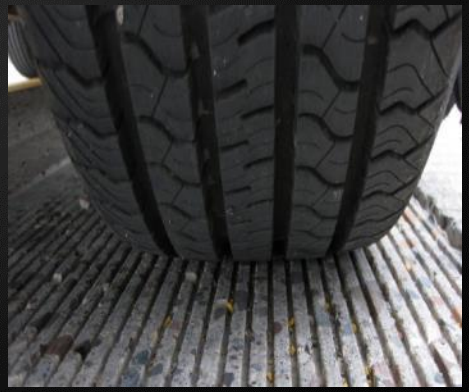
MnROAD Pavement Preservation Benefits



Joint number	Condition Rating (patches installed in September 2011)				
	February 2012	October 2012	April 2013	September 2013	October 2014
74	4	3	1	1	1
75	5	4	3	3	2
76	5	5	4	4	3

- **Partial Depth Patches**
  - Installed 2011 (22 materials/93 joints)
  - http://www.lrrb.org/media/reports/201616.pdf

- **Diamond Grinding**
  - 2008 National Pooled Fund
- **Full Depth PCC Repairs**
- **Dowel Bar Retrofits**



National Research Initiatives

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Minnesota Department of Transportation

Pooled Fund - TPF-5(267)

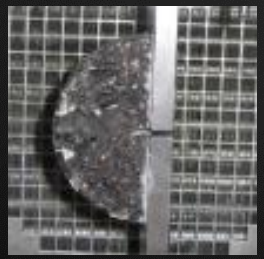
National Pavement Preservation Study

Development of a National Cracking Test


ADEM
Alabama Department of Environmental Management
Alabama Department Of Transportation
COLLABORATIVE AGGREGATES LLC
CDOT
CO
Department of Transportation United States of America
FP2
State of Florida Department of Transportation
GDOT
Georgia Department of Transportation
Illinois Department of Transportation
Kentucky Transportation Cabinet
MDOT
Michigan Department of Transportation
MDOT
Mississippi Department of Transportation
MnROAD
Minnesota Department of Transportation
MoDOT
New York State of Opportunity. Department of Transportation
State of North Carolina Department of Transportation
National Center for Asphalt Technology NCAT at Auburn University
DOT
Oklahoma Department of Transportation
SCDOT
South Carolina Department of Transportation
TN TDOT Department of Transportation
VDOT
Virginia Department of Transportation
Wisconsin Department of Transportation
nppc16
National Pavement Preservation Conference 2016

National HMA Cracking Performance Test

- **Partnerships (**Utilize both MnROAD / NCAT Test Tracks)
  - Top Down / Reflection / LTC cracking Efforts
  - Range of cracking potential mixes
  - Battery of testing of many different existing tests Nationally
- **Goals (We need….)**
  - Tests and criteria that relate to performance.
  - Practical for both mix design verification and quality control testing purposes.
  - Accommodate recycled materials, new and future additives, and combinations.





MnROAD HMA Mix Designs – 2016

MIX DESCRIPTION	RAP	RAS	CELL	BINDER	Aggregate Size	POLY	CRACK POTENTIAL
High Temp Mix	~30	5	16	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	3	17	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	0	18	PG 64S-22	12.5mm	No	Med/High
High Temp Mix + regressed voids (3.0)	<20	0	19	PG 64S-22	12.5mm	No	Med/High
Soft Binder Mix	>30	0	20	PG 52S-34	12.5mm	No	Med
Typical Low-Temp Mix	<20	0	21	PG 58H-34	12.5mm	Yes	Low
Typical Low-Temp Mix + limestone	<20	0	22	PG 58H-34	12.5mm	Yes	Low/Med
HiMA Mix	<15	0	23	PG 64E-34	12.5mm	Yes	Low

National Pavement Preservation Study

- Partnership
  - MnROAD (North) / NCAT (South)
    - Offsite Low and High Volume Road Installations
    - Asphalt Focus (no Concrete, yet)
  - FP² / National Center for Pavement Preservation
  - Government / Academia / Industry involvement
- Goals
  - National Study (Climatic zones)
  - Provide consistently collected data / analysis
  - *Quantify the life extending benefits*

Minnesota Department of Transportation

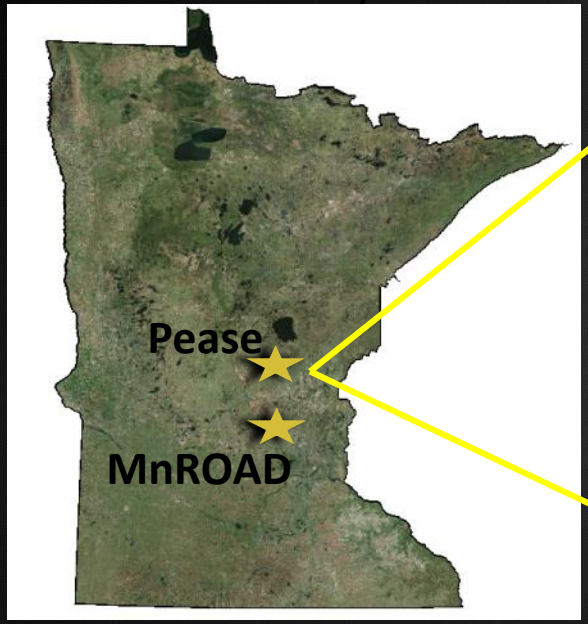
FP²

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

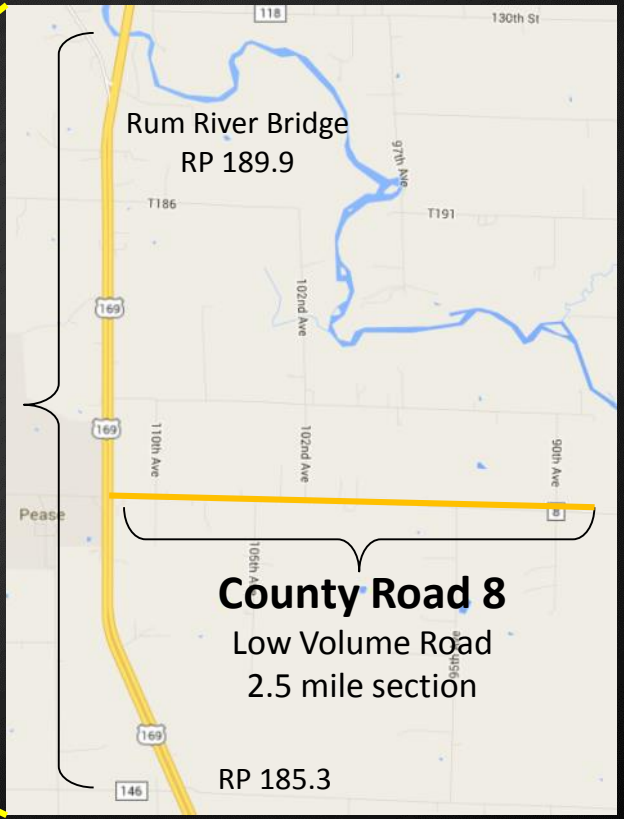
ncpp National Center for Pavement Preservation

National Center for Pavement Preservation
MICHIGAN STATE UNIVERSITY
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

National Pavement Preservation Study

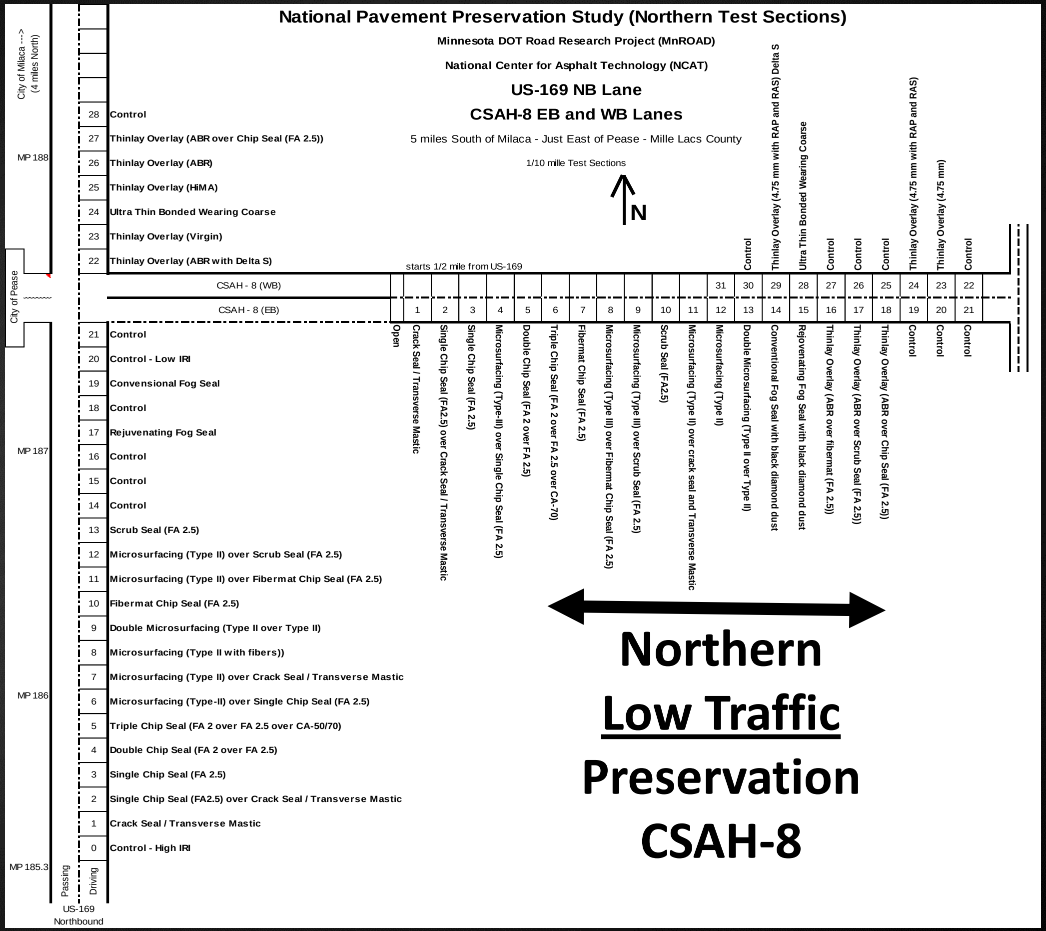


US-169
High Volume
Road
4 mile section



National Pavement Preservation Study

Northern
High Traffic
Preservation
on US-169



PreTreatment Condition

US-169
Northbound Lanes

PreTreatment Condition

CSAH-8

East and Westbound Lanes

Construction Documentation

- **Setup (Truck Station)**
  - **Equipment**
  - **Get working**
- **Calibration (Truck Station)**
  - Emulsion Rates
  - Aggregates Rates
  - Mix Designs
- **Verification (Field)**

Crack Sealing Mastic

Northern
Low Traffic
Preservation
CSAH-8

1 **Crack Seal / Transverse Mastic**
2 **Single Chip Seal (FA2.5) over Crack Seal / Transverse Mastic**
3 Single Chip Seal (FA 2.5)
4 Microsurfacing (Type-III) over Single Chip Seal (FA 2.5)
5 Double Chip Seal (FA 2 over FA 2.5)
6 Triple Chip Seal (FA 2 over FA 2.5 over CA-70)
7 Fibermat Chip Seal (FA 2.5)
8 Microsurfacing (Type III) over Fibermat Chip Seal (FA 2.5)
9 Microsurfacing (Type III) over Scrub Seal (FA 2.5)
10 Scrub Seal (FA2.5)
11 **Microsurfacing (Type II) over crack seal and Transverse Mastic**
12 Microsurfacing (Type II)
13 Double Microsurfacing (Type II over Type II)
14 Conventional Fog Seal with black diamond dust
15 Rejovenating Fog Seal with black diamond dust

16 Thinlay Overlay (ABR over fibermat (FA 2.5))
17 Thinlay Overlay (ABR over Scrub Seal (FA 2.5))
18 Thinlay Overlay (ABR over Chip Seal (FA 2.5))
19 Control
20 Control
21 Control
22 Control
23 Thinlay Overlay (4.75 mm)
24 Thinlay Overlay (4.75 mm with RAP and RAS)
25 Control
26 Control
27 Control
28 Ultra Thin Bonded Wearing Coarse
29 Thinlay Overlay (4.75 mm with RAP and RAS) Delta S
30 Control

Crack Sealing / Mastic Details

- **Crack Sealing**
  - Hot Poured, Crafco 522 = 3725 spec.
  - Overbanded, routed both transverse, and a few longitudinal cracks.

- **Mastic**
  - Crafco Mastic One
  - Applied to bad longitudinal joint on US 169, and transverse cupped cracks on CSAH 8.

Chip Sealing

Northern
Low Traffic
Preservation
CSAH-8

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19 Control
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22 Control
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24 Thinlay Overlay (4.75 mm with RAP and RAS)
25 Control
26 Control
27 Control
28 Ultra Thin Bonded Wearing Coarse
29 Thinlay Overlay (4.75 mm with RAP and RAS) Delta S
30 Control

Chip Seal Details

Single, FA 2.5

- 0.33 g/sy at application temp
- 23 lbs/sy

Double, FA 2.5 covered by FA2

- FA2.5 at 0.29 g/sy and 17 lbs/sy
- FA2 at 0.29 g/sy and 15 lbs/sy

Triple, CA 70, FA2.5, FA2

- CA70 at 0.30 g/sy and 25 lbs/sy
- FA 2.5 at 0.41 g/sy and 21 lbs/sy
- FA2 at 0.30 g/sy and 15 lbs/sy

Scrub Seals

Northern
Low Traffic
Preservation
CSAH-8

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6 Triple Chip Seal (FA 2 over FA 2.5 over CA-70)
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20 Control
21 Control
22 Control
23 Thinlay Overlay (4.75 mm)
24 Thinlay Overlay (4.75 mm with RAP and RAS)
25 Control
26 Control
27 Control
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30 Control

Scrub Sealing Details

Pull a broom system, behind the distributor to scrub the emulsion into cracks

- Uses a rejuvenating emulsion
  - PASS CR from Asphalt Materials Inc.
- Scrub and scrub covered by microsurfacing
  - FA 2.5 at 0.30 g/sy and 20.5 lbs/sy
- Scrub covered by 4.75 mm thinlay on milled HMA
  - FA 2.5 at 0.36 g/sy and 20.5 lbs/sy

Microsurfacing

Northern
Low Traffic
Preservation
CSAH-8

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20 Control
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30 Control

Microsurfacing Details

- Type II on US 169
- Type III on CSAH 8 (3 Cells)
- Emulsion CQS-1hP
  - CQS-1P did not pass ISSA mix specifications
- Single (19.2 lbs/sy → 13.6% emulsion)
- Double (16 lbs/sy (each) → 13.5% emulsion)
- Micro over surface treatment (25 lbs/sy → 12.5% emulsion)

Microsurfacing QA/QC Innovation

- **Field Test Method**
- **Simple test to Verify**
  - Water Content
  - Asphalt Content
  - Aggregate Percent
  - Aggregate Gradation

Thinlay Overlays

Northern
Low Traffic
Preservation
CSAH-8

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15 Rejuvenating Fog Seal with black diamond dust

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18 Thinlay Overlay (ABR over Chip Seal (FA 2.5))
19 Control
20 Control
21 Control
22 Control
23 Thinlay Overlay Virgin (4.75 mm)
24 Thinlay Overlay ABR(4.75 mm with RAP and RAS)
25 Control
26 Control
27 Control
28 Ultra Thin Bonded Wearing Coarse
29 Thinlay Overlay (4.75 mm with RAP and RAS) Delta S
30 Control

Thinlay Details

- 0.75” Mill and Fill
- 4.75 mm HMA
  - Virgin
  - ABR (asphalt binder replacement)
    - 12% fine frac RAP and 3% RAS
  - ARB with Delta S rejuvenator
  - HiMA binder 64E-34 (US 169 only)
  - UTBWC
  - On CSAH 8, chipe seal, scrub seal and fibermat chip seal, all under ABR HMA

Fog Seals

Northern
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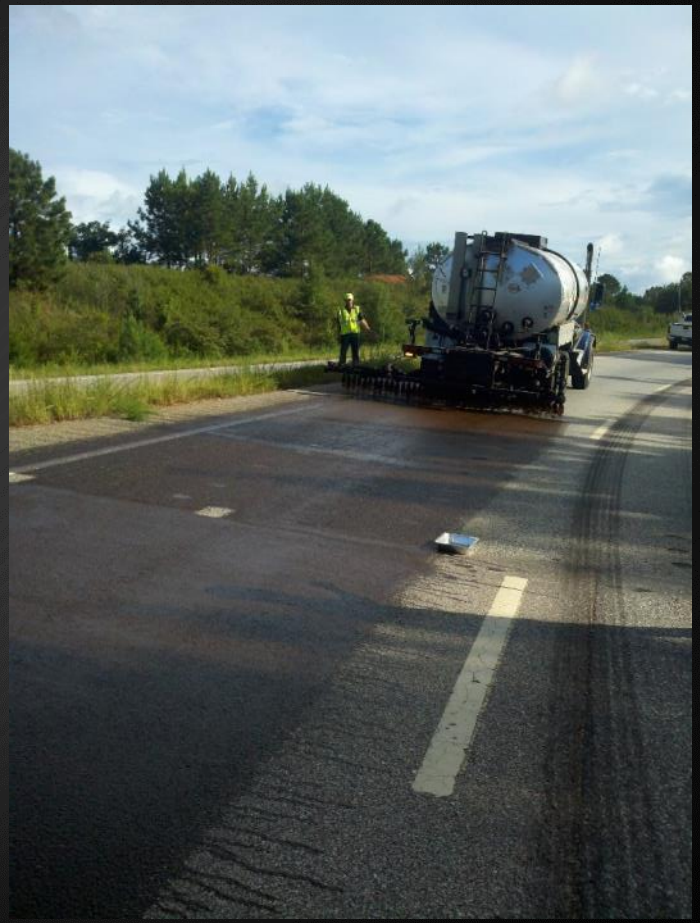
Fog Seal Details

- **Conventional fog seal**
  - CSS-1H, diluted 1:1, shot at 0.10 g/sy
  - Black Diamond Dust
- **Rejuvenating fog seal**
  - PASS QB (CMS-1P), target 0.10 g/sy
  - Black Diamond Dust



UTBWC

Northern
Low Traffic
Preservation
CSAH-8

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26 Control
27 Control
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30 Control

UTBWC Details

- Ultra Thin Bonder Wearing Course
- Gap Graded Mix
- Spray Paver
- Polymer Modified Quick Break Tack

Control

Northern
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Preservation
CSAH-8

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18 Thinlay Overlay (ABR over Chip Seal (FA 2.5))
19 Control
20 Control
21 Control END OF EB CELLS
22 Control FIRST WB CELL
23 Thinlay Overlay (4.75 mm)
24 Thinlay Overlay (4.75 mm with RAP and RAS)
25 Control
26 Control
27 Control
28 Ultra Thin Bonded Wearing Coarse
29 Thinlay Overlay (4.75 mm with RAP and RAS) Delta S
30 Control

Open Graded Friction Coarse“OGFC”

August 2016 – Harddrives Contractor

OGFC/PCC
conventional tack

OGFC/PCC
ultrafuse tack

OGFC/HMA
ultrafuse tack

OGFC/HMA
conventional tack

Thank You
Contractors and Material Suppliers

- Vance Brothers
- Brockwhite
- Crafco
- Colas
- Etyner
- Astech Corp
- Hardrives
- Roadtech
- East Alabama Paving
- Collaborative Aggregates
- Asphalt Materials
- Martin Marietta Materials

Commitment Requirements

- Short Term (till 2018)
  - Results as they become available
  - Document Performance
- Long Term (after 2018)
  - Expect long term commitment needed (10-15 years)
  - Data to support the life extending /condition benefits

Thank You

MnROAD/NCAT Sponsor Meeting
Minneapolis – October 26-27, 2016