NRRA National Road Research Alliance

Meeting Minutes: NRRA Intelligent Construction Technologies (ICT) Team

(Agency & Associate Member Meeting)

Date: July 8, 2021
Minutes prepared by: Rebecca Embacher
Location: Microsoft Teams
NRRA Team Webpage: http://www.dot.state.mn.us/mnroad/nrra/structure-teams/intelligent-construction/index.html

Attendance

Agency Members

Participated	Affiliation	State Contact	e-mail
☒	California	Deepak Maskey	deepak.maskey@dot.ca.gov
☒	California	Ragu Thangavelautham	raguparan.thangavelautham@dot.ca.gov
☒	Illinois	Brian Hill	Brian.Hill@illinois.gov
☐	Illinois Tollway	Cindy Williams	cmwilliams@getipass.com
☒	Illinois Tollway	Supraja Reddy	sreddy@interraservices.com
☐	Illinois Tollway	Signe Reichelt	smreichelt@behnkematerialsengineering.com
☒	Illinois Tollway	Jake Sumeraj	jmsumeraj@behnkematerialsengineering.com
☐	Iowa	Chris Brakke	Chris.Brakke@iowadot.us
☒	Iowa	Jeff De Vries	Jeff.DeVries@iowadot.us
☒	Michigan	Matthew Bellgowan	BellgowanM@michigan.gov
☐	Michigan	Jason Clark	ClarkJ25@michigan.gov
☒	Minnesota	Rebecca Embacher	rebecca.embacher@state.mn.us
☒	Minnesota	Kyle Hoegh	kyle.hoegh@state.mn.us
☐	Mississippi	Alex Middleton	middleton@mdot.ms.gov
☐	Missouri	Jen Harper	Jennifer.Harper@modot.mo.gov
☐	Missouri	Dan Oesch	Daniel.Oesch@modot.mo.gov
☐	New York	Michael Heim	Michael.Heim@dot.ny.gov
☐	New York	Brett Dean	Brett.Dean@dot.ny.gov
☐	New York	Edward Collins	Edward.Collins@dot.ny.gov
☐	North Dakota	Curt Dunn	cdunn@nd.gov
☒	North Dakota	Amy Beise	abeise@nd.gov
☒	Wisconsin	Drew Kottke	Drew.Kottke@dot.wi.gov

Associate Members

Participated	Affiliation	Contact	e-mail
☐	American Engineering and Testing, Inc.	Derek Tompkins	dtompkins@amengtest.com
☒	Braun Intertec	Mohammad Sabouri	msabouri@braunintertec.com
☐	Braun Intertec	Heidi Olson	holson@braunintertec.com
☐	California State University, Los Angeles	Mehran Mazari	mmazari2@calstatela.edu
☐	Caterpillar Global Paving	Brian Nagel	Nagel_Brian_D@cat.com
☒	Caterpillar Global Paving	Todd Mansell	mansell_todd_w@cat.com
☐	Concrete Paving Association	Matt Zeller	mjzeller@cpamn.com
☐	GSSI	Roger Roberts	roger@geophysical.com
☐	GSSI	Rob Sommerfeldt	sommerfeldtr@geophysical.com
☐	Infrasense	Ken Maser	kmaser@infrasense.com
☐	Leica Geosystems	Brad Adams	brad.adams@leicaus.com
☒	Consultant	Erv Dukatz	flyereld@gmail.com
☐	Mathy Construction	Matt Oman	matt.oman@mathy.com
☐	Midstate Reclamation & Trucking, Inc.	Dan Schellhammer	dans@midstatecompanies.com
☐	Midstate Reclamation & Trucking, Inc.	John Peterson	johnp@midstatecompanies.com
☐	Minnesota Asphalt Paving Association	Brandon Brever	bbrever@mnapa.org
☒	Moba	Paul Angerhofer	pangerhofer@moba.de
☐	Moba	David Shelstad	dshelstad@moba.de
☐	National Asphalt Pavement Association	Brett Williams	bwilliams@asphaltpavement.org
☐	Surface Tech	Steve Santa Cruz	steve@surface-tech.com
☐	Syracuse University	Baris Salman	bsalman@syr.edu
☐	Terracon	Andrea Blanchette	Andrea.Blanchette@terracon.com
☐	Terracon	Sheue Torng Lee	Sheue.Lee@terracon.com
☒	The Transtec Group, Inc.	George Change	GKChang@TheTranstecGroup.com
☐	Topcon Positioning Systems, Inc.	Evan Monroe	emonroe@topcon.com
☐	Topcon Positioning Systems, Inc.	Jim Preston	jpreston@topcon.com
☐	Trimble	Kevin Garcia	kevin_garcia@trimble.com
☐	Trimble	Devin Laubhan	devin_laubhan@trimble.com
☒	The University of Texas at El Paso	Nazarian Soheil	nazarian@utep.edu
☒	Wirtgen Group	Tim Kowalski	Tim.Kowalski@wirtgen-group.com
☒	Wirtgen Group	Nars Laikram	Laikram.Narsingh@wirtgen-group.com
☐	WSB & Associates	Mike Rief	mrief@wsbeng.com

Friends

Participated	Affiliation	State Contact	e-mail

☐	FHWA	Kevin Kliethermes	Kevin.Kliethermes@dot.gov
☒	FHWA	Stephen Cooper	stephen.j.cooper@dot.gov
☒	Minnesota	Emil Bautista	Emil.Bautista@state.mn.us
☒	Minnesota	Shongtao Dai	shongtao.dai@state.mn.us
☒	Minnesota	Lauren Dao	Lauren.Dao@state.mn.us
☒	Minnesota	John Siekmeier	john.siekmeier@state.mn.us
☒	Minnesota	Eyoab Zegeye Teshale	eyoab.zegeye.teshale@state.mn.us
☒	Minnesota	Curt Turgeon	curt.turgeon@state.mn.us
☒	Minnesota	Raul Velasquez	Raul.Velasquez@state.mn.us
☐	Minnesota	Michael Vrtis	Michael.Vrtis@state.mn.us
☒	Minnesota	Ben Worel	ben.worel@state.mn.us
☐	North Dakota	Jordan Nehls	jnehls@nd.gov
☐	North Dakota	Darin Lindblom	dlindblom@nd.gov
☐	North Dakota	Carey Schreiner	
☐	North Dakota	David Bruins	
☐	North Dakota	Nathan Haaland	

Other Attendees: Jake Sumeraj

Decisions Made

- None

Action items

- Continue working on contract paperwork for projects approved for funding.

NRRA National Road Research Alliance

Agenda

- Veta Web and Veta MDMS Contract
- Schedule
- ICT During MnROAD Reconstruction
- Round Robin

Next Meeting

Date: August 5, 2021
Time: 10:30-11:30AM Central Time
Location: Microsoft Teams
Agenda items: Complete Brainstorming of ICTs to use during MnROAD Reconstruction

Meeting Notes

ISIC Webinar Series – No. 004 (Chang)

See attached flyer for additional information. Reminder to register to join this webinar being held on July 29 from 9 to 11AM CDT.

ISIC 2022 Conference Call for Abstracts (Chang)

See attached flyer for additional information. Conference will be held in Portugal in September 2022. Discussions are occurring about featuring it also virtually for international participation.

Abstracts are due on October 15, 2021. Conference topics are everything under the sun for intelligent construction technologies. Accepted papers will be included in the ISIC 2022 Conference Proceedings being published by Springer Series Lecture notes in Civil Engineering.

Phase II Schedule (Worel)

Discussed construction schedule and need to get designs and plan development complete for February letting date.

Discussed RFP process and which projects are moving forward through this solicitation. See slides 6-8 for additional details.

Project Technical Advisory Panels (TAPs) (Worel)

Reminder that if you are interested in participating as a TAP member to go to the given team page on the NRRA website, select the project, and scroll to the bottom of the project page and select “Contact us to join this TAP”.

ICT Phase II Veta Contracts (Embacher)

All needed paperwork has been submitted and MnDOT research services is currently working on putting together the contract for converting Veta from a desktop platform to a web-based platform and for creation of the Veta MDMS platform.

ICT During MnROAD Construction (All – Working Group Discussion)

(Please note that ICT ideas were written “live” on the slides during the meeting.)

Quickly reviewed discussions that were completed on Cells 16-23 (see slides 9-12).

Discussed studies for cells 12, 70-78, 96, 7-9, 506, 606, 706, 806 and generated listing of potential ICTs. (see slides 13-17).

Started discussions on cells 2-3, 4, 115, and 215, but ran out of time (slides 18-21). Will begin discussions with these cells during August meeting and try to complete the remaining cells shown on slides 22-26.

ISIC Webinar Series - No.004

New Digital As-Built and Project Information Model

Time/Date 9AM to 11AM US CDT (2PM WET, 10PM Beijing Time), July 29, 2021
Venue GotoWebinar

Moderators

Dr. George K. Chang, PE, President of ISIC; Transtec Group, USA
Todd Mansell, Vice-President of ISIC NA Chapter; Product Application Specialist, Caterpillar, USA

Speakers

David Unkefer, PE, FHWA, USA
Lance Parve, WSP, USA
Becky Hjelm, Utah DOT, USA
Michael Cremin, MN DOT, USA
Ahmad Abu-Hawash, IA DOT, USA
Alexa Mitchell, HDR, USA

Description

The past highway as-built has been paper or image-based technology. This practice has limited as-constructed information gathering and cannot make the information readily accessible and geospatially located accurately. The new digital as-built or project information model (DAB/PIM) can overcome the above limitations. DAB/PIM uses modern digital delivery technologies to support construction management and eConstruction. DAB/PIM can also capture other critical project information beyond construction. This new approach to digital project delivery is proven successfully to integrate design-construction data during the stages of before, during, and after construction. Therefore, DAB/PIM can produce benefits, including improved efficiency, quality, and cost savings. Ultimately, project-level DAB/PIM will contribute to a Digital-Twin of our highway system, i.e., a system-wide lifecycle collection of inventory information, geometrics, and other valuable information. The Digital-Twin will then be used for agencies' business needs to manage maintenance, operations, assets, and future project scoping/design/construction. Digital-twin can also support future connected vehicle technologies such as accurately updated maps. This webinar will focus on the driving forces, benefits, challenges, and what can be done to lay out a practical road map to start implementing DAB/PIM using existing and emerging tools and technology. Speakers will share US agencies' real-world experience and provide a vision for the future DAB/PIM.

Registration

The registration is free. We will provide certificates of 0.2 PDH to participants upon request.

REGISTER NOW

Agenda

Time	Topic	Speakers
95 min.	US National Implementation – EDC-6	Unkefer
	Overview on US National Technical State of Practice	Parve
	Utah DOT's Implementation	Hjelm
	Minnesota DOT's Implementation	Cremin
	Iowa DOT's Implementation	Abu-Hawash
25 min.	Panel Discussion	Unkefer, Parve, Hjelm, Cremin, Abu-Hawash, Mitchell

Speakers' Bio

David Unkefer, PE, FHWA, USA (ISIC Technical Committee member)

Mr. Unkefer is a Senior Construction and Project Management Engineer providing US national technical assistance to FHWA and its partners. He is responsible for deploying innovative practices related to BIM for Infrastructure (aka civil integrated management or CIM), digital project delivery, and construction automation. He has led previous Every Day Counts initiatives for 3D engineered models and alternative contracting methods and currently is hosting post-EDC support for digital construction inspection and BIM usage for lifecycle asset management. David has been with FHWA for 27 years holding various engineering and leadership positions in 9 states. He is a professional engineer with degrees in Civil Engineering from the University of Florida and Purdue University.

Lance Parve, WSP, USA (ISIC Steering Committee member)

Mr. Parve is the Director of BIM Services, Advisory Services, WSP USA. Before joining WSP, Lance worked at Wisconsin DOT to plan, design, and construct mega-major transportation civil infrastructure projects. He also provided CIM-CAD-GIS, 3D-4D-xD technologies, and LiDAR-UAS survey coordination support. Working for WisDOT for over ten years involving public sector work, with 15 years of involvement in private sector civil and environmental infrastructure work, he has been involved in numerous successful planning, design, and construction mega-major transportation projects WisDOT. He has an MS Engineering degree, MS Certificate Urban Planning GIS degree, and a BS Geological Sciences degree from UW-Milwaukee. He serves as co-chairperson of the TRB AED80(1) subcommittee on BIM for Infrastructure and a member of the TRB AED80 Visualization in Transportation Committee.

Becky Hjelm, Utah DOT, USA

Ms. Hjelm has been a member of the Utah DOT team for over nine years and played an instrumental role in adopting GIS at UDOT. About three years ago, she left her role as the Data and Analytics Manager to move into preconstruction, focusing on advancing Digital Delivery. Becky has over twenty years of experience in GIS management, data analysis, project management, and IT development in government. She received her Bachelor's Degree from the University of Utah and her Master's Degree from the University of North Texas.

Michael Cremin, MN DOT, USA

Mr. Cremin is a Statewide Project Engineer with Minnesota DOT Asset Management Program Office. He received a degree from the University of Minnesota. He has gained ten years (7 years of private consulting and three years of state DOT) of implementing asset management programs, including data-driven risk-based decision engineering support. He focuses on ancillary asset management maturity development for Transportation Asset Management System software utilization (240 asset class codes), Transportation Asset Management Plan development (10 asset classes), Asset Management Strategic Implementation Plan development (72 asset classes), and Mobile Collection.

Ahmad Abu-Hawash, IA DOT, USA

Mr. Abu-Hawash is the Chief Structural Engineer for Iowa DOT, responsible for overseeing structural design activities on major bridge projects and reviewing design policies. He oversees research and coordinates the implementation of innovations in the Bridges and Structures Bureau. Ahmad received a BS degree from the University of Iowa and an MS degree from Iowa State University in Civil Engineering and Structures. Ahmad serves as the Chair of AASHTO Bridge and Structures Technical Committee on Software and Technology and as the Vice-Chair of AASHTO Technical Committee on Construction. He is a member of the AASHTO Technical Committee on Electronic Engineering Standards (JTCEES).

Alexa Mitchell, HDR, USA

Ms. Mitchell is HDR's Transportation BIM Program Manager and a professional engineer registered in MO and AZ. Alexa provides strategic and technical leadership to expand HDR's building information modeling practice and its use on significant infrastructure projects. She brings over 20 years of experience in project delivery and demonstrated a history of working in the highway industry, providing leadership to implement innovative solutions that transform everyday workflows. For 16 years with MoDOT, she led the agency by implementing 3D-engineered models for construction, electronic plans and signatures, and 3D surveys. She has spent the last six years working as a BIM consultant to help clients navigate the changing environment of BIM-enabled project delivery, from determining the proper approach to using the model as the legal document to construction and asset management. Her guidance adds value entire project life cycle.

Moderators' Bio

Dr. George K. Chang, PE, President of ISIC; Transtec Group, USA

Dr. Chang is a world expert on pavement smoothness and intelligent compaction/construction technologies. He has founded the International Society for Intelligent Construction - ISIC (www.IS-IC.org). His research, teaching, specification development, and software tools have helped make significant technological advancements in the above fields. The websites he develops and maintains, Profile Viewing and Analysis - ProVAL (www.RoadProfile.com) and Intelligent Construction Technologies - Veta (www.IntelligentConstruction.com), have become a one-stop-shop for pavement smoothness and intelligent compaction (IC)/construction technologies (ICT). In the past 15 years, he has been leading the IC/ICT implementation efforts worldwide, including the US, China, and Australia.

Todd Mansell, Vice-President of ISIC North American Chapter; Product Application Specialist, Caterpillar, USA

Mr. Mansell has worked in the asphalt paving industry for over 30 years in different roles ranging from a transportation department, engineering consulting firms, a heavy highway & civil construction company, and two equipment manufacturers. For the past eight years, Todd has been with Caterpillar as a Product Application Specialist focusing on asphalt pavers, soil and asphalt compaction, and new and emerging technologies.

ISIC
INTERNATIONAL SOCIETY FOR INTELLIGENT CONSTRUCTION

July 29, 2021

ISIC Webinar No. 4

New Digital As-Built & Project Information Model (DAB/PIM)

David Unkefer
FHWA
Construction/Project Management Engineer

Lance Parve
WSP
BIM Services, Advisory Service

Becky Hjelm
Utah DOT
GIS Manager

Michael Cremin
Minnesota DOT
Chief Structural Engineer

Ahmad Abu-Hawash
Iowa DOT
Chief Structural Engineer

Alexa Mitchell
HDR
Transportation BIM Program Manager

REGISTER NOW

ISIC 2022 Conference Call-for-Abstracts

The International Society for Intelligent Construction 2022 Conference (ISIC 2022) will be held in Guimarães, Portugal, from September 6 to 9, 2022. The conference theme is "**Trends on Construction in the Post-Digital Era**. " The city of Guimarães, Portugal, is also a UNESCO World Heritage site.

The conference topics cover everything under the sun for intelligent construction technologies. The abstracts submission will be due on October 15, 2021 (download abstract template). Accepted papers will be included in the ISIC 2022 Conference Proceedings that will be published by Springer Series Lecture Notes in Civil Engineering and further indexing by Scopus and Web of Science.

Recommend using Edge, Chrome, or a similar browser to visit the ISIC 2022 conference website (https://ICISIC2022.com) for further detail.

Intelligent Construction Technology Team

Meeting | 07/08/21

Microsoft Teams

National Road Research Alliance

Agenda

- ISIC Webinar Series & ISIC 2022 Call for Abstracts
- MnROAD 2022 Construction Schedule
- 2022 MnROAD Construction Designs/Special Provisions
- Phase II Contract Development
- Project Technical Advisory Panels (TAPs)
- ICT During MnROAD Construction

ISIC Webinar Series – No. 004
New Digital As-Built and Project Information Model

- When:
  - July 29, 2021
  - 9AM to 11AM CDT (Goto Webinar)
- Speakers
  - David Unkefer, PE, FHWA, USA (National Implementation – EDC-6)
  - Lance Parve, WSP, USA (Overview National Technical State of Practice)
  - Becky Hjelm, Utah DOT, USA
  - Michael Cremin, MN DOT, USA
  - Ahmad Abu-Awash, IA DOT, USA (Bridges and Structures)
  - Alexa Mitchell, HDR, USA

- www.IS-IC.org

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ISIC 2022 Conference Call for Abstracts

- Guimarães, Portugal
- September 6 to 9, 2022
- Conference theme
  - “**Trends on Construction in the Post-Digital Era**”
- Conference topics
  - everything “under the sun” for intelligent construction technologies
- Abstracts due on October 15, 2021 (download abstract template)
- Accepted papers
  - Included in the ISIC 2022 Conference Proceedings that will be published by Springer Series Lecture Notes in Civil Engineering and further indexing by Scopus and Web of Science.
- https://ICISIC2022.com

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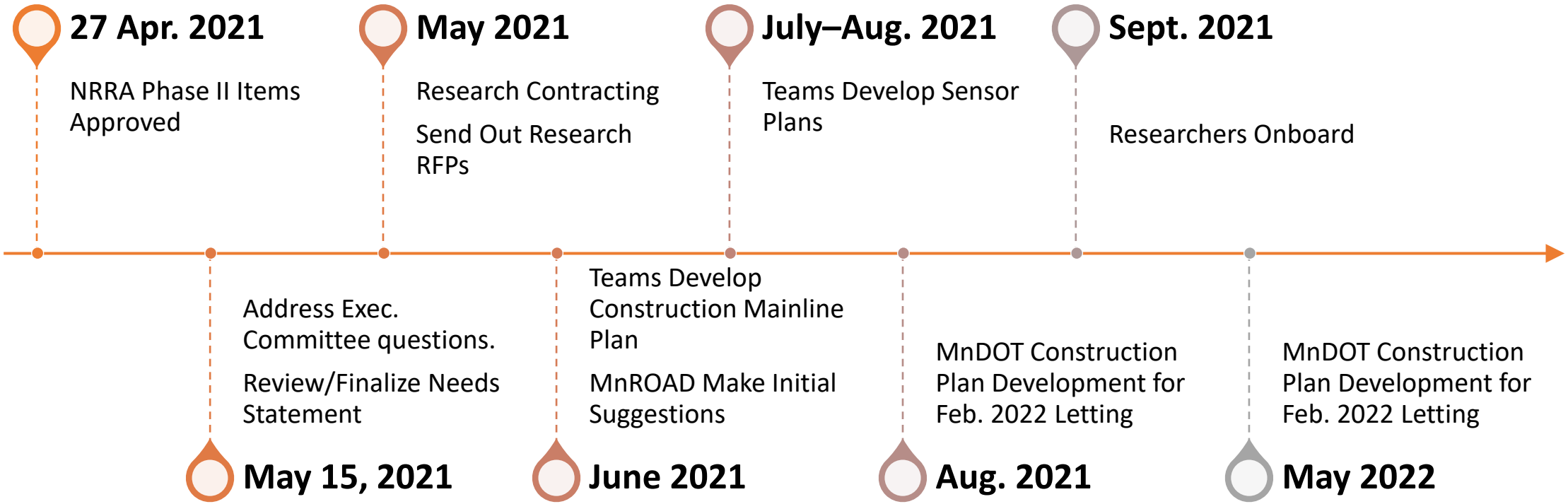
Schedule


27 Apr. 2021
NRRA Phase II Items Approved
May 2021
Research Contracting
Send Out Research RFPs
July–Aug. 2021
Teams Develop Sensor Plans
Sept. 2021
Researchers Onboard
Address Exec. Committee questions.
Review/Finalize Needs Statement
May 15, 2021
Teams Develop Construction Mainline Plan
MnROAD Make Initial Suggestions
June 2021
MnDOT Construction Plan Development for Feb. 2022 Letting
Aug. 2021
MnDOT Construction Plan Development for Feb. 2022 Letting
May 2022

Phase II Contract Development

NRRA Team	NRRA Contract Idea	Funding Approved	Changes Funding*	Update / Action Items
Flex	MnROAD Reflective Cracking Challenge Tied to NCAT Additive Group Experiment Tied to Companion Sections in Missouri	225,000		RFP going into its final review with the flex TAP in July
	Recycled Binder Availability	200,000		RFP going into its final review with the flex TAP in July
	Validation of Loose Mix Aging Procedures for Cracking Resistance Evaluation in Balanced Mix Design	100,000		RFP going into its final review with the flex TAP in July
	Perpetual Pavements in Wet Freeze Climate Tied to WI test section construction	200,000		Should these be combined to one RFP (ask each team)? Otherwise each RFP will be going into its final review with the TAPs in July
Flex-PM	Reclamation and Recycling Techniques to Achieve Perpetual Pavements Characteristics	150,000		

Phase II Contract Development (cont.)

NRRA Team	NRRA Contract Idea	Funding Approved	Changes Funding*	Update / Action Items
PM	Thinlays as a PM Treatment	50,000		PM final review of the tasks in this effort. Then PM team (state members) direct select contractor for this effort.
Rigid	Reduced Cement in Concrete	150,000		Should these be combined to one 450K RFP? Otherwise each RFP will be going into its final review with the TAPs in July
	Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements Supported with FHWA for this contract 150K	150,000		
	Alternative Cementitious Materials – Geopolymer Concrete	300,000	150,000	
	Technical Expert Guidance on PCC Mixes and Construction	Discuss	100,000	MnDOT working to develop this support needed and expect this to be a direct select contract – will report to the rigid team
	Sampling and Testing Contract (construction)	Discuss		Direct Select contract with AET – construction funding source might be possible at ~100K

Phase II Contract Development (cont.)

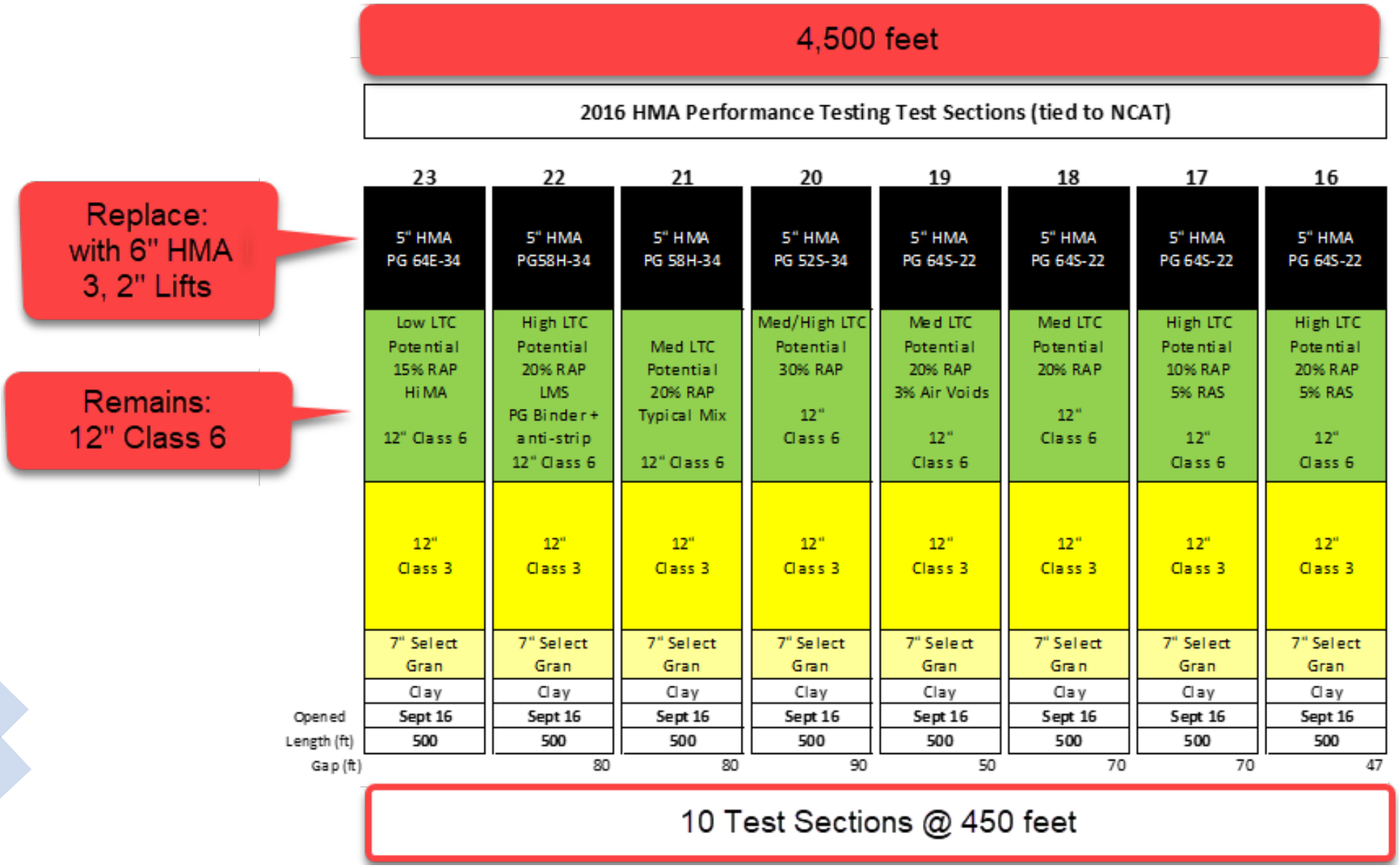
NRRA Team	NRRA Contract Idea	Funding Approved	Changes Funding*	Update / Action Items
All	EPD Development for 2022 MnROAD Construction	Discuss	150,000	Need to discuss with all teams – Use construction funding or NRRA to accomplish this effort. Estimated at 150K
PM-Geo	Flooded Pavements Assessment App–Phase 2	200,000		Contract with University of New Hampshire because they did phase-1 and can most efficiently accomplish phase-2 – working to develop this contract. Share team outline for university to develop contract and get TAP ok
Geo	Performance Evaluation of Wicking Geotextiles for Improving Drainage and Stiffness of Road Foundation	150,000		RFP going into its final review with the Geo TAP in July
ICT	Convert Desktop Version of Veta to a WebBased Application and Standardized Material Delivery Management System Platform (Phase-1 and 2) Support with FHWA	800,000 + FHWA $		Transtec is in the process of being contracted under a sole source contract / Sole Source Contract due to Cross Licensing Agreement

* Discuss the funding changes with Executive Committee

HMA Reflective Cracking Study

- tied to NCAT additive and Missouri test sections
- Existing Test Sections: 16-23 (4,487 feet)
- Construction:
  - Remove 5” HMA – Replace with 6” HMA mix on 12” class-6 granular base
  - 10 test sections (400 feet with 25’ before and after for coring ~450 feet total of each mix)
- Action Needed:
  - Flexible Team determine what 10 HMA mixes are needed?
  - GeoTechnical Review (at a later time) base materials (we need a consistent base for study)
  - ICT Team – what technology could be utilized in this ~4,500 ft of granular base or HMA paving?

Reconstruction of Cells 16-23



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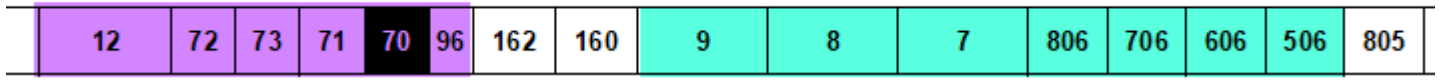
Cells 16-23 ICT

Material	Technology
Pre-Milling	3D GPR (thickness), FWD, TSD (traffic speed deflectometer / NCHRP project) Smoothness Scan road and create 3D existing and milled surface models Is milling texture being looked at and affect on bonding (e.g., drum speed)?
Milling	AMG (Variable Depth) Milling (>=1,000 feet) – tie Phase I milling study – Include as Contract Item
12” Granular Base	IC Pre-Mapping (Phase I project – level 3 ICMV depending upon timing) – include as contract item LWD, DCP (assuming refusal) – collecting by OMRR Research? Scanning of Moisture – tie to Phase I project Corrective Action Needed?…

Material	Technology
6” Hot Mix Asphalt	Variable Depth Paving – Contract (concern: No paving contractors in MN set up with this technology – pave to depth with AMG milling) Asphalt Real-Time Smoothness (ARTS) (Phase I project – if available) – Add via Change Order if technology ready IC – contract item PMTP – contract item MDMS – contract item Smoothness – contract item FWD – collected by OMRR research DPS – collected by OMRR research (collaboration on cores w/ Flex Team) must collect 3 linear passes of k-measurements (adjacent CL, middle of lane, adjacent to shoulder; data lot labeling must be used and follow other ICT requirements); MnDOT AMT unit/NDDOT will mine data in Veta) Seismic – collected by Geotech if system available (phase I project) Road Doctor (include GPR – layer thickness) – collected by OMRR research TSD (Pay for service is available)

All spot tests – collect GPS coordinates and/or station and offset
Monitoring Plan
Laser Scanning?
As-Builts recorded during AMG milling & paving

3 Concrete Studies



Study - Use of Carbon Dioxide for Sustainable and Resilient Concrete Pavements

Study - Reduced Cement in Concrete

Alternative Cementitious Materials – Geopolymer Concrete

- (three studies – Rigid team determines the number of cells for each)

- Existing Test Sections:
  - First Grouping - 506, 606, 706, 806, 7, 8, 9 (2,074 feet)
  - gap
  - Second Grouping - 96, 70 (648 feet), 71, 73, 72 (945 feet), 12 (499 feet)
- Construction:
  - Remove existing concrete and base materials varying depths
  - Pave 7.5” PCC with common drainable granular base – 15’ panels - input from Geotech team
    - First Grouping - 8 test sections (~250 feet each with no transitions)
    - Second Group – 8 test sections (~250 feet each with no transitions)
- Action Needed:
  - Rigid Team determine the number and concrete mixes for each study from the above utilizing the 16 test section locations.
  - Rigid Team discuss the need for a consistent base support (can the geotechnical have variations built into the test sections and not effect the surface material studies)?
  - GeoTechnical Review (at a later time) base material
  - ICT Team – what technology could be utilized in this granular base or PCC paving?
  - Assume a common control mix could be shared as one test section leaving 15 test sections.
  - Note that cells 71,73,72 do not have to be reconstructed due to pavement condition. Could be withheld from the contract if costs come in high.

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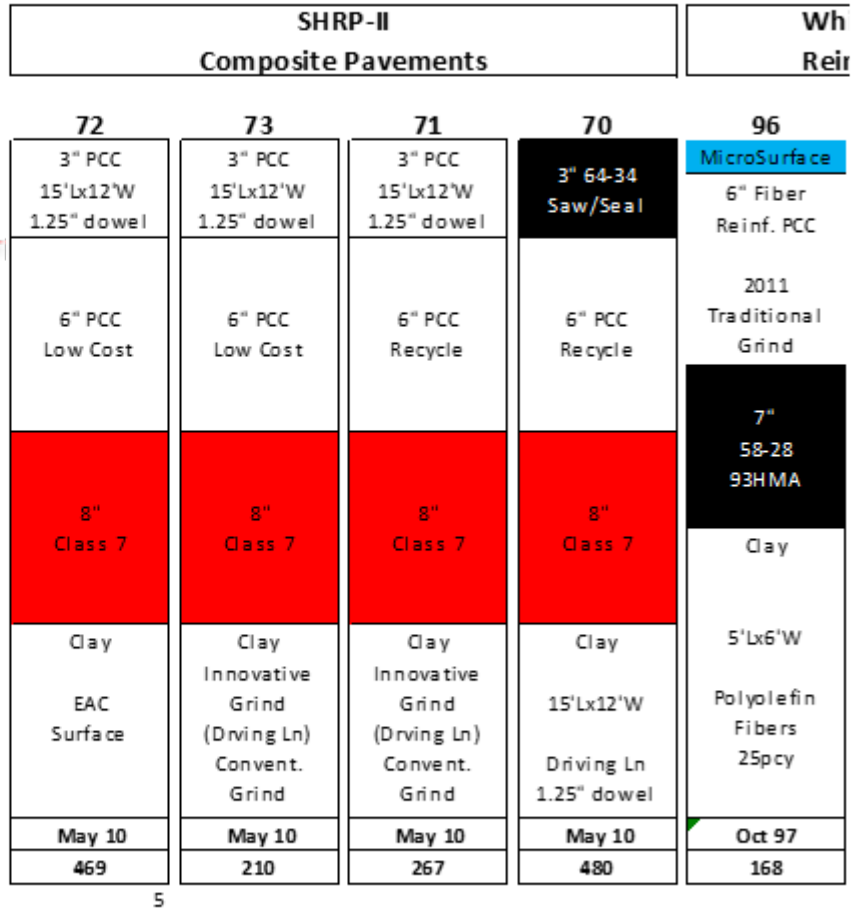
Reconstruction of Cells 12, 70-73 & 96

Remove Existing Concrete & Base at varying depths

~ 2,000 feet

7.5" PCC 15' Panels

Common Drainable Base



8 Test Sections ~ 250 feet (no transitions)

4" Class 5Q Drainable Granular Base
5.5" Class 7 Recycled Granular Base
(may or may not use a paver)

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Reconstruction of Cells 7-9, 506, 606, 706, 806

Remove Existing Concrete & Base at varying depths

7.5" PCC 15' Panels

Common Drainable Base

4” Class 5Q Drainable Granular Base
5.5” Class 7 Recycled Granular Base
(may or may not use a paver)

8 Test Sections ~ 250 feet (no transitions)

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Material	Technology
4” Class 5Q Drainable Granular Base	IC Pre-Mapping (Phase I project – level 3 ICMV depending upon timing) – include as contract item (mat’l left in place) IC during compaction efforts (ICMV, MDP) LWD, DCP (assuming refusal) – collecting by OMRR Research? Continuous Moisture Testing – tie to Phase I project Automated Plate Load Testing Modulus Testing – coordinate with cont. moisture & Level 3/4 testing Density
5.5” Class 7 **Recycled** Granular Base	See 5Q comments Use sand cone if testing for density – not nuke
Concrete Paving (may or may not use a paver)	Concrete Real Time Smoothness (CRTS) – SHRP2 program if paver
Concrete Removals (5-9”)	Wirtgen – Hamm H25iVC roller (vibration crusher) – Tim will send info. (particle size ~ 2 ft down to 4” or less) – out for 5-6 years (will not work in 12” thick rebar enforced concrete; uses force going into mat’l to crush – not affected by underlying mat’l; often used in demolition locations, where vibration not a factor) Include vibration monitoring (Geotech) Pre-thickness evaluation with 3D GPR

Material	Technology
Existing Clay Subgrade	Will send link to MnDOT standard specs. for subgrade Link is on Geotech team website (state specs and design manuals posted on NRRA Geotech website). IC: CMV / MDP – if compaction needed

Studies

Reclamation and Recycling Techniques to Achieve Perpetual Pavements Characteristics

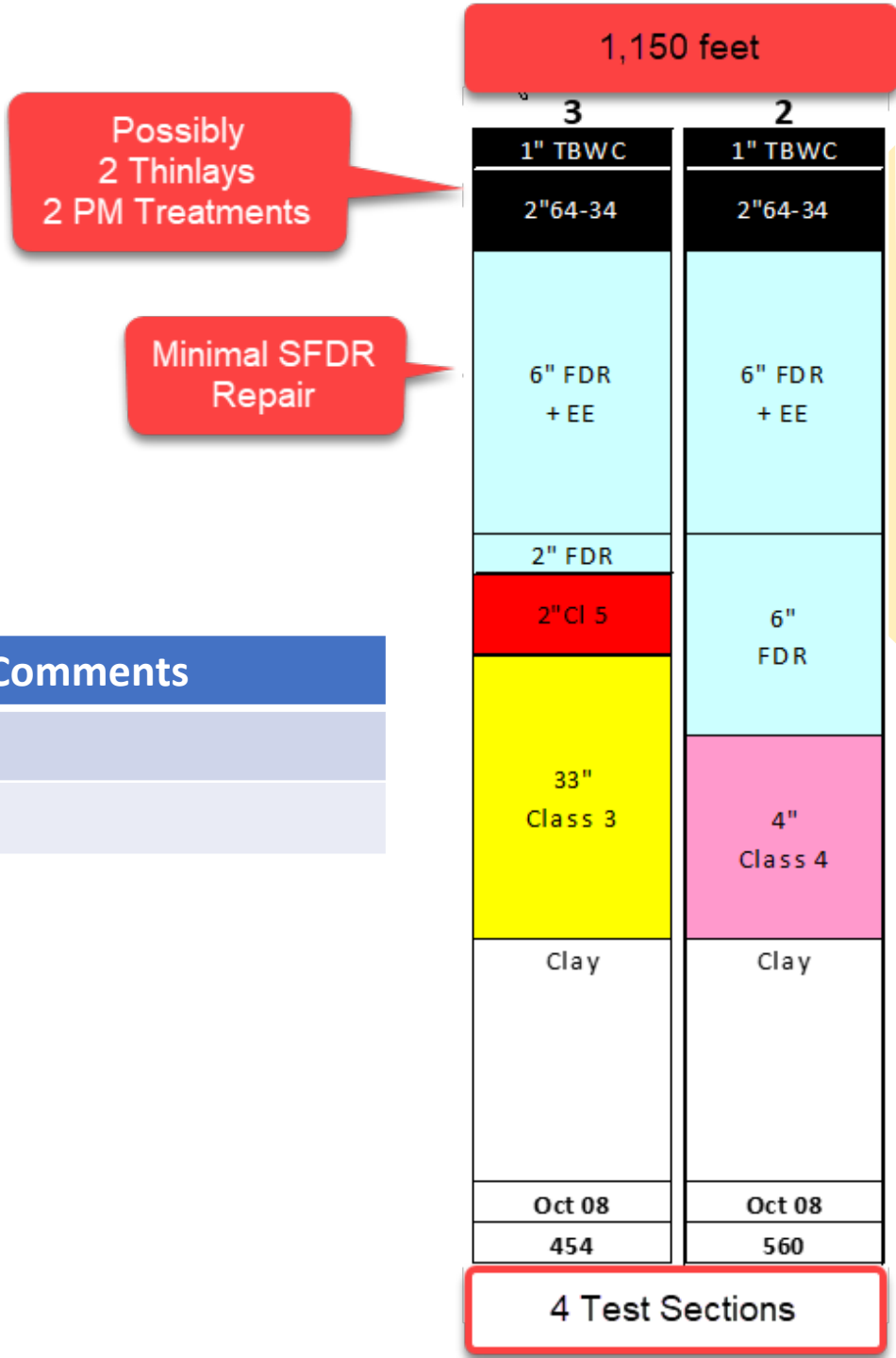
Thinlays as a PM Treatment

Performance Evaluation of Wicking Geotextiles for Improving Drainage and Stiffness of Road Foundation (ties to 4 and 15 SFDR)

- Existing Test Sections: 2 (575 feet),3 (575 feet) ,4 (575 feet), *gap to*, 115,215 (573 feet)
- Construction:
  - Cell 2,3 (minimal repair of SFDR) – split into 4 test sections with minimal PM treatment and thinlay as other treatment. Flex group designs if any milling is done and the mix designs. Example 102 PM treatment, 202 thinlay, 103 thinlay, 203 PM treatment.
  - Cell 4 (extensive repair of SFDR) – Flex and Geotech team design section. How can the wicking geotextile be used to improve system from the past (full depth section with no base was the original roadway before SFDR in 2007)
  - Cell 115,215 (New reclamation of a ~14 inch full depth roadway with no granular base) – Flex and Geotech team to design section. How can the wicking geotextile be used to improve system?
- Action Needed:
  - PM and Flex design surface treatments for cells 2 and 3 good performing SFDR (thinlay and another surface treatment). Note cell 4 and 115-215 also will need surfaces.
  - Flex and Geotech design repairs to cell 4 – highly distressed SFDR
  - Flex and Geotech design a perpetual type of recycled cell to replace 115 and 215.
  - ICT Team – what technology could be utilized in this area?

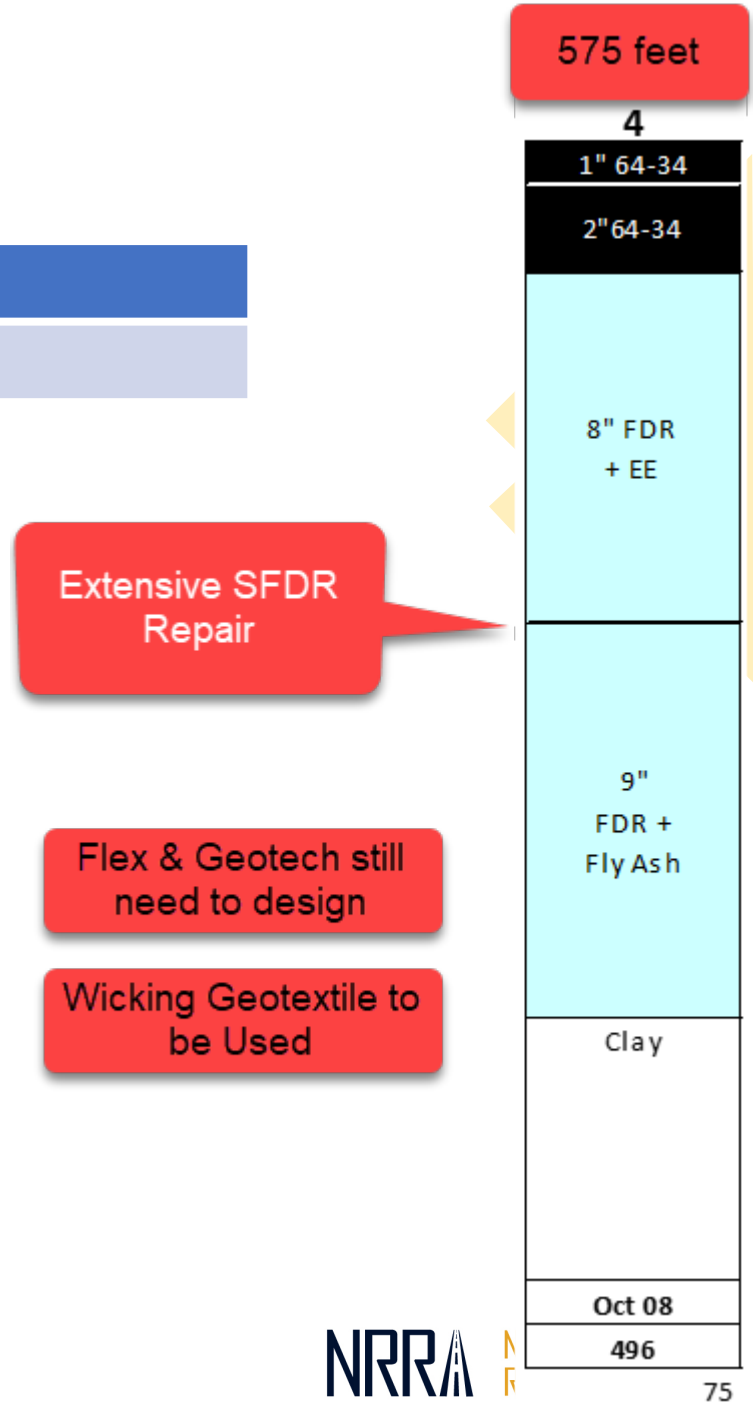
Cells 2-3 ICT

Material	Technology	Comments
PM Treatments		
Thinlays	AMG Milling	

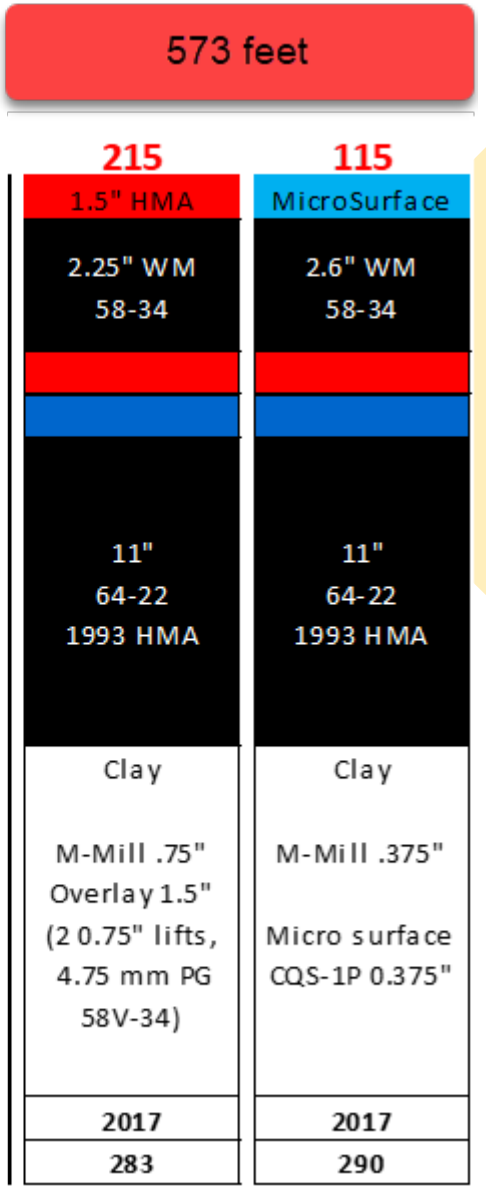


Cell 4 ICT

Surface (?)		
SFDR Repairs		



Cells 115 & 215 ICT



Material	Technology
HMA	
FDR	

NRRA National Road Research Alliance

Perpetual Pavements in Wet Freeze Climate

- Existing Test Sections: 101,201 (500 feet)
- Construction:
  - Flexible Team design needed
  - 1 or 2 test sections – match Wisconsin plus?
- Action:
  - Flexible Team – Designs needed for two perpetual pavements
  - Can a 250 foot section work?
  - ICT Team – what technology could be utilized in these test sections?

ICT team needs to wait for more details ….

Recycled Binder Availability

- Existing Test Sections:
  - 160,162 (447 feet)
  - (Break between the cells)
  - 114,214,314,414,514,614,714,814,914 (520 feet)
- Construction:
  - Remove 18” of whitetopping and clay subgrade on all cells and replace with a 12” granular base with 6” HMA surface
  - 4 test sections at 250’ each with transitions.
- Questions:
  - Flex team – what mix four mix designs?
  - Flex team – do these test sections have to be at MnROAD? Could they be on another roadway because instrumentation is not a priority?
  - Geotechnical Group – What base is suggested?

Cells 160,162,114,214,314,414,514,614,714,814,914 ?

- 12” Granular Base
- 6” HMA
- 4 test section @ 250 feet each with transitions (1,000 ft)

Material	Technology	Comments
Granular Base		
HMA		

BCOA “Whitetopping” with Fibers

- Existing Test Sections: 114,214,314,414,514,614,714,814,914 (520 feet)
- Construction:
  - Remove existing 6” PCC + mill 1” HMA
  - Construct 5” FRC, 6’x6’ panels BCOA. Use fibers intended to enhance joint LTE (ranked #6)
- Question:
  - Test sections do need work
  - MnDOT would do the needed research at our costs

Cells 114,214,314,414,514,614,714,814,914 (520 feet)?

Material	Technology	Comments
Concrete		