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U.S. Department of Transportation
Federal Highway Administration

Michigan County Engineers' *56th annual workshop* February 8, 2022

FHWA MOBILE ASPHALT TECHNOLOGY CENTER AND OUTREACH TO LOCAL AGENCIES

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FHWA Office of Preconstruction, Construction and Pavements

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Acronyms

- 3D: Three Dimensional
- ABML-ID: FHWA Asphalt Binder and Mixture Laboratory – Implementation Division
- AC: Asphalt Content
- AMPT: Asphalt Mixture Performance Tester
- BMD: Balanced Mix Design
- DPS: Dielectric Profiling System
- FTIR: Fourier Transform Infrared Spectroscopy
- GPR: Ground Penetrating Radar
- IDEAL-CT: Ideal Test for Cracking
- IDEAL-RT: Ideal Test for Rutting
- I-FiT: Illinois Fatigue Test
- MATC: FHWA Mobile Asphalt Technology Center
- MPD: Mean Profile Depth
- PMTP: Paver Mounted Thermal Profiler
- QA: Quality Assurance
- RLTS: Rapid Laser Texture Scanner
- RLTS-C: Rapid Laser Texture Scanner, confined in field
- RLTS-UC: Rapid Laser Texture Scanner, unconfined specimen in lab
- SMA: Stone Matrix Asphalt
- SSR: Stress Sweep Rutting
- XRF: X-Ray Florescence

On Deck: Outreach to Local Agencies

FHWA Infrastructure Programs

- Who we are, what we do in pavements

FHWA Resilient Pavements

- Defining resilience
- Resilience in Transportation Asset Management Plans in regulation
- Adaptation strategies
- FHWA resources available to help agencies

FHWA Mobile Asphalt Technology Center (MATC)

- Program Goals
- Activities and Opportunities for Local Agencies
- Deploying field technology that supports pavement durability and safety

FHWA Infrastructure Programs

- Program Offices
- Office of Research, Development and Technology
- Federal Aid Divisions
- Resource Center

Brian Fouch
Director, Office of Preconstruction, Construction and Pavements

- **Robert Mooney, TL**
  Preconstruction
- **Brian Hogge, TL,**
  Contract Administration & Construction
- **Gina Ahlstrom, TL**
  Pavement Materials
- **LaToya Johnson, TL,**
  Pavement Design & Performance

Pavement and Materials: Who We Are

- **Richard Duval:** program coordination for Performance Engineered Mixtures and Design and Performance Related Specifications
- **Tim Aschenbrener:** asphalt pavements, Asphalt QA, increased density, asphalt recycling
- **Leslie Myers:** flexible pavements, asphalt materials, Mobile Asphalt Technology Center
- **Mike Praul:** concrete pavements and materials, concrete QA, Mobile Concrete Technology Center
- **Sam Tyson:** long-life concrete pavement strategies, concrete repair strategies, concrete recycling and industrial byproducts, concrete overlays

Pavement and Materials: What We Do

- All things Asphalt Materials
- All things Concrete Materials
- Technologies for pavements and materials
- Movement toward Performance Engineered Pavements
- Pavement Sustainability and Resilience

FHWA Resilience

Application to Pavements

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Turner-Fairbank
Highway Research Center

What Is Resilience?

Resilience: the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions, FHWA Order 5520 (FHWA 2014a).

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Resilience in Transportation Asset Management Plans in Regulation

23 CFR Part 515.7

State DOTs are required to develop a risk-based asset management plan to include specific minimum processes including the following section on life cycle planning identified in subsection (b)*:

- A state DOT shall establish a process for conducting life cycle planning for an asset class or asset subgroup at the network level (network to be defined by the state DOT). As a state DOT develops its life cycle planning process, the state DOT should include future changes in demand; information on current and future environmental conditions including extreme weather events, **climate change**, and seismic activity; and other factors that could impact whole-life costs of assets.

*Similar requirements are in subsection (c) which addresses Risk Management Plans

Adaptation Strategies:

1. Monitor Trends

Most predicted changes to environmental variables are projected to occur relatively slowly in relation to a typical infrastructure lifecycle (FHWA 2015).

Key pavement indicators to monitor for climate change impacts.

Asphalt Pavement Indicators	Concrete Pavement Indicators
Rutting of asphalt surface	Blow-ups (JPCP)
Low temperature (transverse) cracking	Slab cracking
Block cracking	Punch-outs (CRCP)
Raveling	Joint spalling
Fatigue cracking and pot holes	Freeze-thaw durability
Rutting of subgrade and unbound base	Faulting, pumping, and corner breaks
Stripping	Slab warping
	Punch-outs (CRCP)

Source: FHWA.
(FHWA forthcoming a.)
CRCP = continuously reinforced concrete pavement; JPCP = jointed plain concrete pavement.

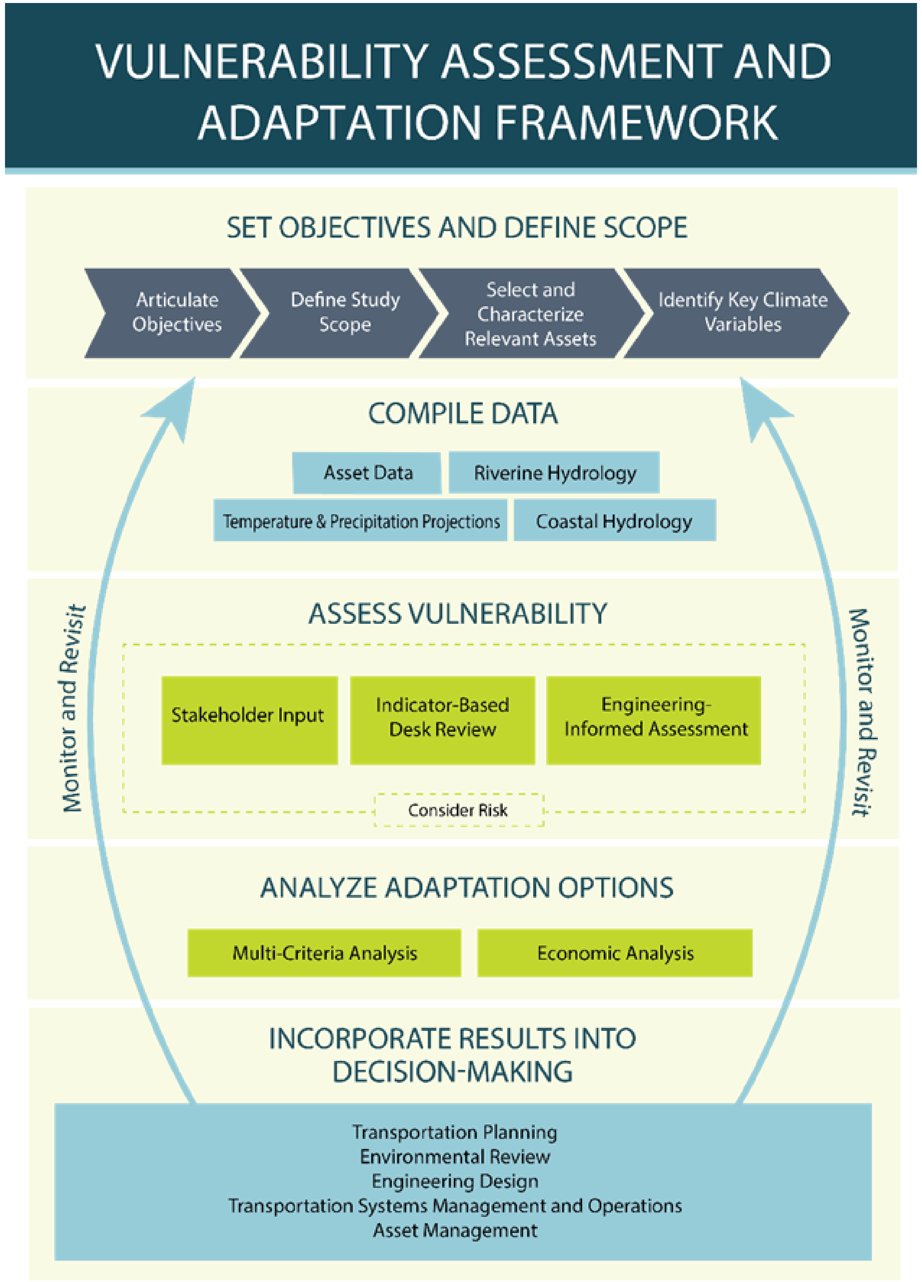
2. When Trends Differ, Evaluate Vulnerability

Objectives:

- Identify whether an asset is more vulnerable than other system assets.
- Prioritize potential vulnerabilities for the system.

Approach:

- Use the Vulnerability Assessment Scoring Tool (FHWA 2017a).
- Input local asset data.
- Output the relative vulnerability scores per asset.



Source: FHWA.

(FHWA 2019)

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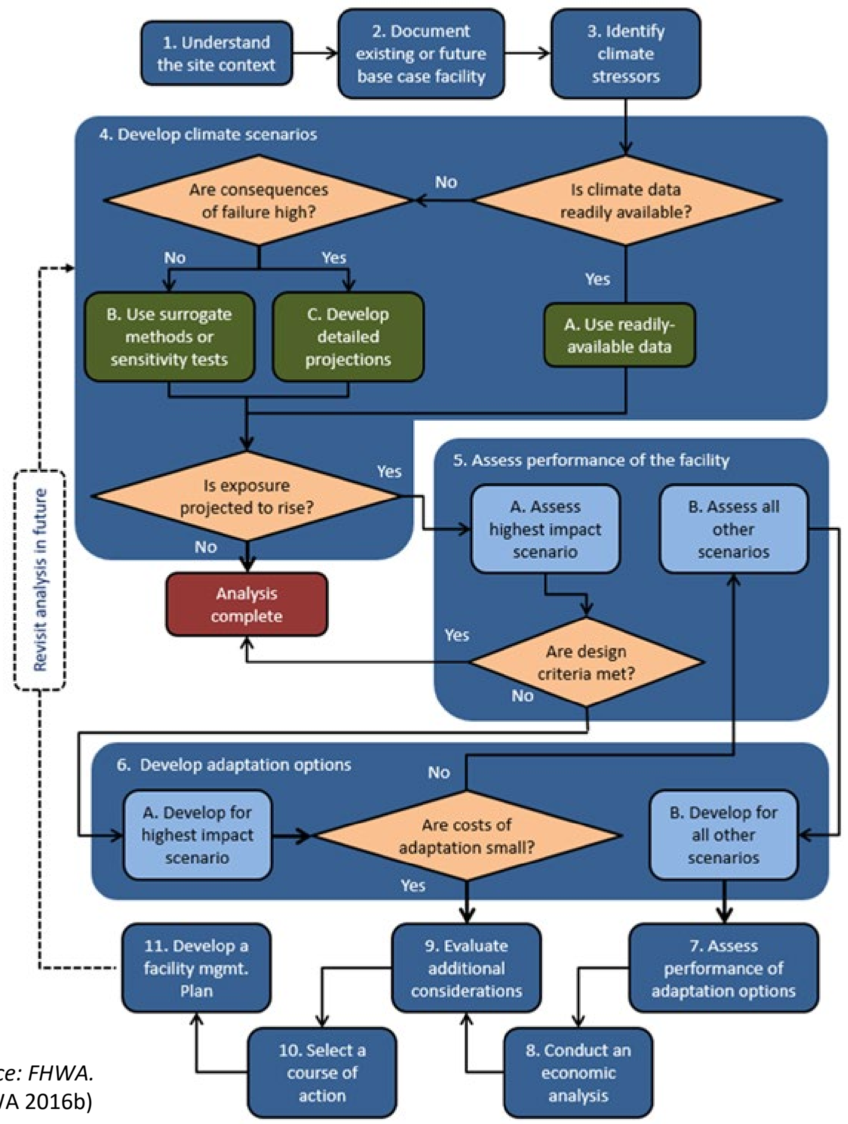
3. Plan and Design Infrastructure to Meet Future Conditions:

- Use the adaptation decisionmaking assessment process (ADAP).
- Use a risk-based approach for planners, designers, or engineers.
- Tailor to each State.
- Aids decisionmakers in determining which project alternative is best (lifecycle costs, resilience, and regulatory and political settings) (FHWA 2021a).

Decision Tree of the ADAP Steps



Source: FHWA.
(FHWA 2016b)

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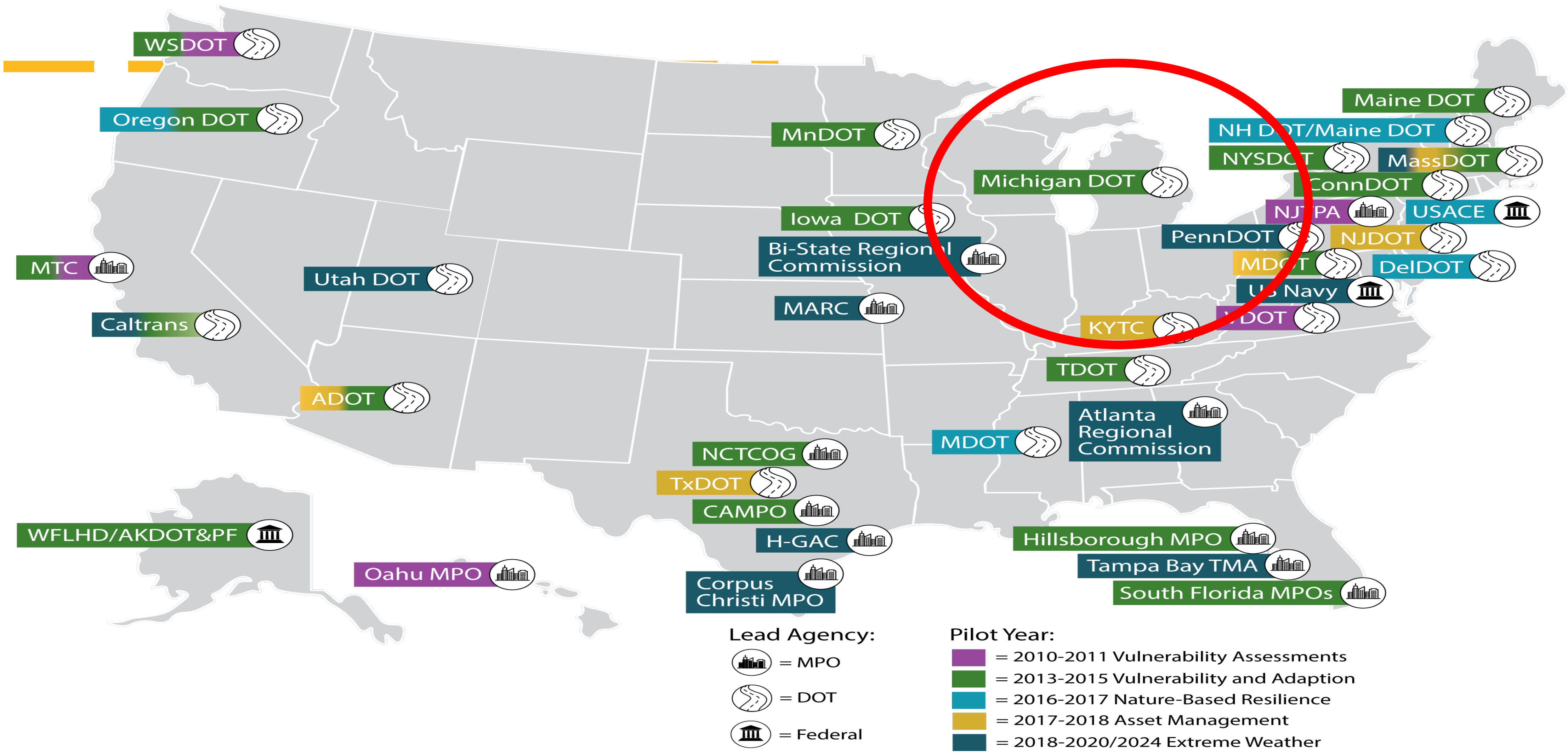
Working with Partners Across the Country



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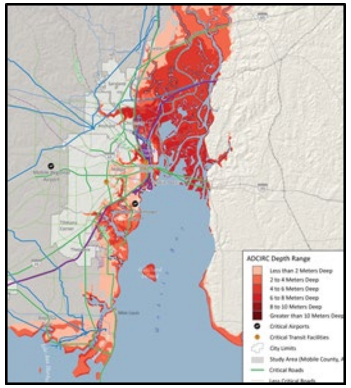
FHWA Resilience Resources

Gulf Coast 2 Study

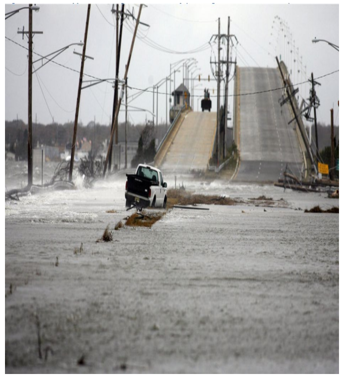


(FHWA 2019)

Resilience Pilots with State DOTs and MPOs

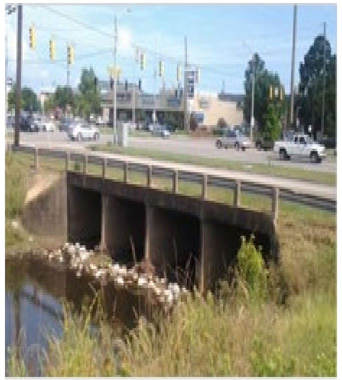
(FHWA 2021b) MPOs = metropolitan planning organizations.

Hurricane Sandy Project



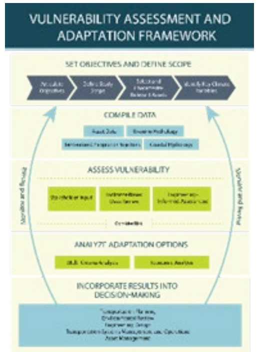
(FHWA 2017b)

Engineering Assessments



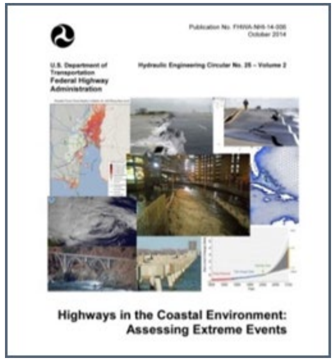
(FHWA 2017c)

Vulnerability and Adaptation Framework



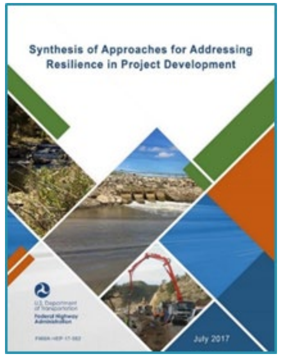
(FHWA 2019)

Engineering Guidance (HEC-25 & 17)



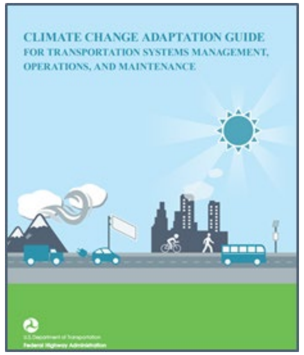
(FHWA 2014c)

Project Development



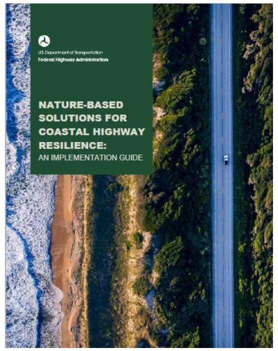
(FHWA 2015)

Operations and Maintenance



(FHWA 2017d)

Nature-Based Solutions



(Buckingham and Torossian 2021)

All photos source: FHWA.

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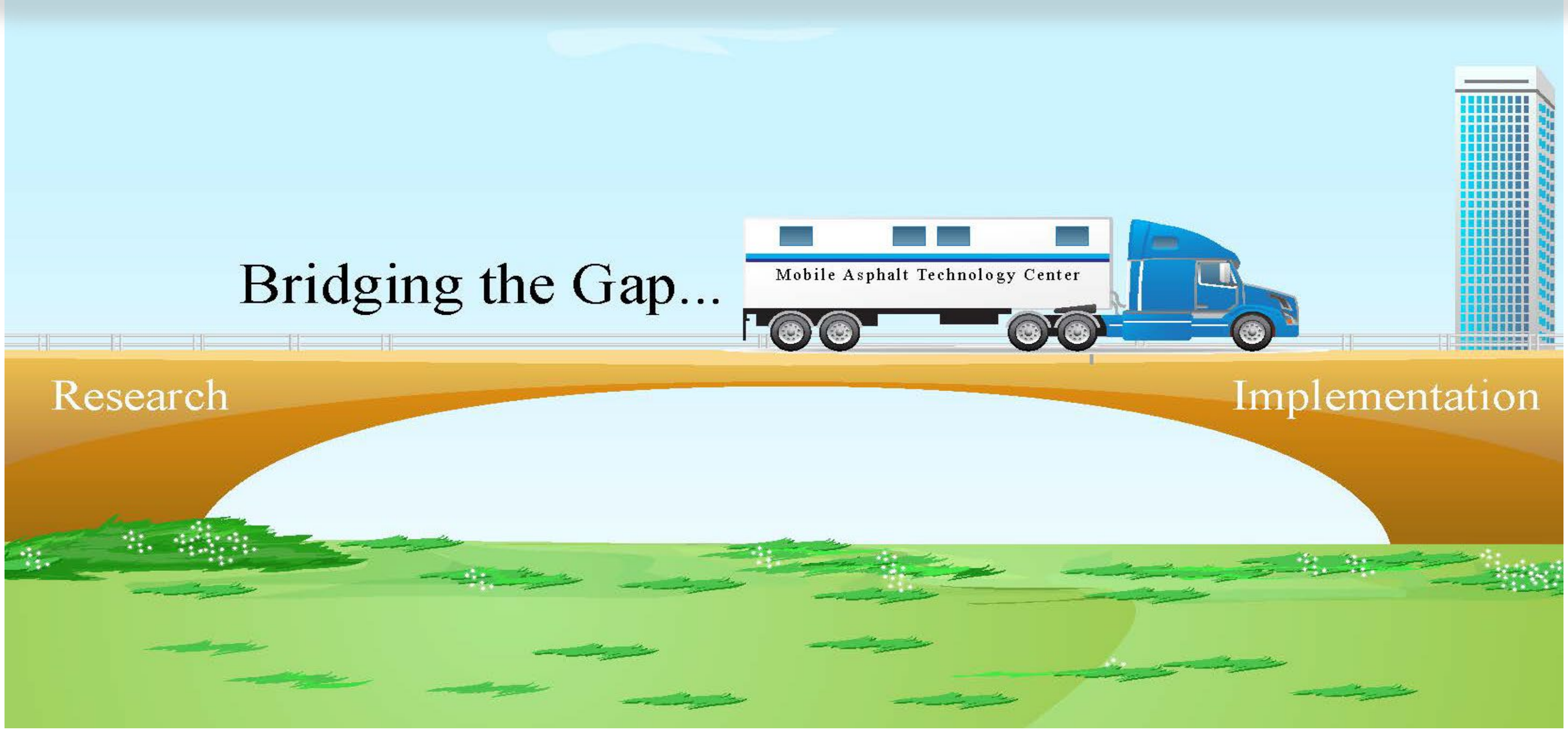
FHWA MATC Program Goal

Innovative technologies and practices are implemented by agencies and industry to provide durable, safe, and sustainable asphalt pavements on our nation's highways.



- On-site field evaluations & training
- Asphalt materials & field testing
- Innovation implementation
- Equipment loans
- Hands-on and virtual demos

FHWA MATC Focus Areas

- **Deployment**
  - *Quality in the Asphalt Pavement Process* workshop
  - Recorded video briefs
- **Troubleshooting**
  - On-site: within scope of standard or agency specification
  - In-depth: through the Asphalt Binder and Mixture Laboratory-Implementation Division (ABML-ID)
- **Post-Construction Evaluation**
  - Density
  - Maintenance and preservation treatment selection
  - Pavement surface characteristics (microtexture, macrotexture)
  - Pavement performance monitoring

Technologies Offered by FHWA MATC

Mixture

- AMPT suite of tests
- Overlay test for reflective cracking
- Flexibility index test (I-FIT) for fracture resistance
- ITC (IDEAL-CT) for crack resistance
- IDEAL-RT for rutting resistance
- Hamburg wheel tracking test

Materials

- X-Ray Fluorescence (XRF) Spectrometer
- ABT (true grade binder)
- FTIR for binder molecular analysis

Field

- Paver-mounted thermal profiler (Pave-IR)
- Pulse induction technology for in-place pavement thickness
- Pavement texture measurements (3 methods)
- Dielectric profiling systems (DPS)

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Deployment of Field Technologies to Assist Asphalt Pavement Constructability

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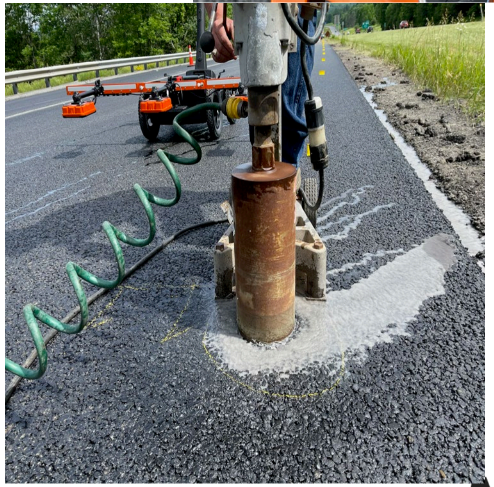
Pulse Induction Technology

- Nondestructive device to measure pavement thickness on either asphalt or concrete pavements
- Eliminates the need for taking cores
- Pulse Induction device requires preplacing a thin metal ‘target’ (plate) on the base before paving
- Distance between the plate and surface of the pavement is measured



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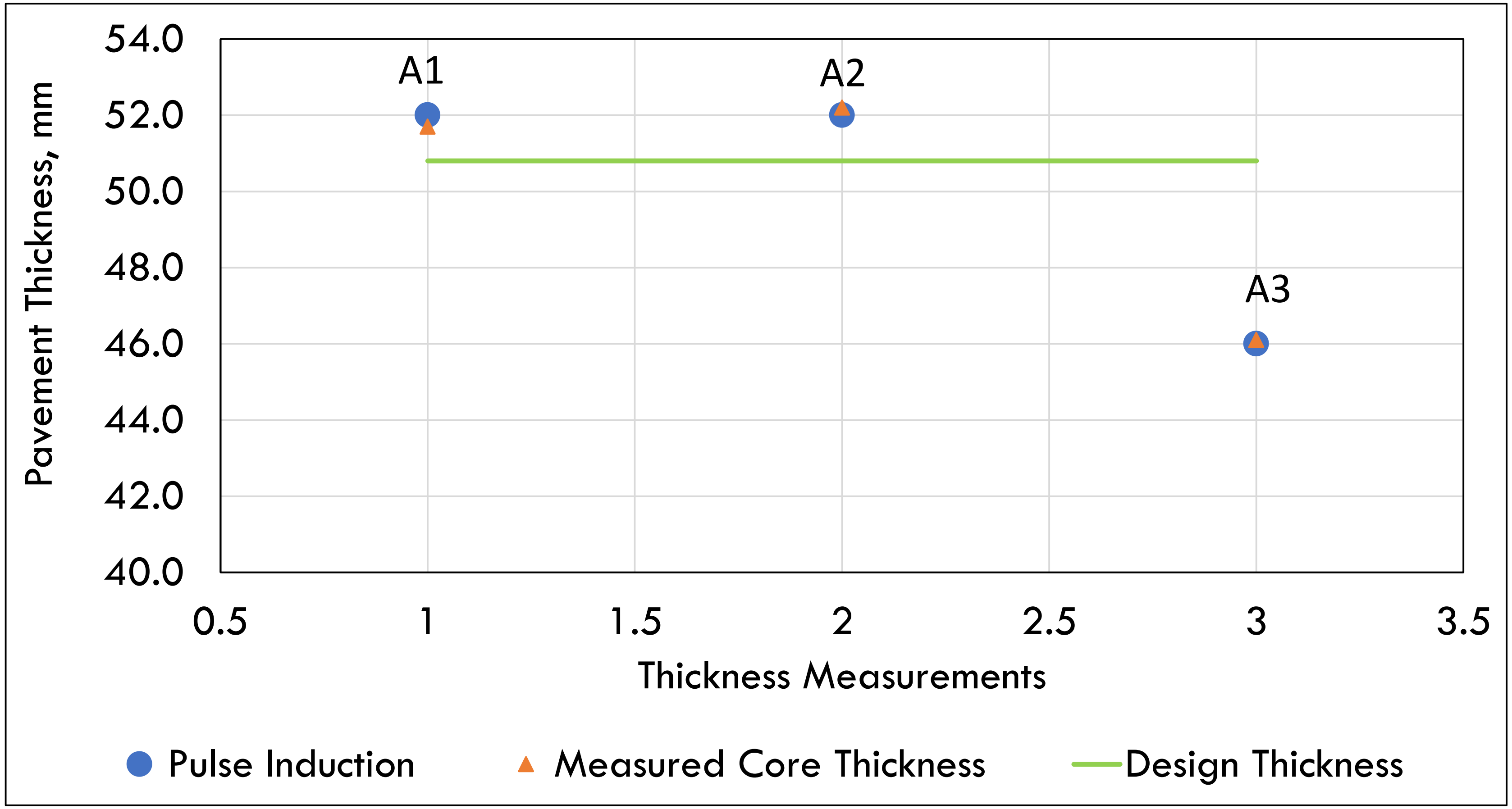
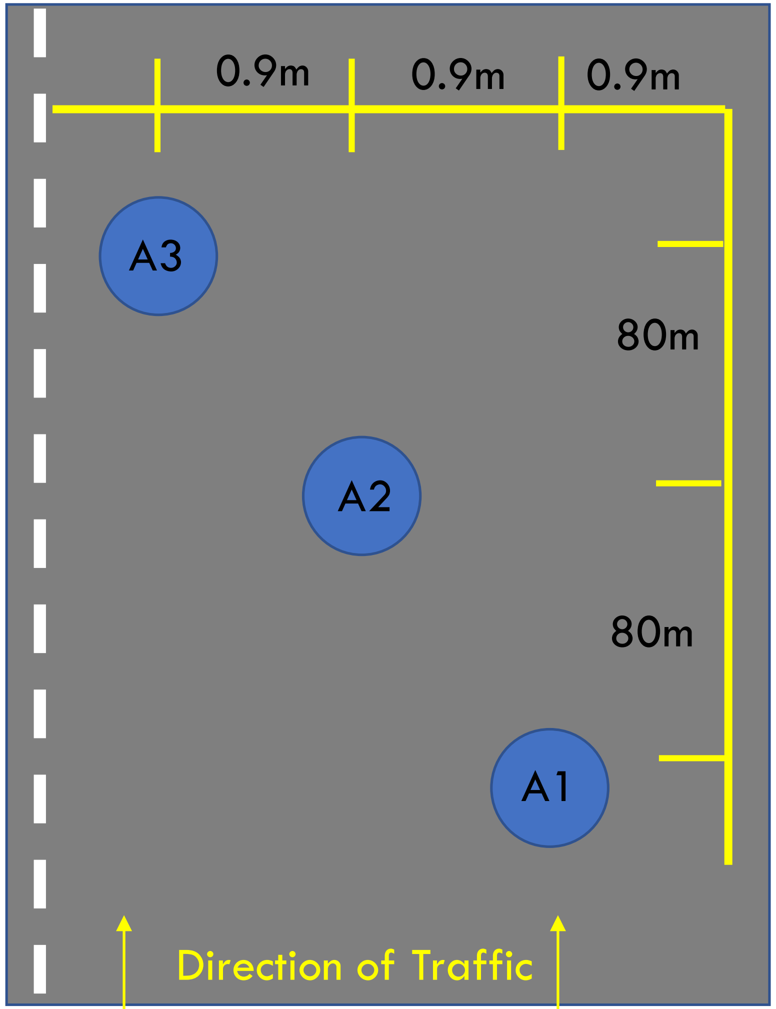
Pulse Induction Technology

GPS - 43°51'13.3"N, 72°36'20.7"W
Location - Interstate 89 N, Bethel, VT



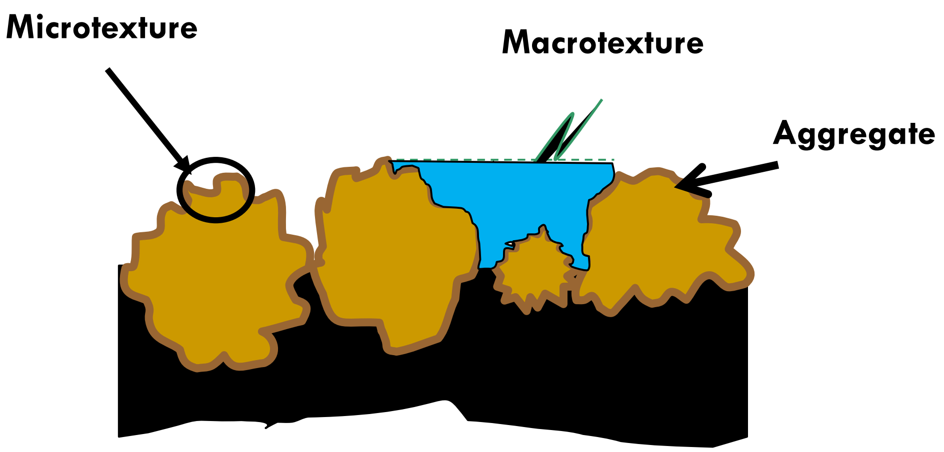


Actual Measured Core thickness and Pulse Induction measurements found to be same

Asphalt Pavement Macrotexture

- **Significant focus on adding life (durability) to dense-graded mixes over the past several years**
  - Concern that macrotexture may be compromised
- **Macrotexture – mix surface voids, aggregate gradation driven**
  - Provides voids/channel to evacuate water – more critical at higher speeds
  - Provides friction from hysteresis – hysteresis increases with speed – more critical at higher speeds
  - FHWA is investigating macrotexture testing procedures that could be used in mix design, mix verification, and field verification

What is texture?



Pavement
Cross Section

Sand Patch

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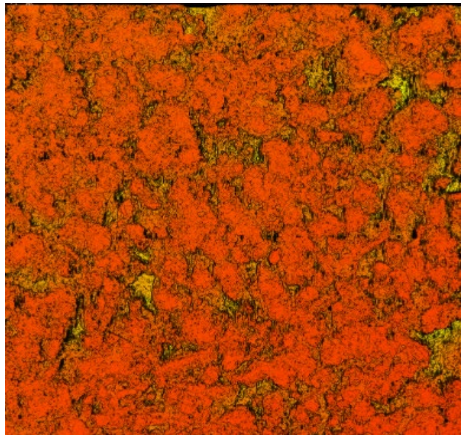
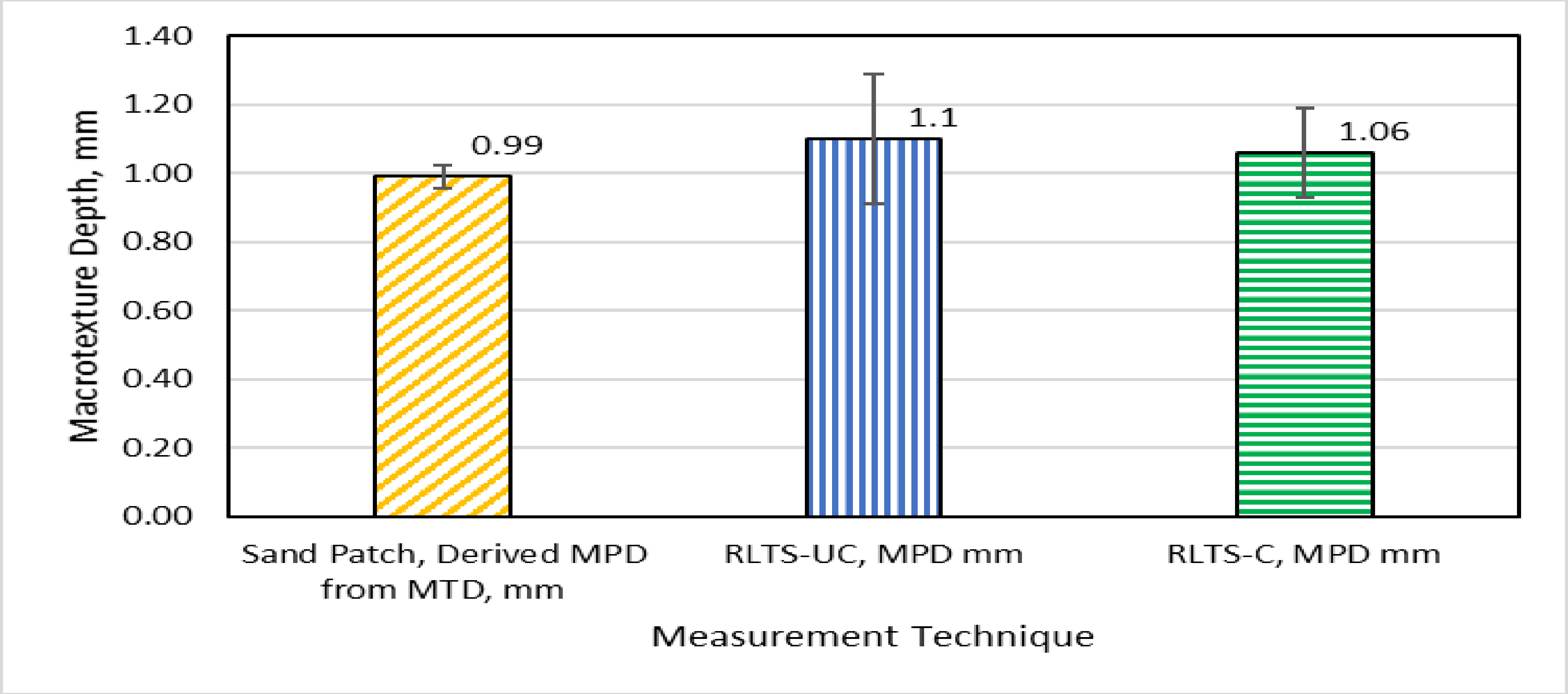
Laser Texture Scanner in Lab or Field

- Lightweight, portable, rapid, 3D scanner
- Utilizes a 100-mm laser line and travels 100 mm to collect a sq. area
- Measures macrotexture on freshly compacted mats in field and on cores or gyratory specimens in lab



Mean Profile Depth (MPD) – Field Measurements



Stone Matrix Asphalt (SMA) – MPD Typically exceeds 1.0 mm (0.04 in) according to 2008 AASHTO Guide for Pavement Friction

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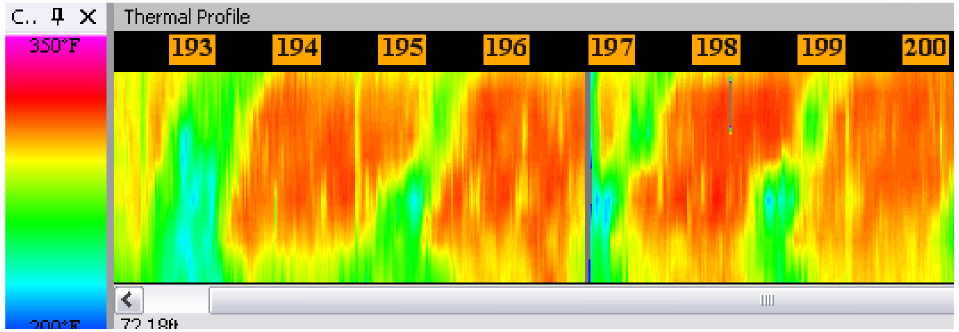
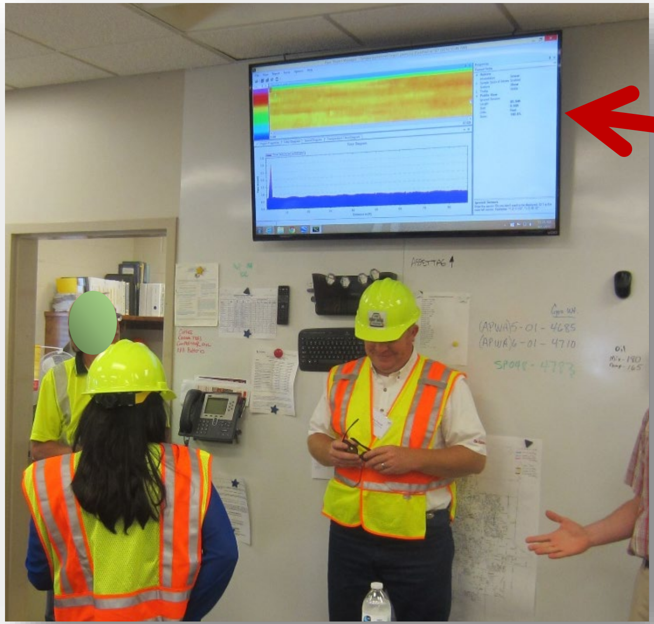
Paver-Mounted Thermal Profiler (PMTP)

- High precision real time thermal profiler to detect pavement mat defects before compaction
- Used for Identifying Segregation and Low-Density Issues
- Infrared Sensors for Measuring Temperature Uniformity of New Asphalt Surfaces
- Thermal Profile Imaging of Mat Surface Done at 2 to 3 meters behind screed

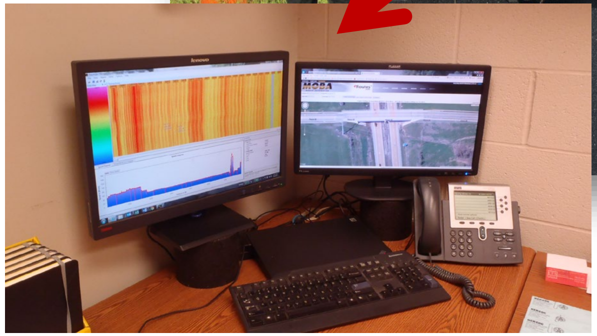


How it works?

- Real-time Data Visualization and Communication Between Plant and Paver to Minimize Temperature Differentials While Paving Operation



Contractor monitors from plant



DOT can monitor from the Office

Images: SHRP2 (R06 C)

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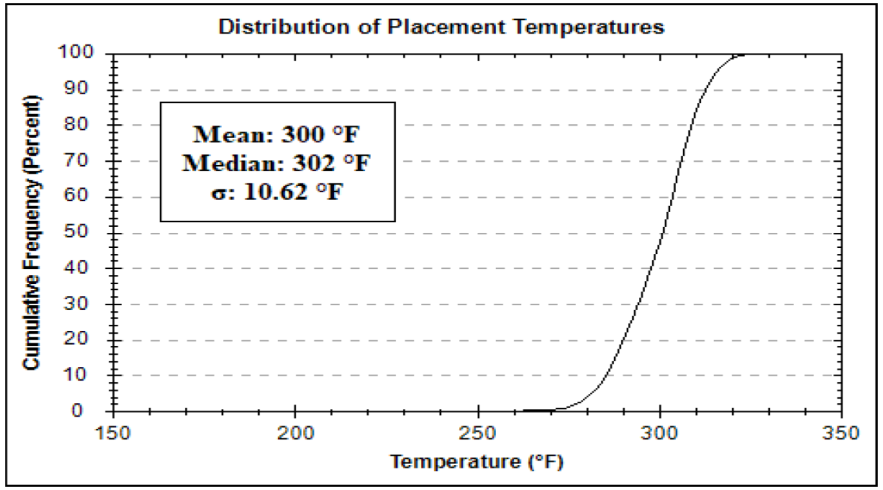
Data from PMTP Technologies



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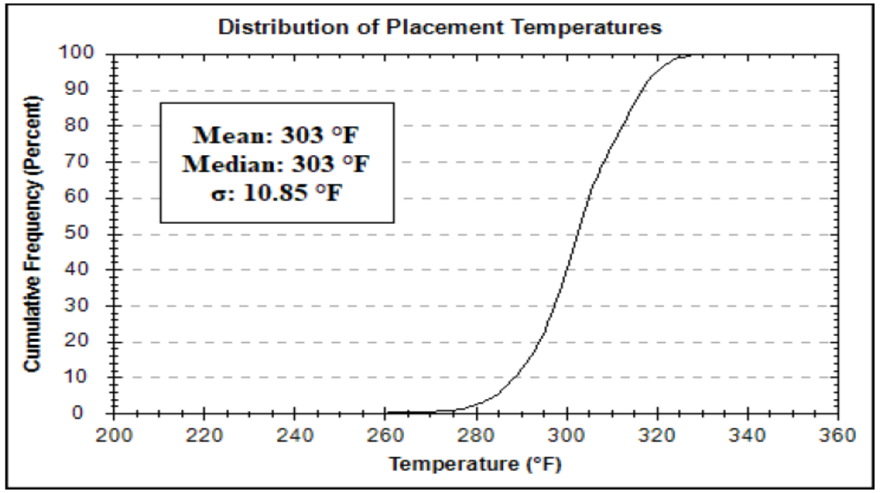

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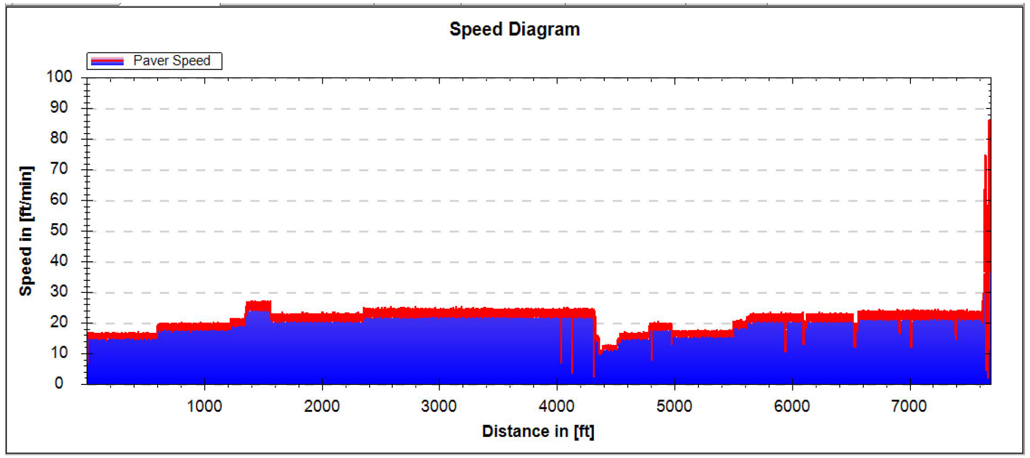
Cumulative Distribution of Mat Temperature

Distribution of Paver Speed



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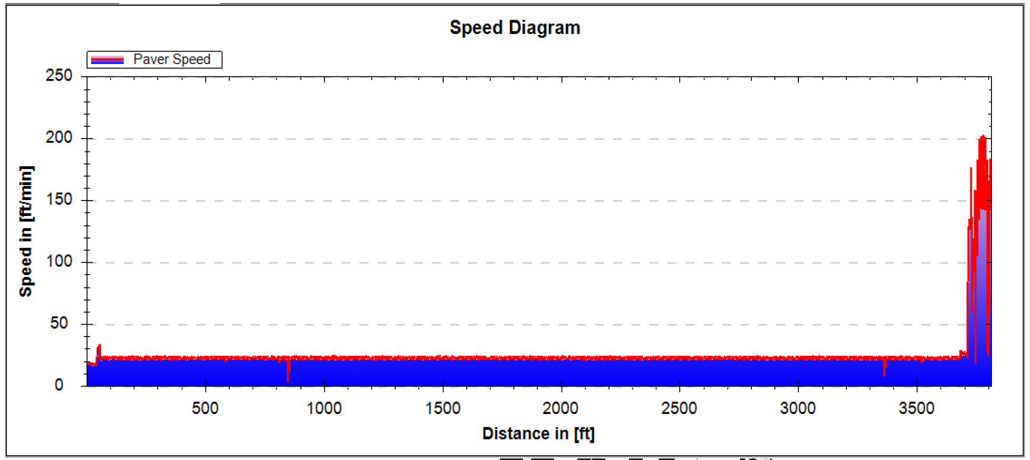

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Dielectric Profiling Systems (DPS)

- Testing equipment that uses high frequency ground penetrating radar (GPR) to nondestructively assess asphalt pavement density
- Reduce turnaround times
- Perform continuous density measurements over larger areas
- Dielectric profiling systems (DPS) address many of the issues with traditional density measurement techniques

Use of DPS Data

Low Dielectric Value → Higher Air Void Content → Lower Density

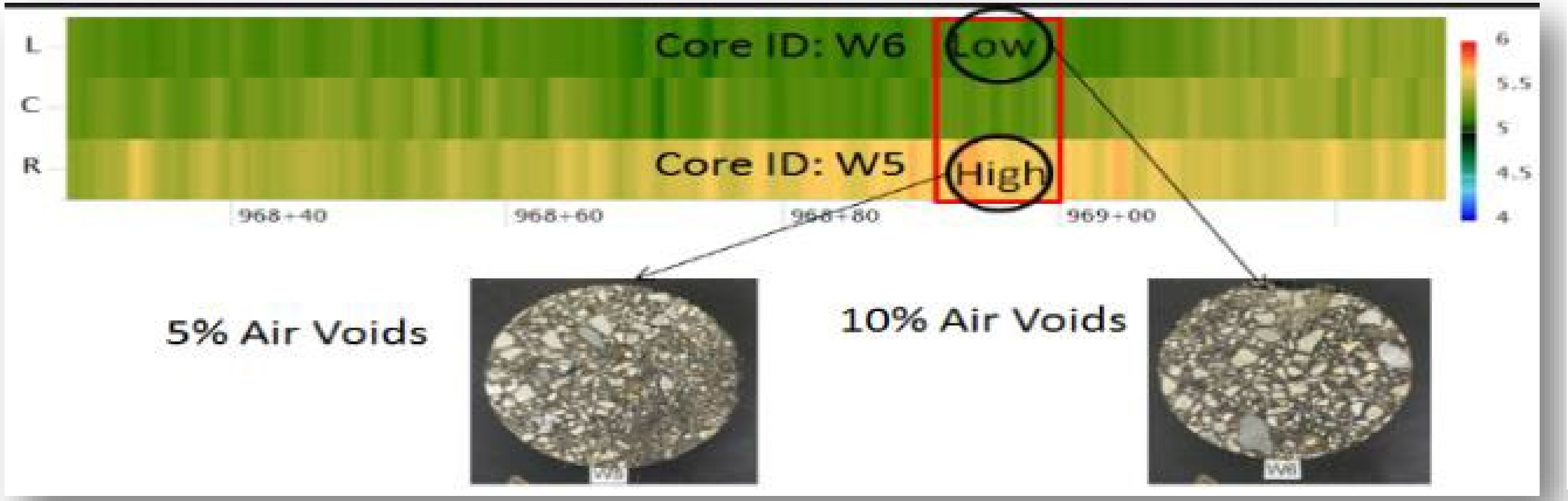

Image Source: GSSI

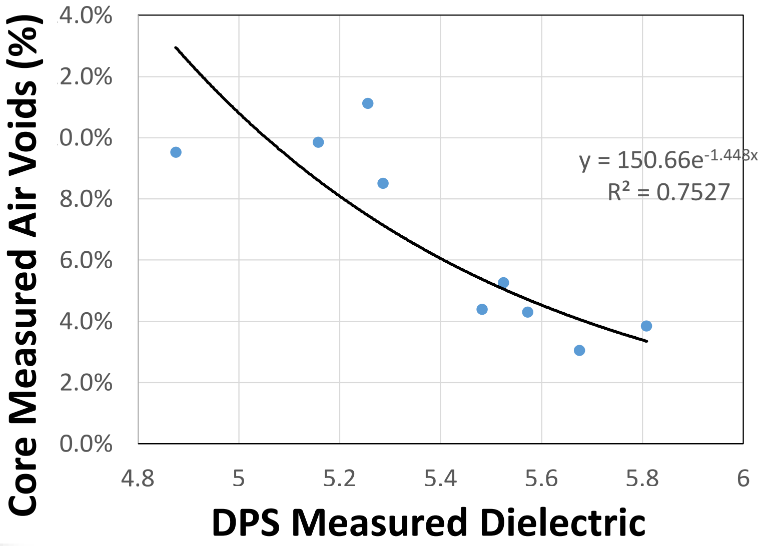

Image Source: FHWA

High Dielectric Value → Lower Air Void Content → Higher Density

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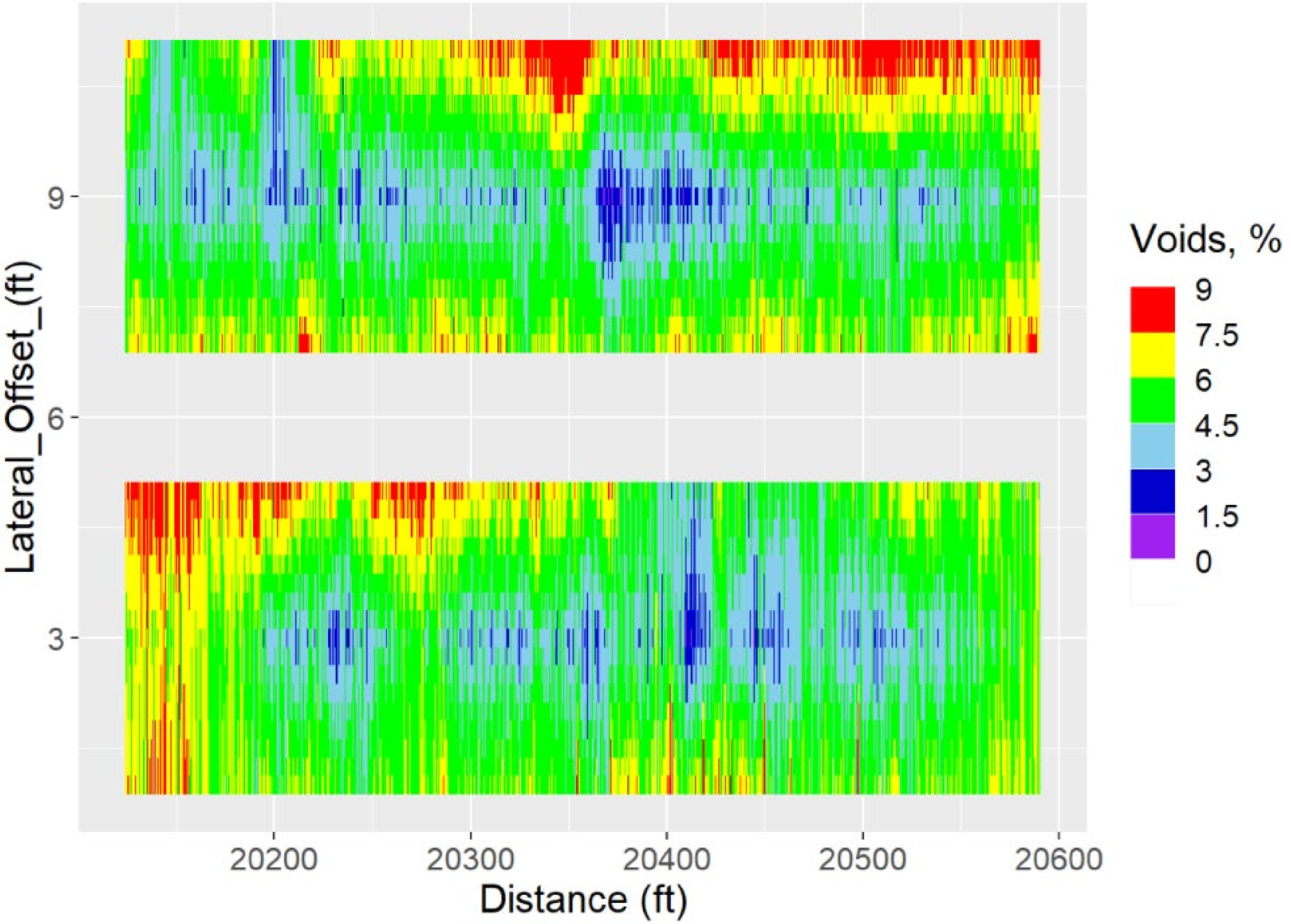
DPS – Heat Maps



Source: FHWA

- Shows the uniformity of the asphalt mat after rolling
- Helps identify low density areas
    - e.g. start of pass, along paving joint, etc.
- View heat maps real time

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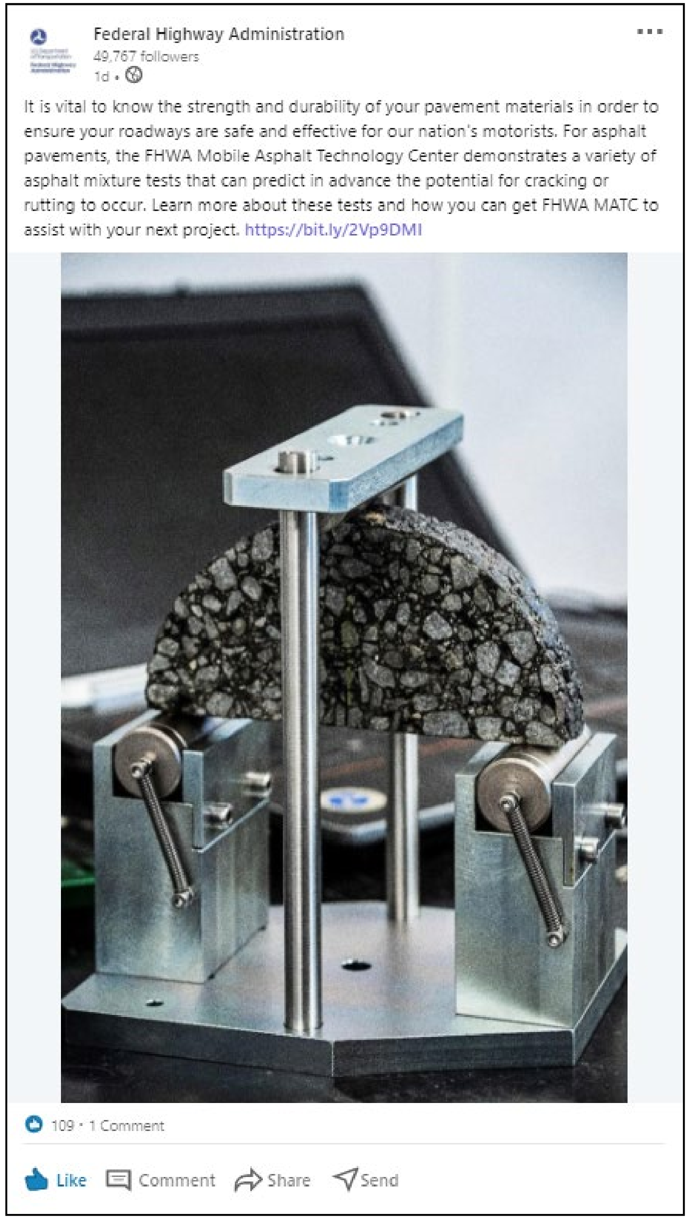
MATC – Technology Transfer

- Use MATC as a communication vehicle to stakeholders
- Use short communication bursts (1-pagers, social media, etc.) to raise awareness on FHWA efforts
- Current Topics:
  - Enhancing in-place density
  - Dielectric profiling systems: Ohio DOT experience



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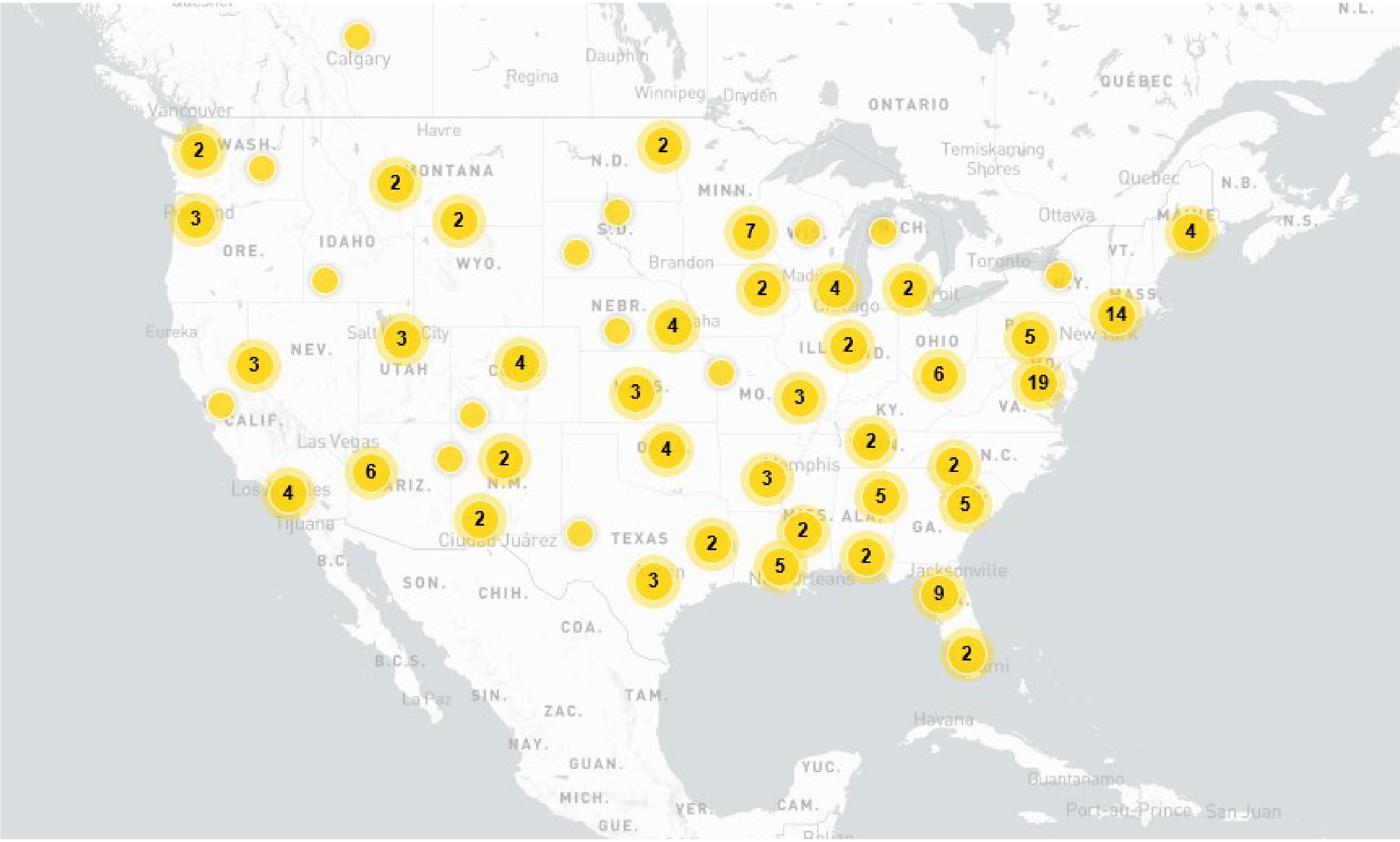
Ongoing MATC Support

- MATC project visits since 1988



RAP	Reclaimed asphalt pavement
RAS	Recycled asphalt shingles
SMA	Stone matrix aggregate mix design
FC	Friction course
WMA	Warm mix asphalt
Hi-RAP	High percentage of RAP (30% plus)
PMA	Polymer modified asphalt
AR	Asphalt rubber
ARB	Asphalt rubber base
PRS	Performance related specification project

https://www.fhwa.dot.gov/pavement/asphalt/trailer/events.cfm

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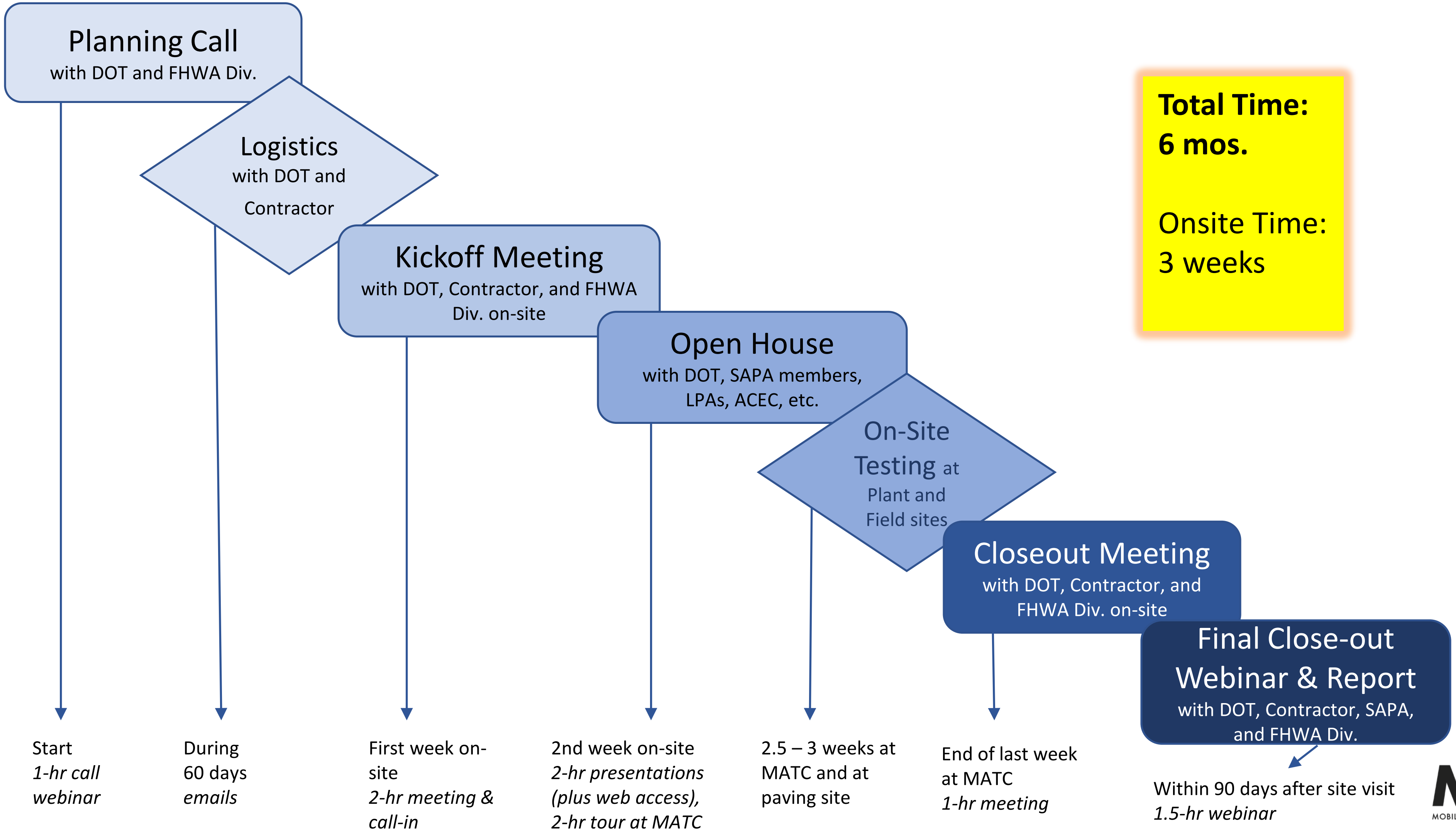
Federal Highway Administration

Typical Site Visit by MATC



Total Time: 6 mos.

Onsite Time: 3 weeks

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What can the FHWA MATC do for you?

- Project Site Visits (coordinate via FHWA division office & state DOT)
- Specification Review
  - Comparison to Gold Medal Density states is popular
- Balanced Mix Design Data Analysis
- Technology Transfer
- ABML-ID program for in-depth troubleshooting or rapid research
- Equipment Loan Program
- *Quality in the Asphalt Paving Process* 2-Day On-site Workshop

THANK YOU!

MATC
MOBILE ASPHALT TECHNOLOGY CENTER

SPREADING ASPHALT PAVEMENT TECHNOLOGY INNOVATION

https://www.fhwa.dot.gov/matc

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