

Optimizing Asphalt Construction: Successful Use of Intelligent Construction Technologies

Anchorage Asphalt Summit

November 6, 2023

By: Amanda Gilliland, The Transtec Group

Overview

01 What are Intelligent Construction Technologies

02 Successful Case Studies

03 The Future of ICT





Source: modified from Wirtgen, GSSI

Paver Mounted Thermal Profiling (PMTP)



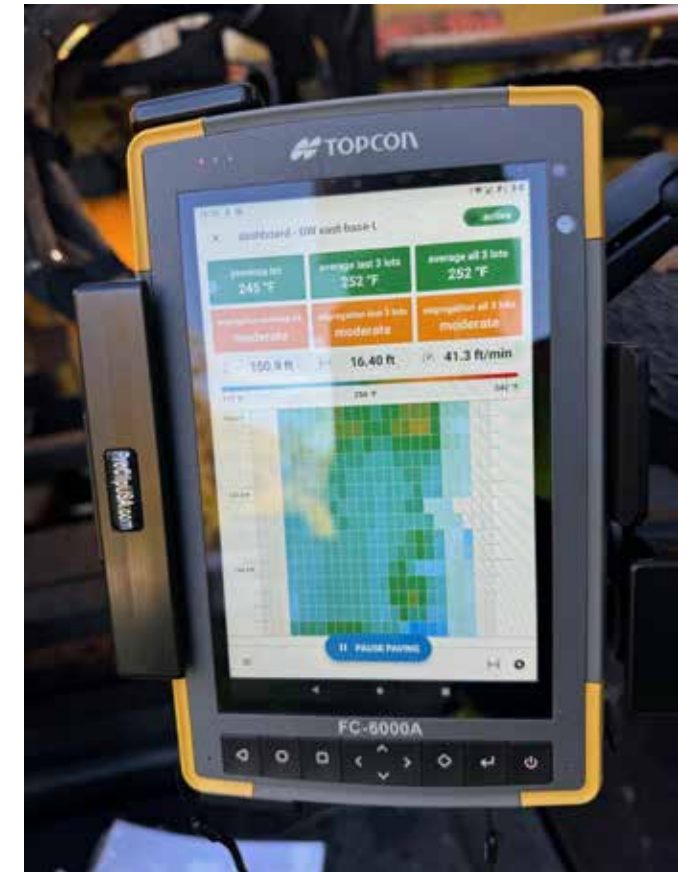
Paver Mounted Thermal Profiling (PMTP)



Photo Credit: Wirtgen America, Caterpillar

Paver Mounted Thermal Profiling (PMTTP)

- Data Collected:
 - Temperatures
 - Speed





PMTP

IC

DPS

Veta
INTELLIGENT CONSTRUCTION

Source: modified from Wirtgen, GSSI

Intelligent Compaction (IC)

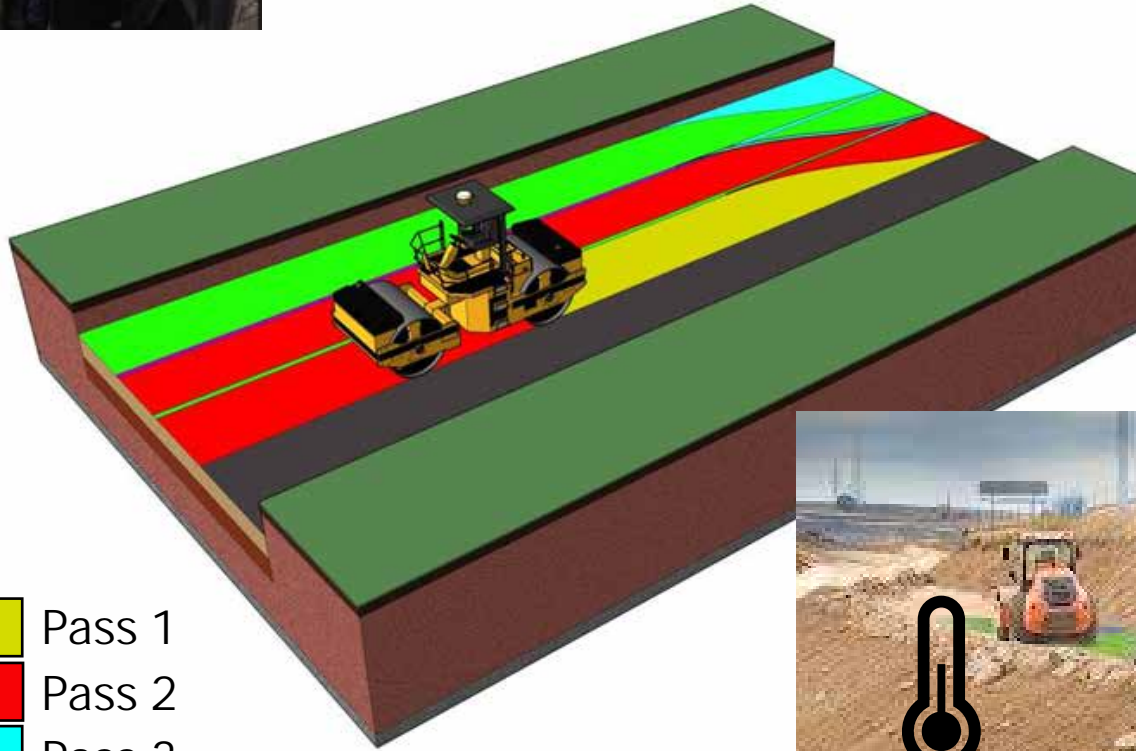






Intelligent Compaction (IC)



Intelligent Compaction (IC)

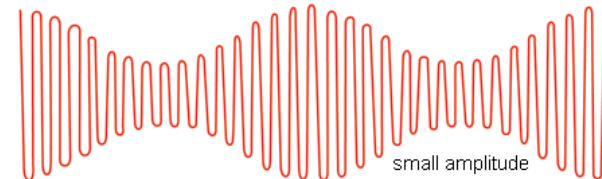
Data Collected: Pass count, temperature, ICMV, roller settings



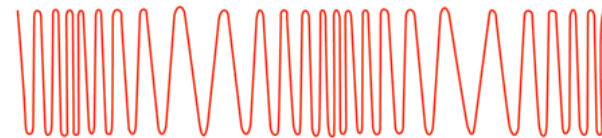
-  Pass 1
-  Pass 2
-  Pass 3
-  Pass 4 (Target)



large amplitude



high frequency





PMP

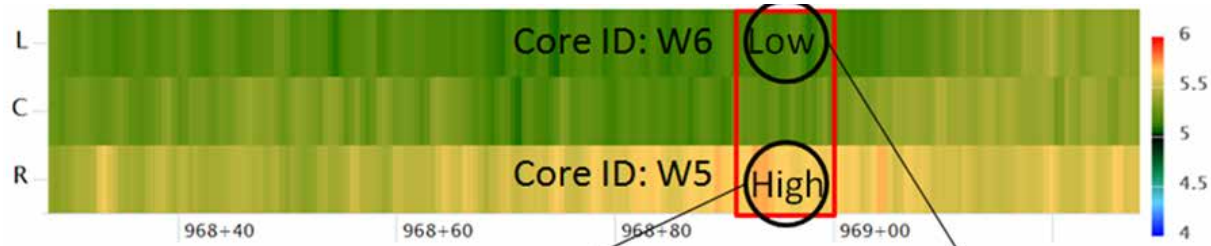
IC

DPS

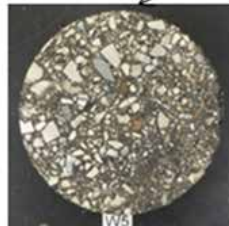
Veta
INTELLIGENT CONSTRUCTION

Source: modified from Wirtgen, GSSI

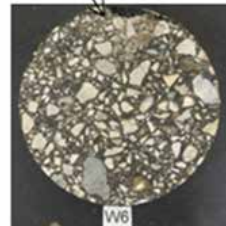
Dielectric Profiling Systems (DPS)



5% Air Voids



10% Air Voids



- Data Collected:
 - Dielectric – correlates to density with gyratory or cores



Dielectric Profiling Systems (DPS)





PMTP

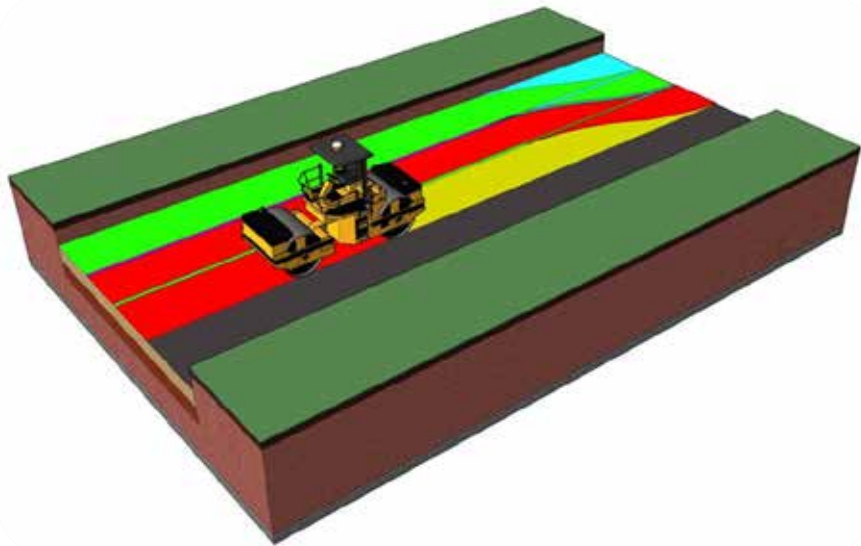
IC

DPS

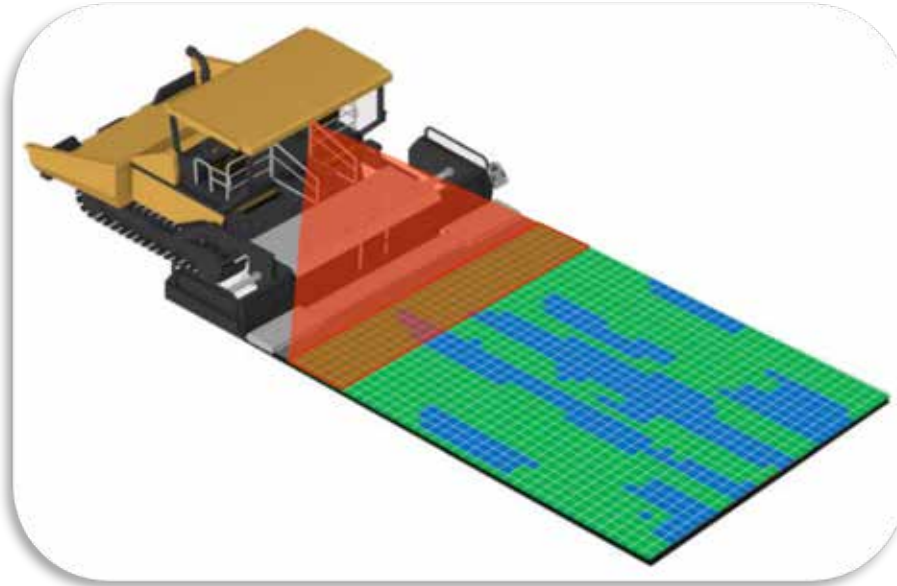
Veta
INTELLIGENT CONSTRUCTION

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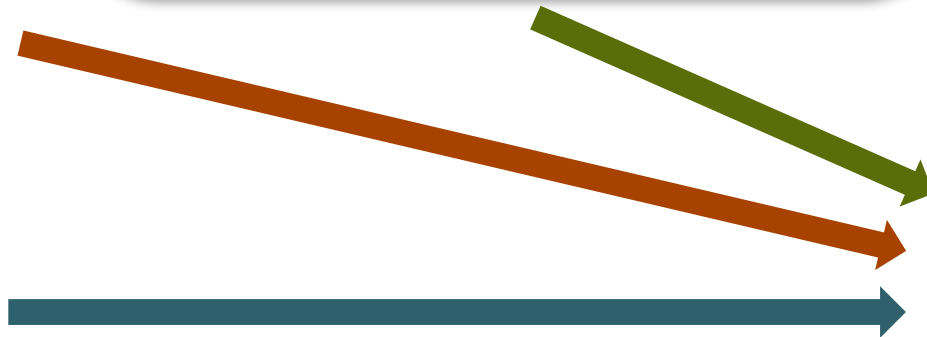
Intelligent Compaction (IC)



Paver-Mounted Thermal Profiling (PMTP)



Dielectric Profiling System (DPS)



Overview

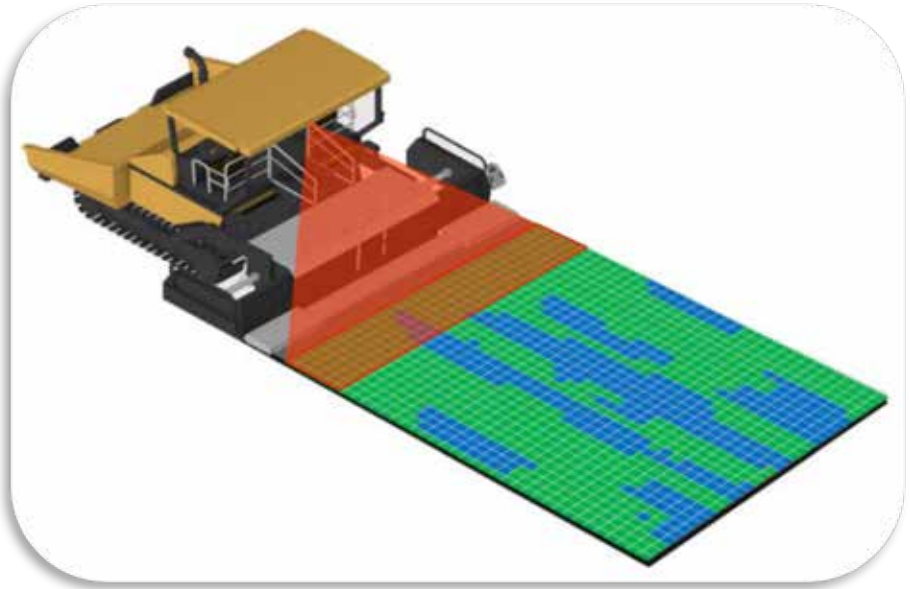
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Case Study - PMTP



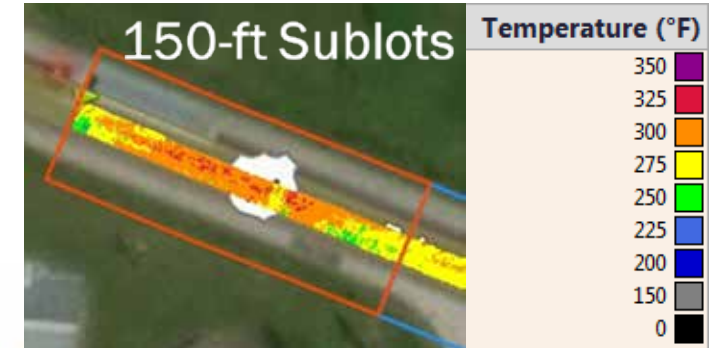
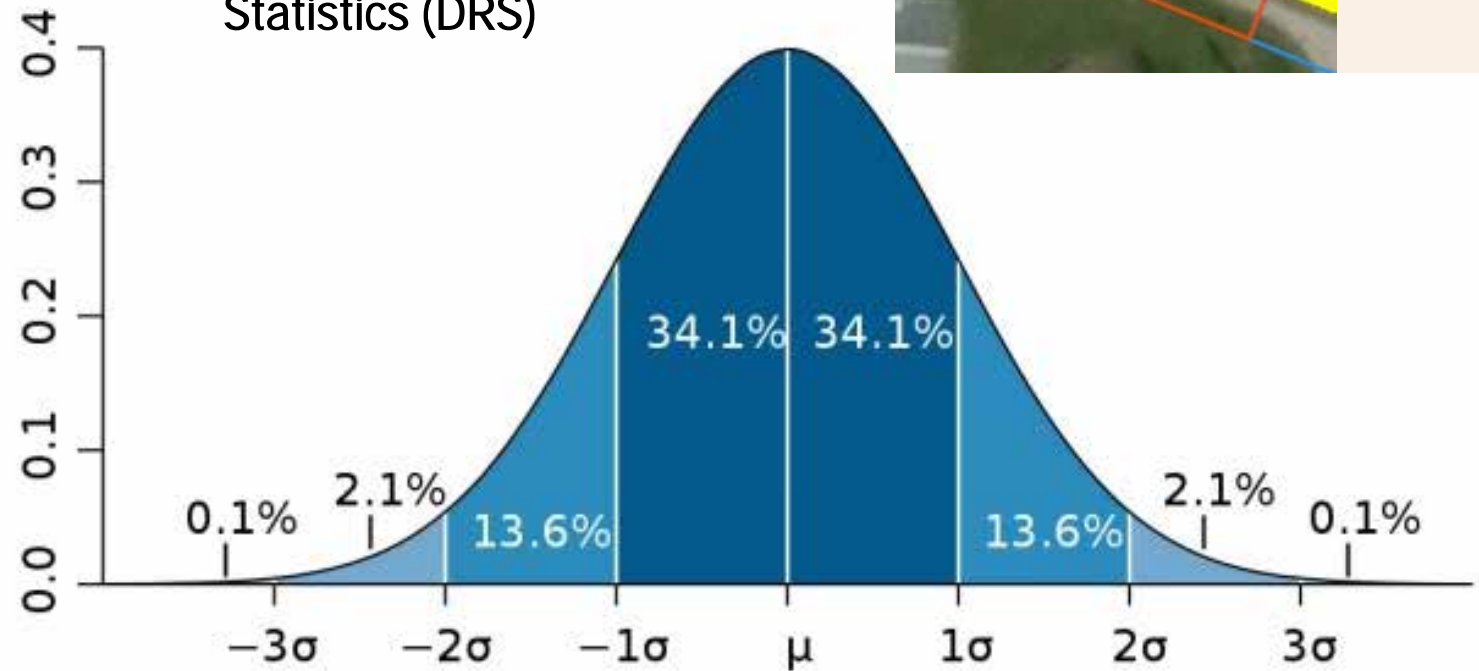
PMTP – Classifying Thermal Segregation – Two Methods

Standard Practice for
Continuous Thermal Profile of
Asphalt Mixture Construction

AASHTO Designation: R 110 (2022)
 Tech Subcommittee: 5c, Quality Assurance and Environmental
 Release: Group 1 (April)

AASHTO
 American Association of State Highway and Transportation Officials
 555 12th Street NW, Suite 1000
 Washington, D.C. 20004

Method 1:
Differential Range
Statistics (DRS)



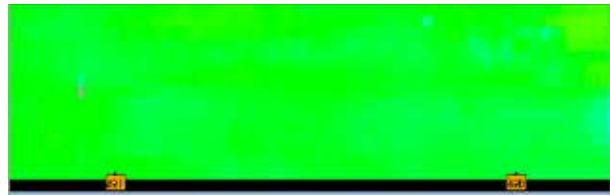
$$DRS = \text{Temp}_{98.5\text{Percentile}} - \text{Temp}_{1\text{Percentile}}$$

AASHTO DRS Temperature Segregation

150-ft Sublots

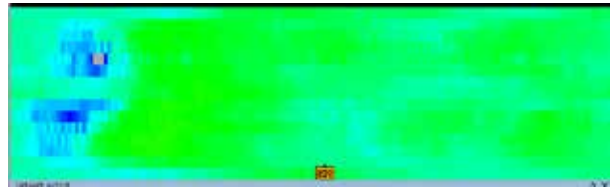
DRS

Segregation



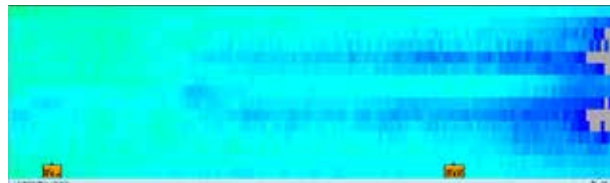
$DRS \leq 25^\circ F$

NO SEG



$25^\circ F < DRS \leq 50^\circ F$

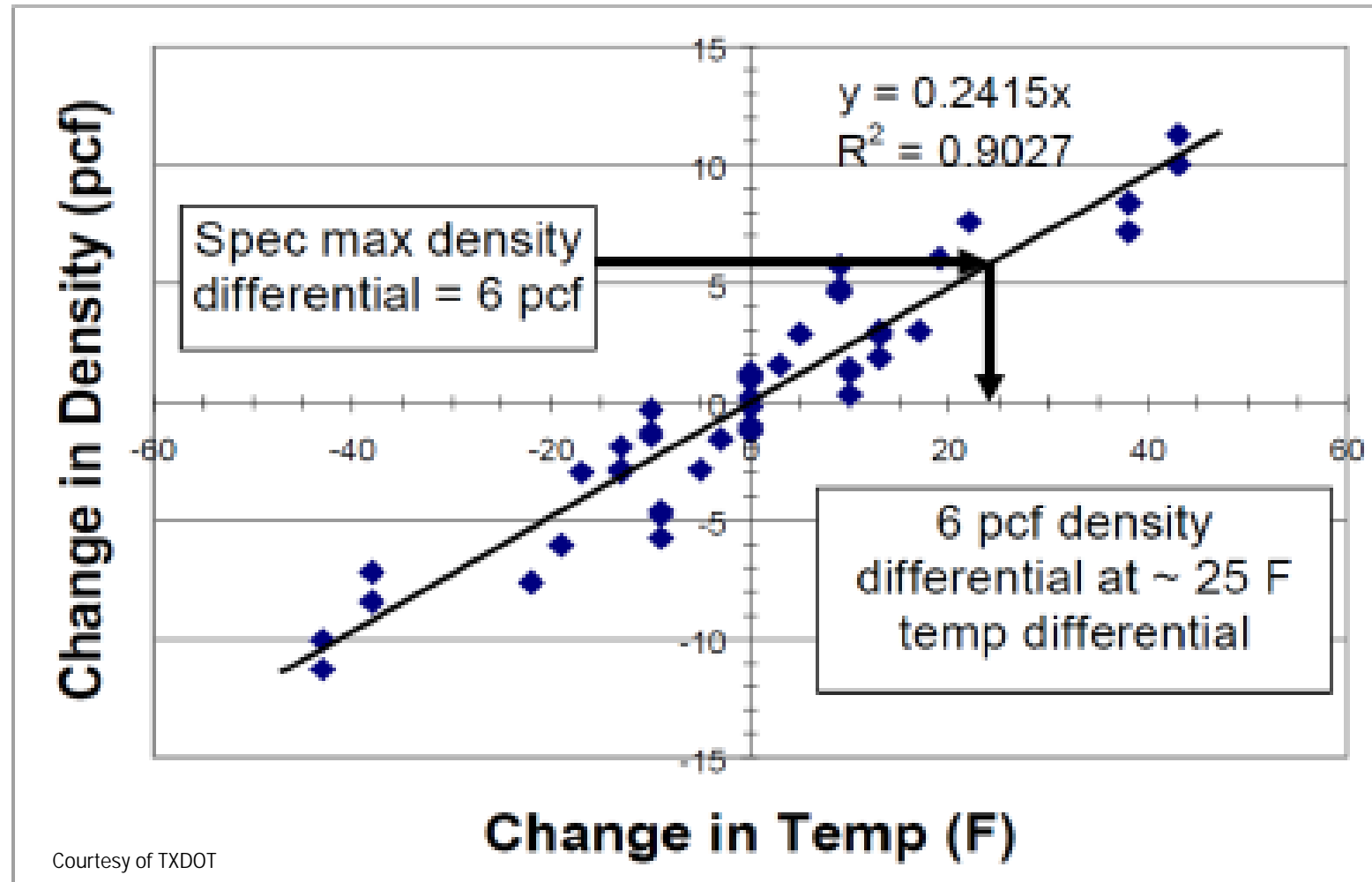
MODERATE



$DRS > 50^\circ F$

SEVERE

Criteria for Severity of Temperature Segregation (DRS)

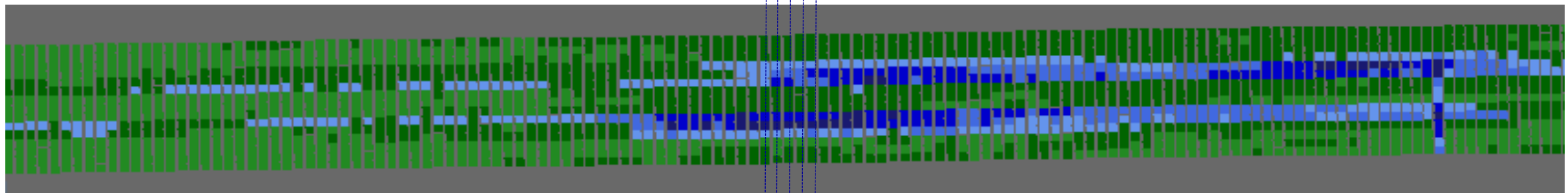
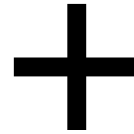
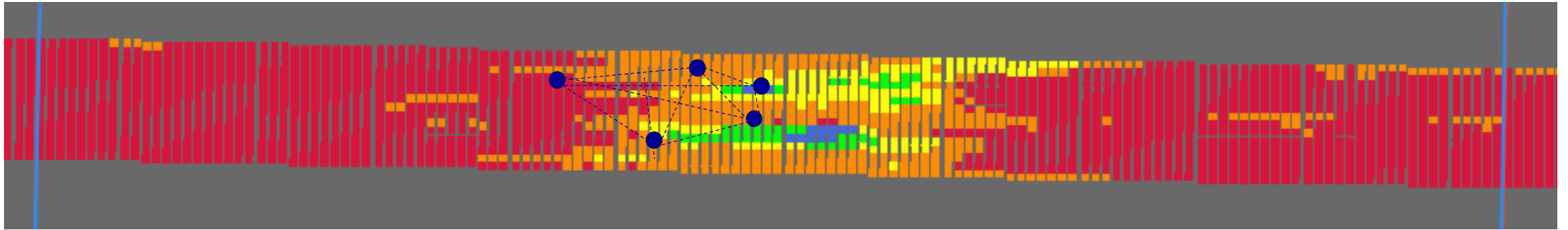


Courtesy of TXDOT

PMTP – Classifying Thermal Segregation – Two Methods

150-ft Sublots

Method 2 : Thermal Segregation Index (TSI)

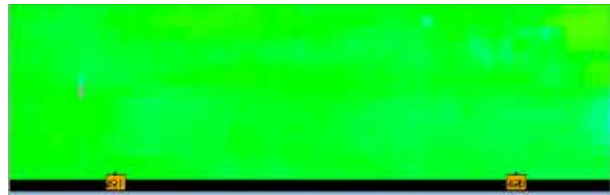


AASHTO TSI Temperature Segregation

150-ft Sublots

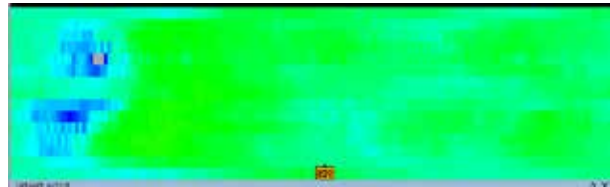
TSI

Segregation



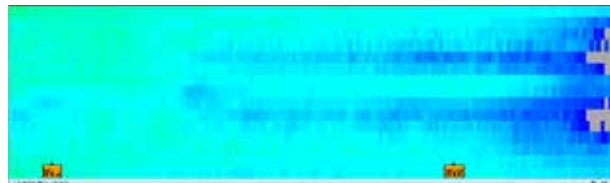
$TSI \leq 30$

NO SEG



$30 < TSI \leq 70$

MODERATE



$TSI > 70$

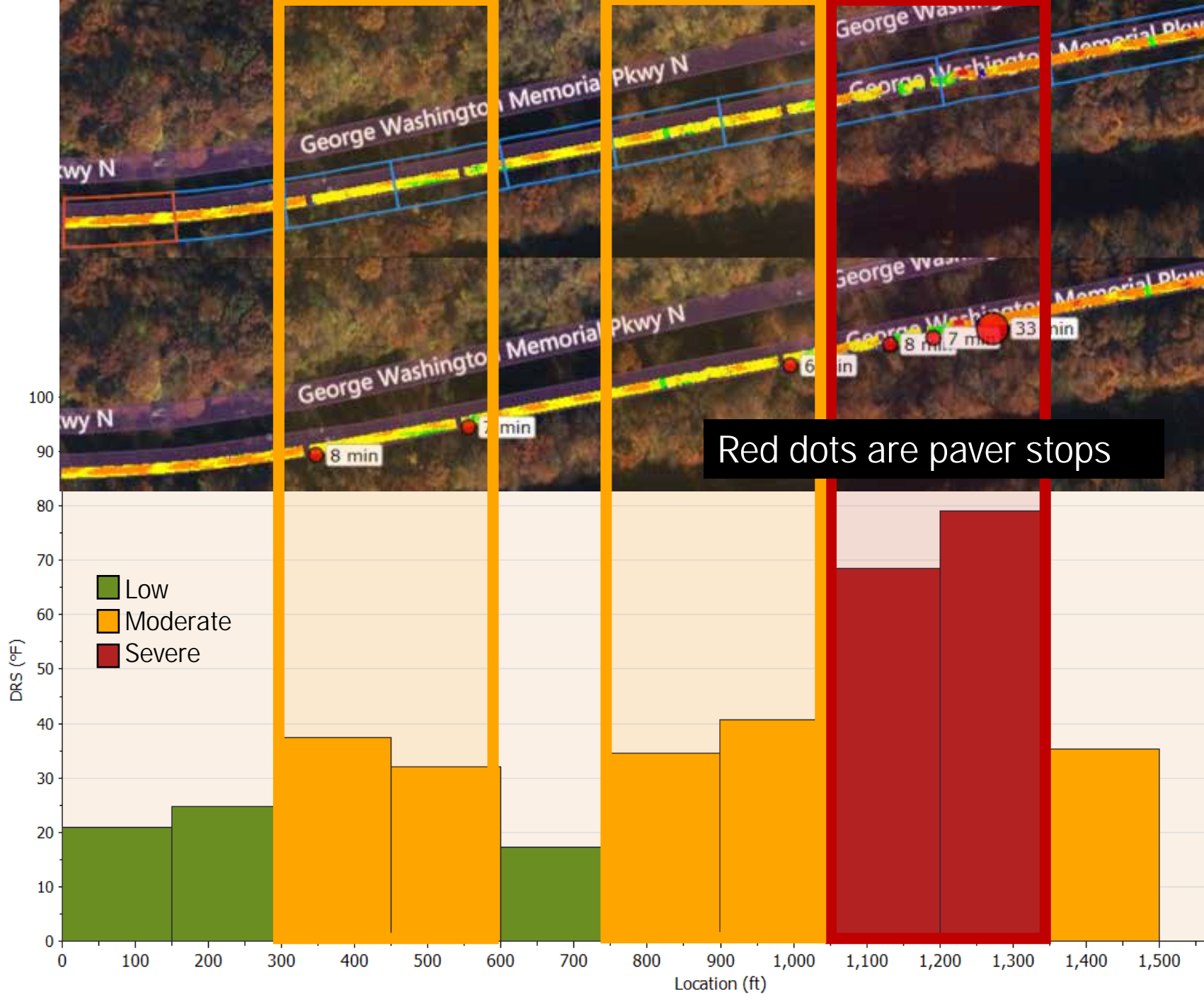
SEVERE

Latitude (°): 38.964512
 Longitude (°): -77.172982

Temperature (°F)

290	■
275	■
260	■
245	■
230	■
215	■
200	■
150	■
0	■

Red dots are paver stops



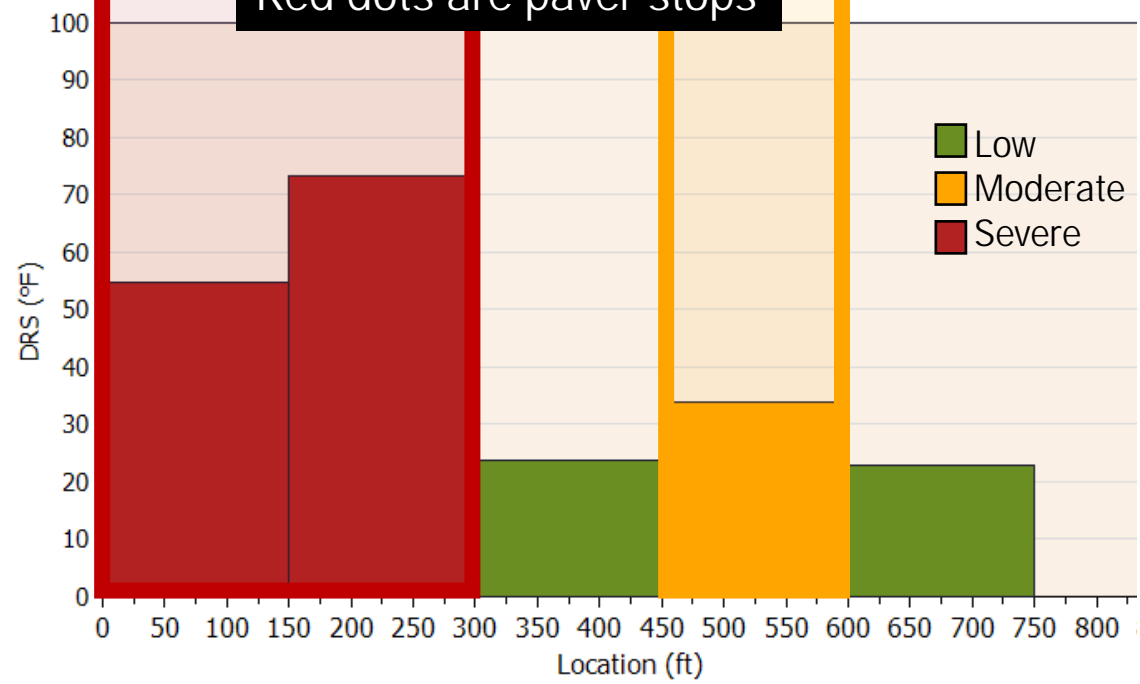


Latitude (°): 38.964512
 Longitude (°): -77.172982

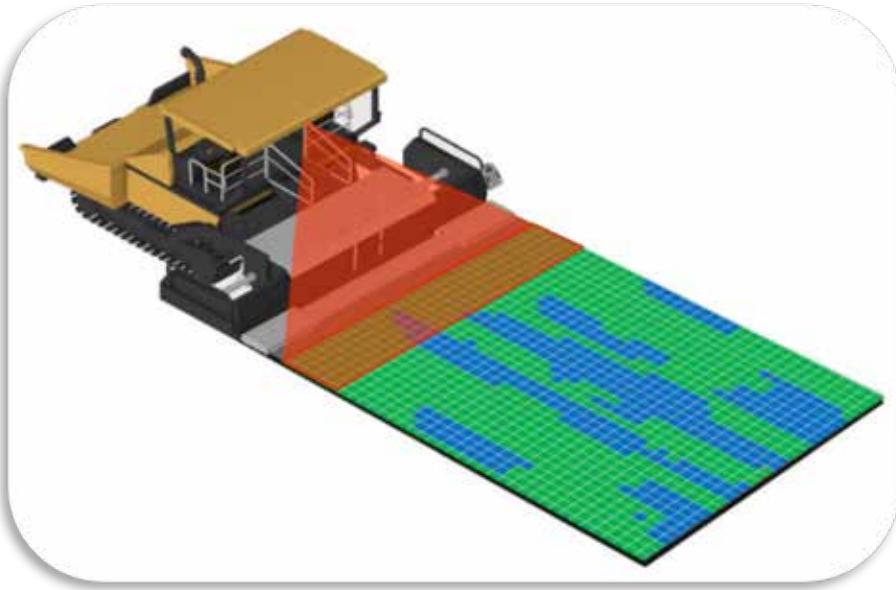
Temperature (°F)

290	■
275	■
260	■
245	■
230	■
215	■
200	■
150	■
0	■

Red dots are paver stops

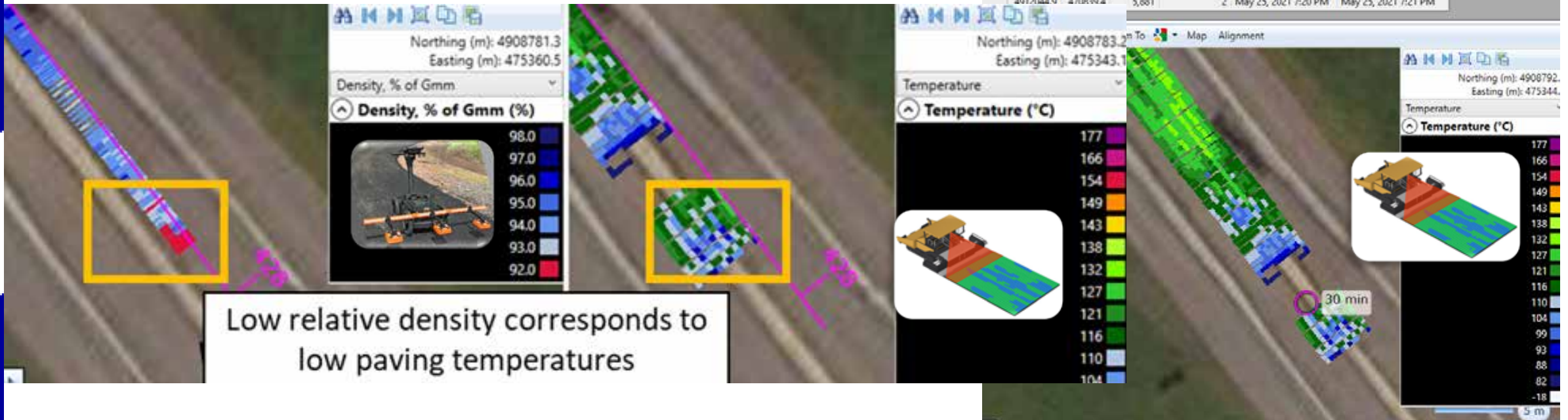


Case Study – PMTP + DPS

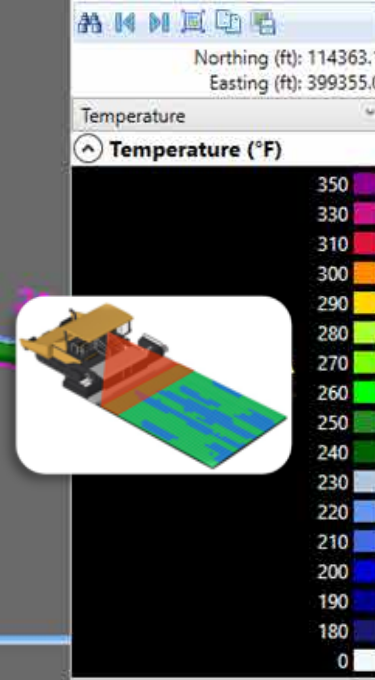
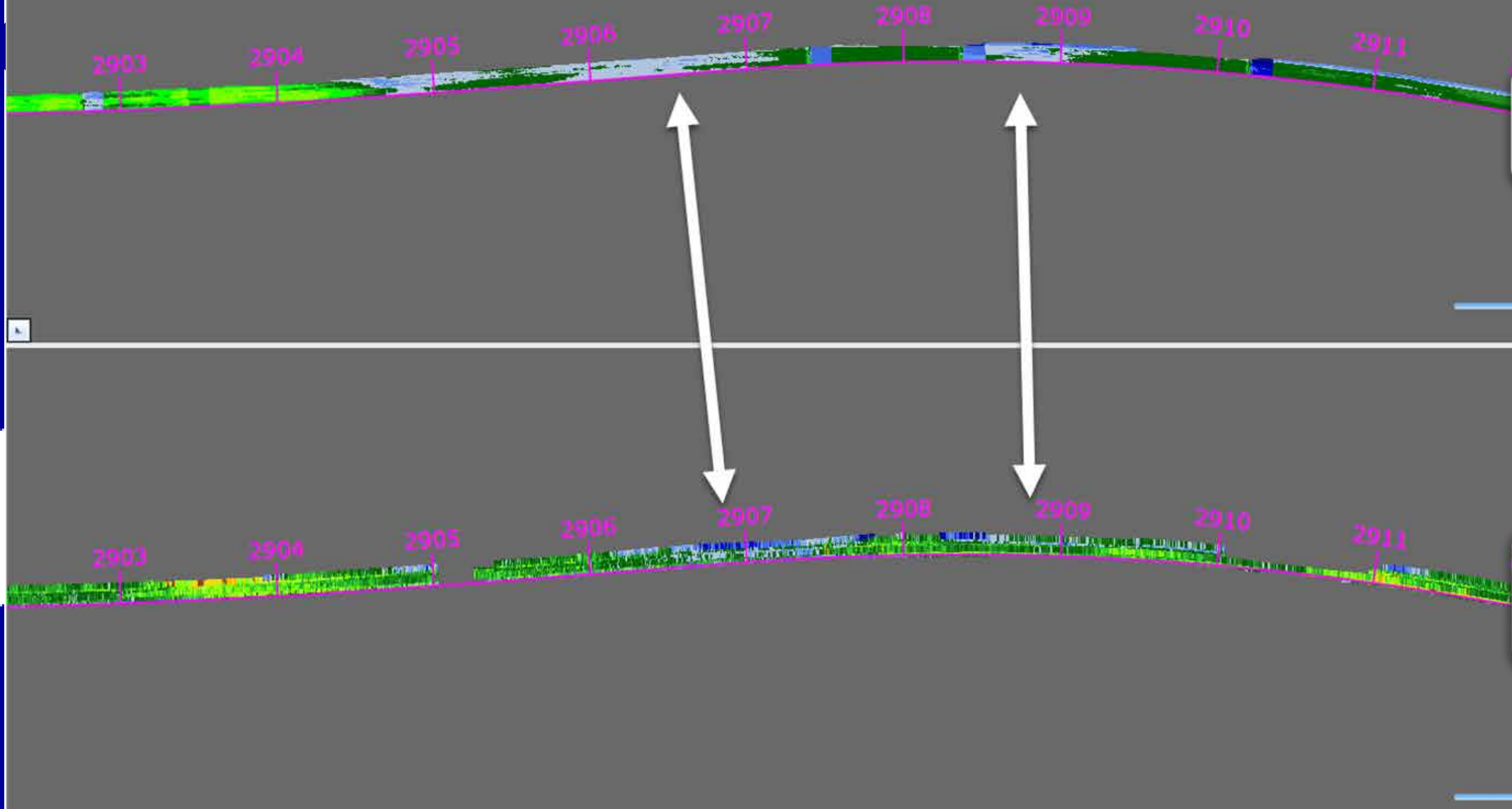


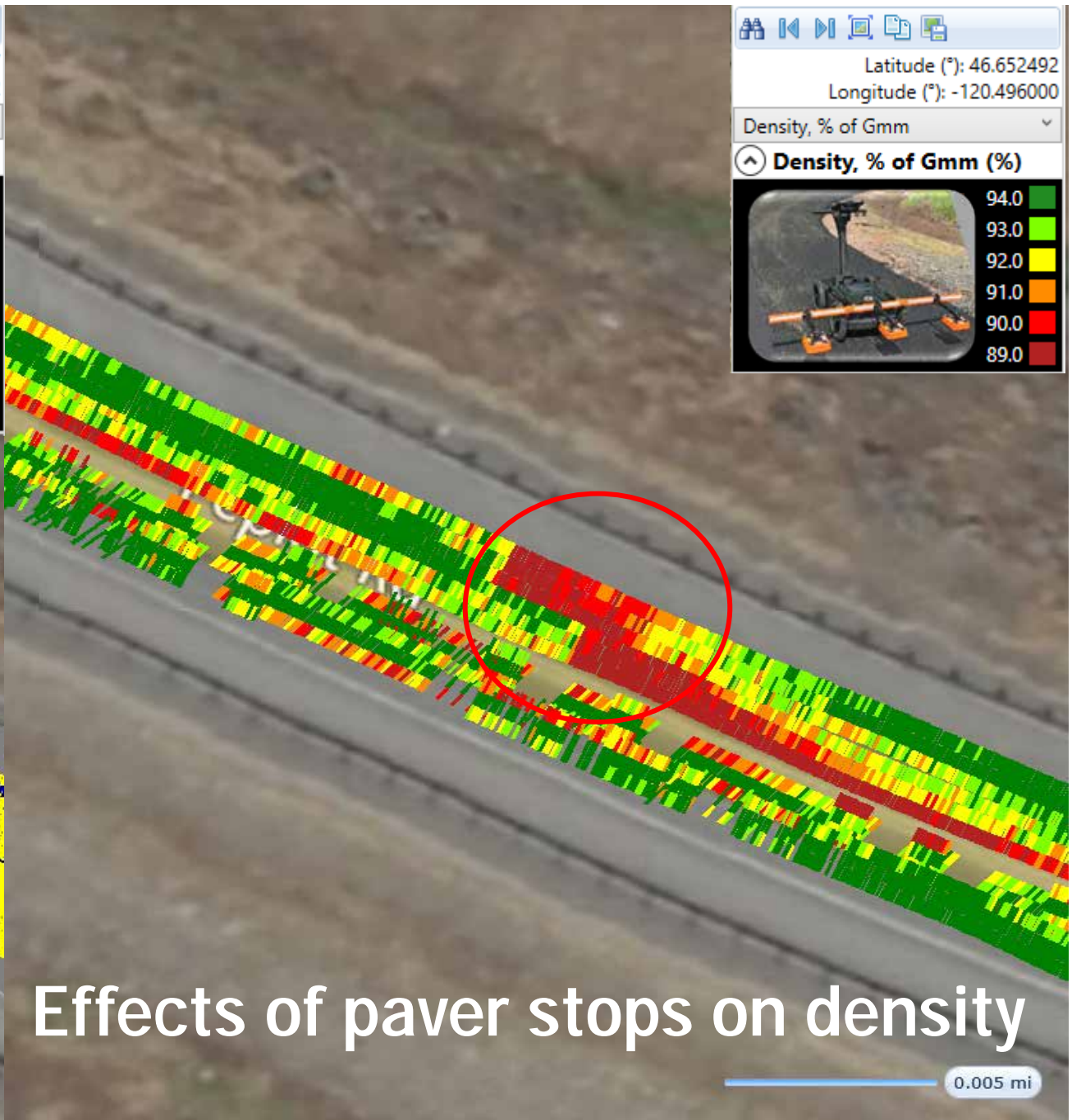
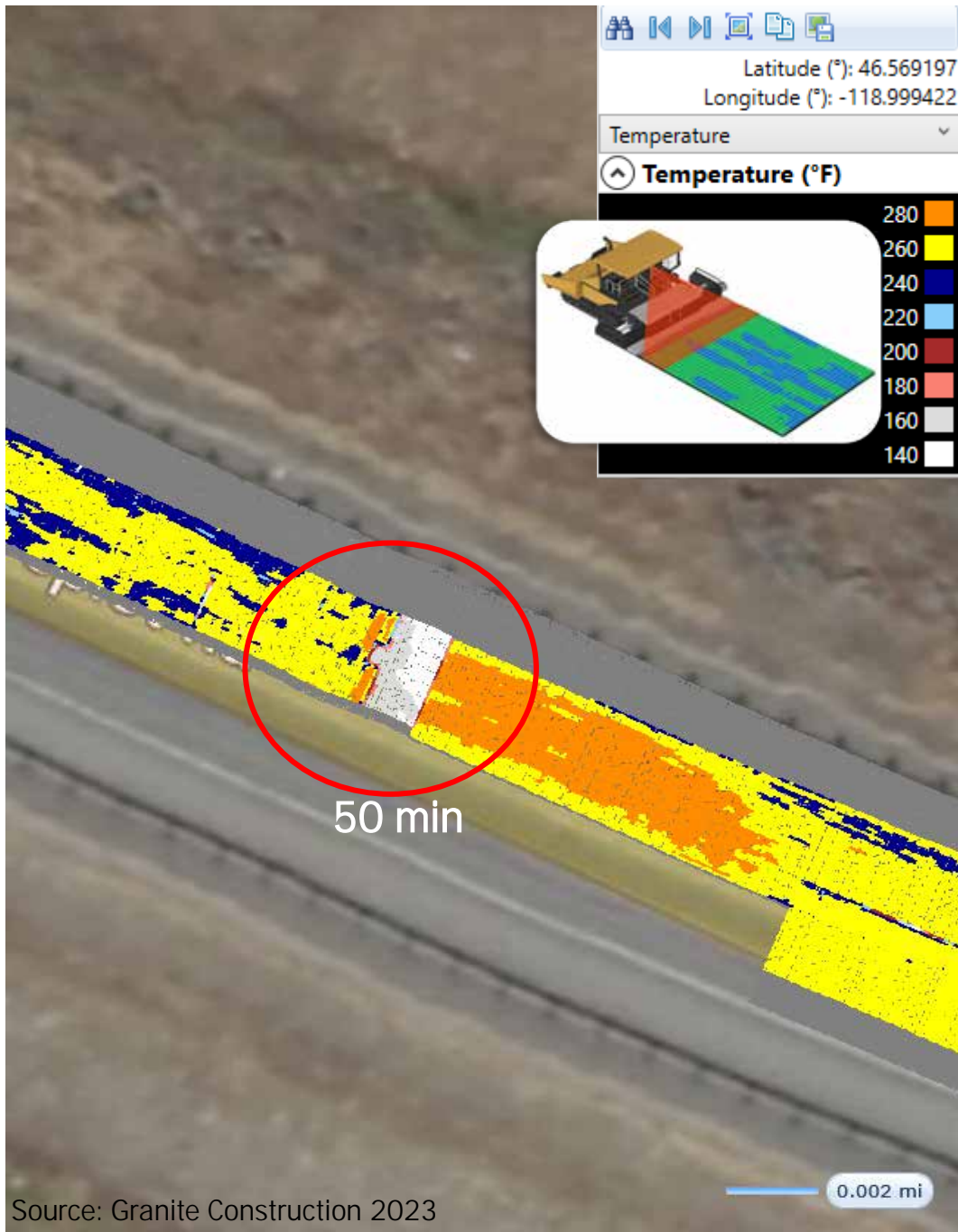
Case Study: PMTP + DPS

Northing (m)	Easting (m)	Distance (m)	Stop Duration (minutes)	Start Time	Stop Time
4908790.1	475349.3	4	30	May 25, 2021 9:30 AM	May 25, 2021 10:00 AM
4910658.4	472865.5	3,324	23	May 25, 2021 3:27 PM	May 25, 2021 3:50 PM
4910734.4	472666.5	3,541	2	May 25, 2021 4:11 PM	May 25, 2021 4:13 PM
4910839.9	472538.7	3,709	2	May 25, 2021 4:28 PM	May 25, 2021 4:30 PM
4911446.7	471951.3	4,560	6	May 25, 2021 5:36 PM	May 25, 2021 5:42 PM
4911981.8	471164.7	5,542	9	May 25, 2021 6:54 PM	May 25, 2021 7:04 PM
4912044.0	470890.4	5,881	2	May 25, 2021 7:20 PM	May 25, 2021 7:21 PM



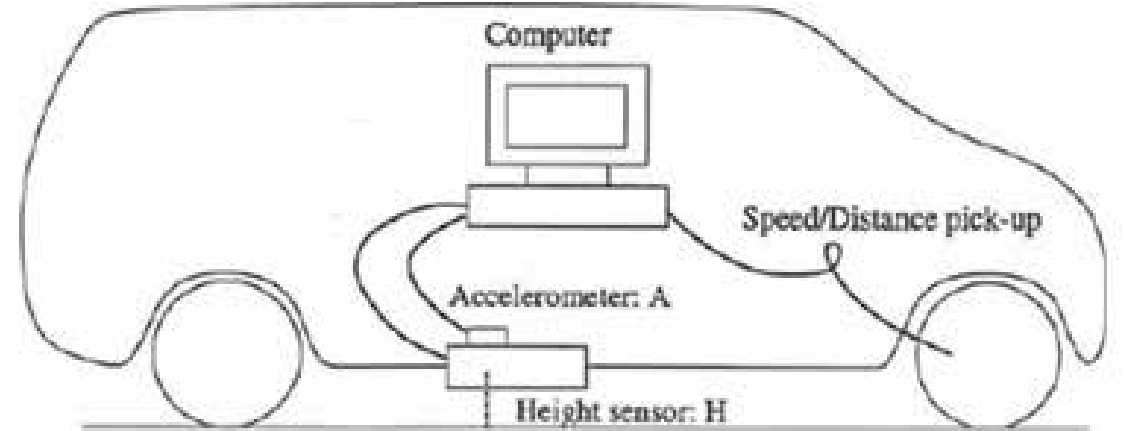
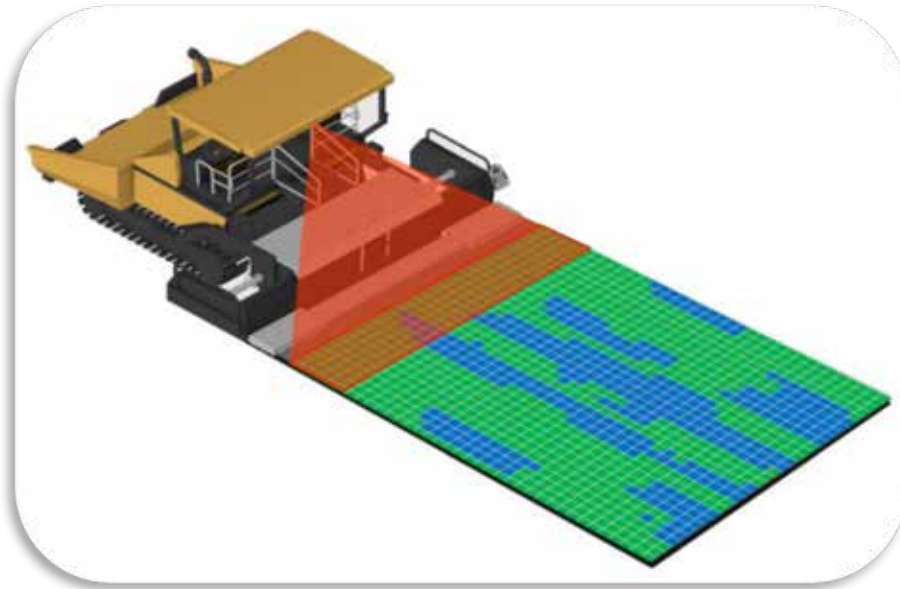
Effects of lower temperatures on density





Effects of paver stops on density

Case Study: PMTP + Inertial Profiler (Smoothness)



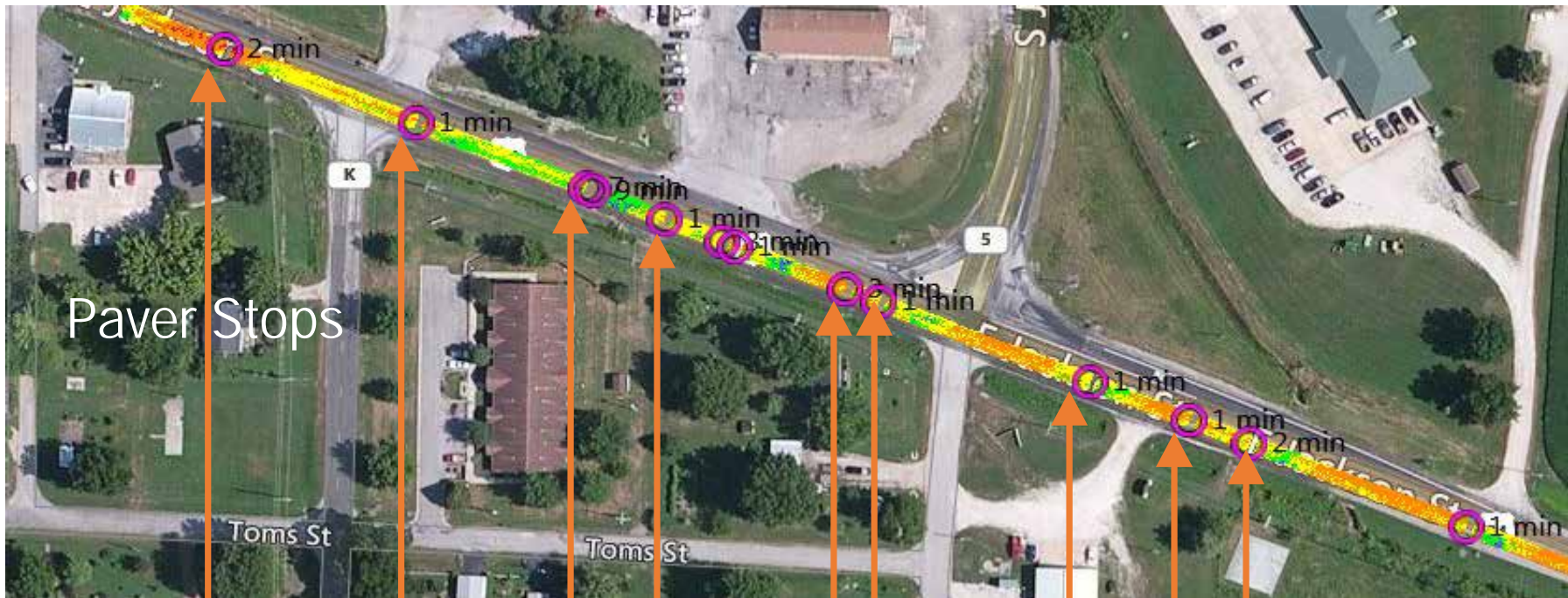
Comparing Paver Stops to IRI



Direction of Paver

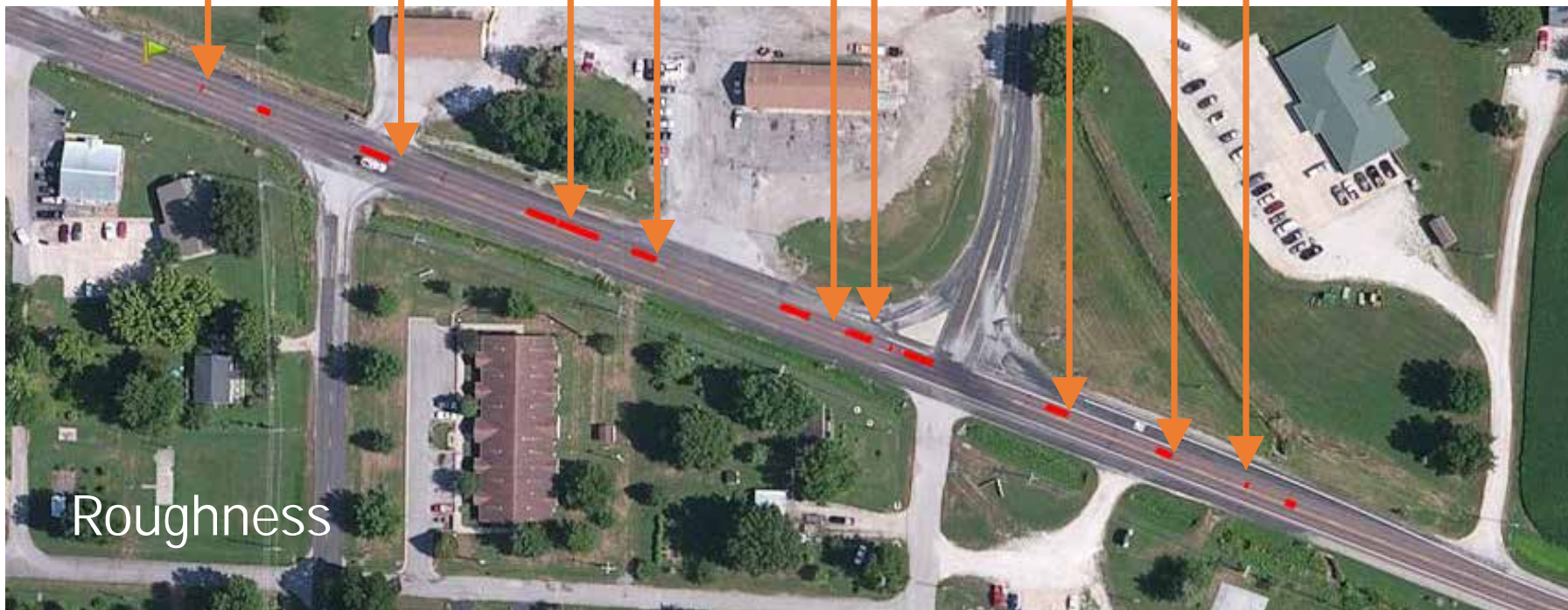
Paver Stops: 
IRI: 

IR & Paver Stops



PMTP
Veta Map

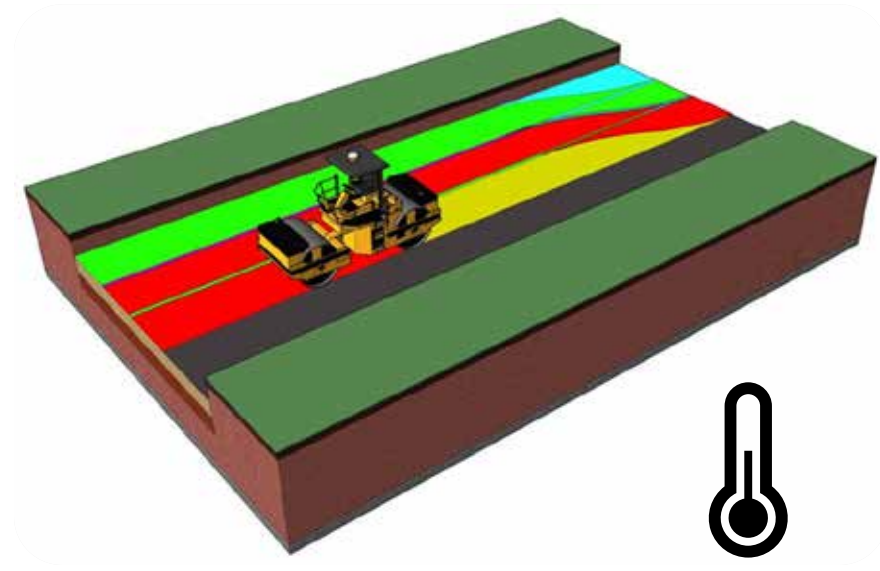
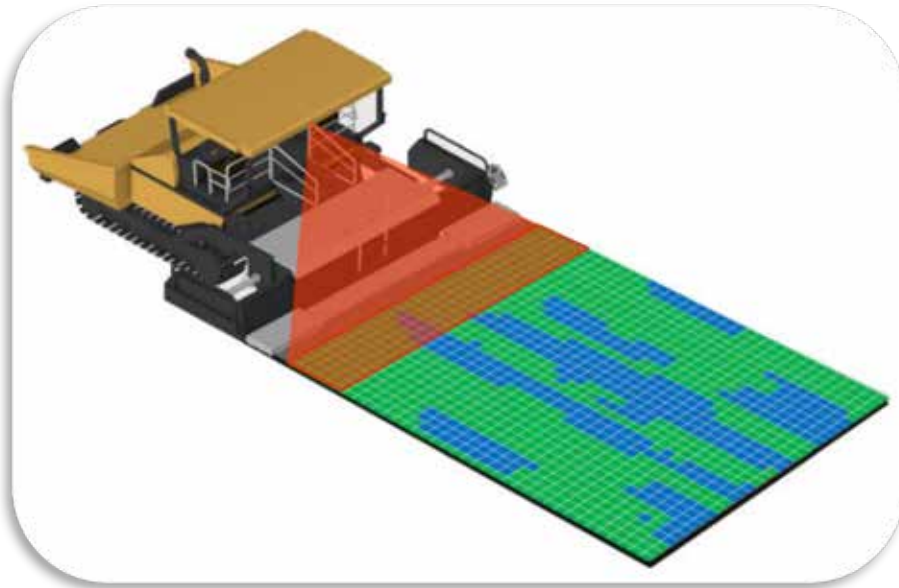
IRI ALR



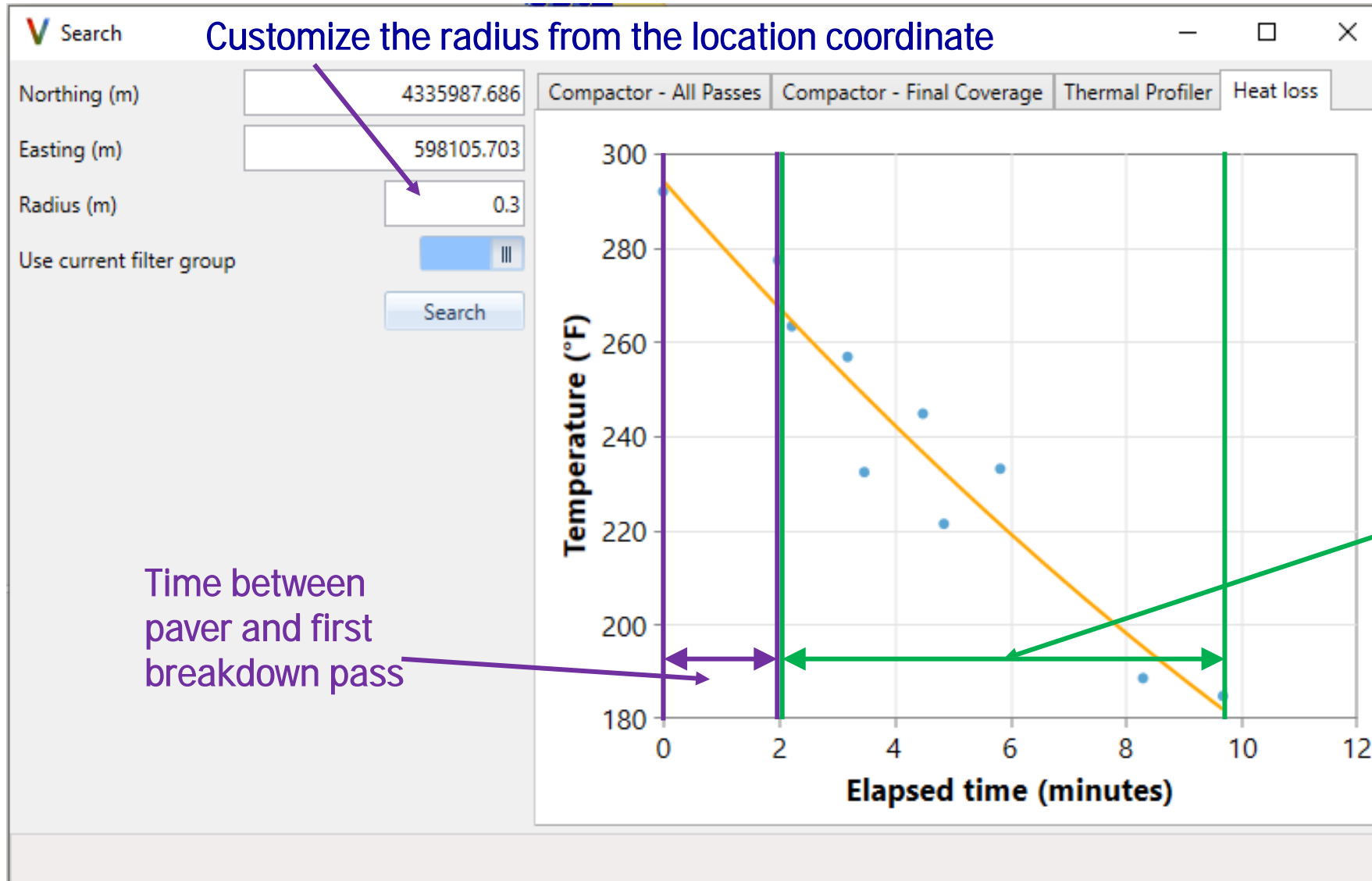
ProVAL Map

EB, RT24
2017-04-24

Case Study: PMTP + IC Temperatures



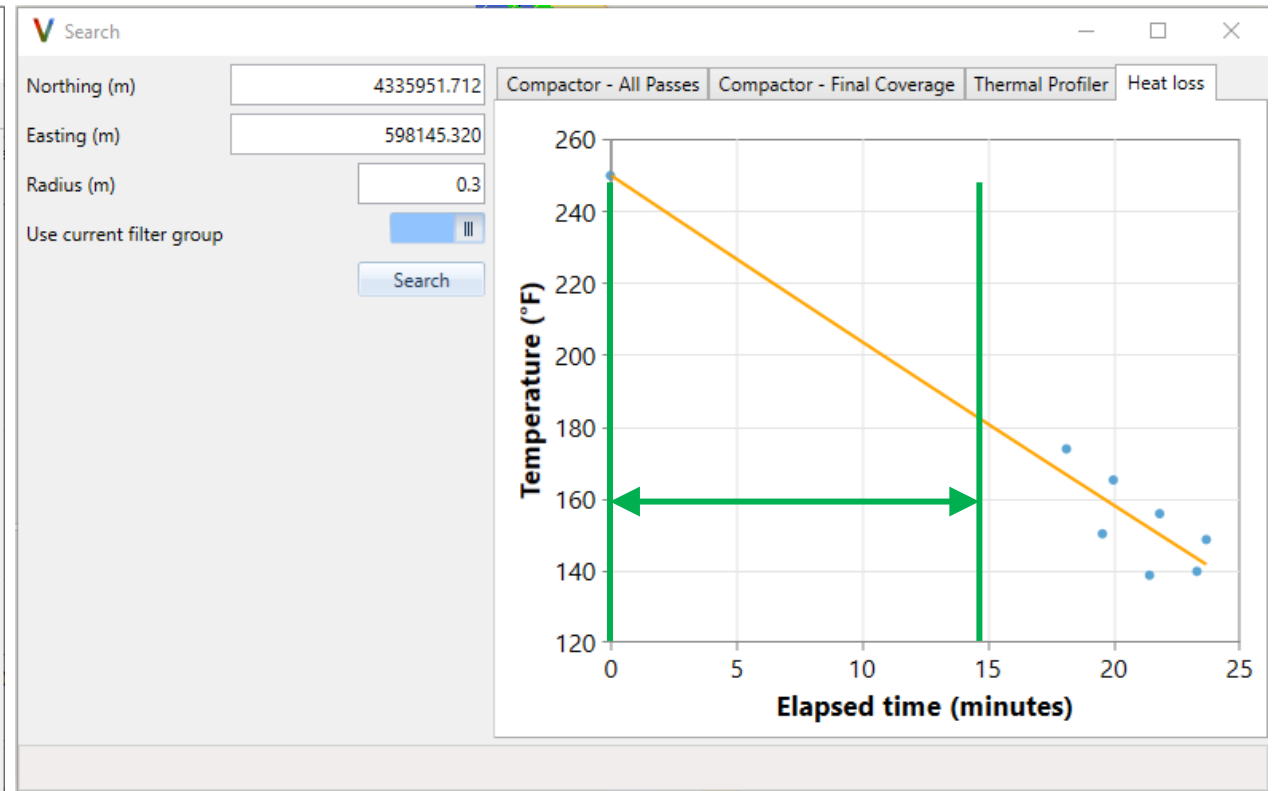
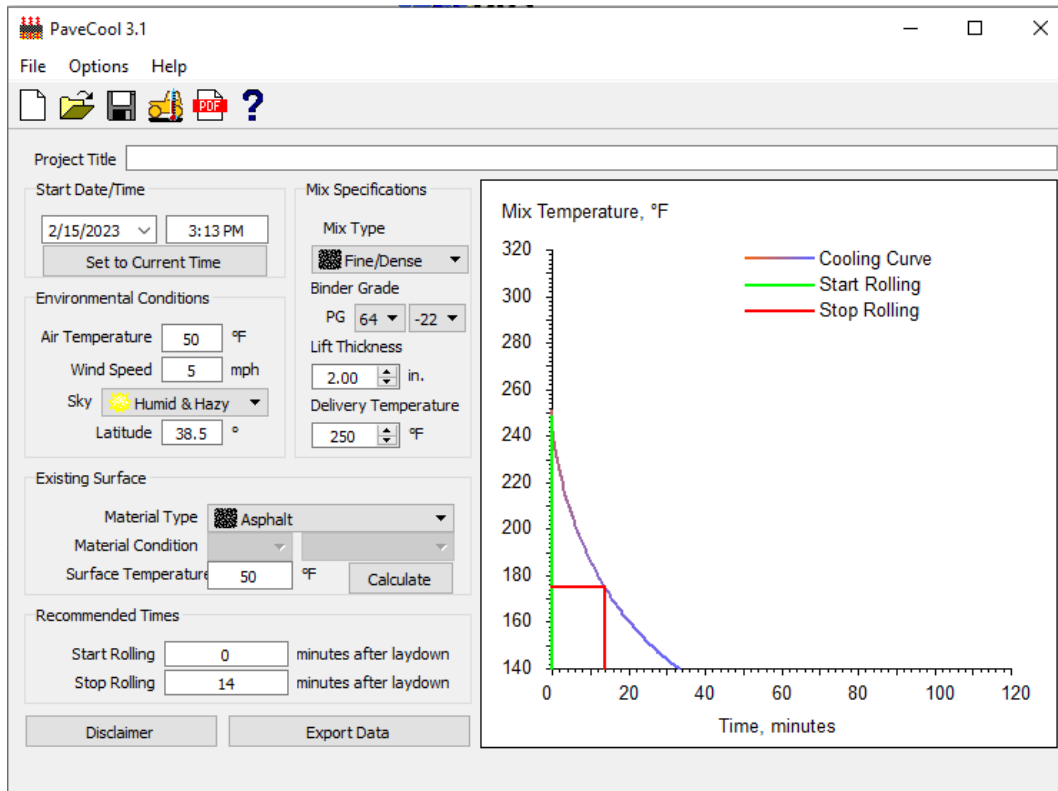
Case Study: PMTP + IC Temperatures



Time between paver and first breakdown pass

Total compaction time

Check Against Target Compaction Window

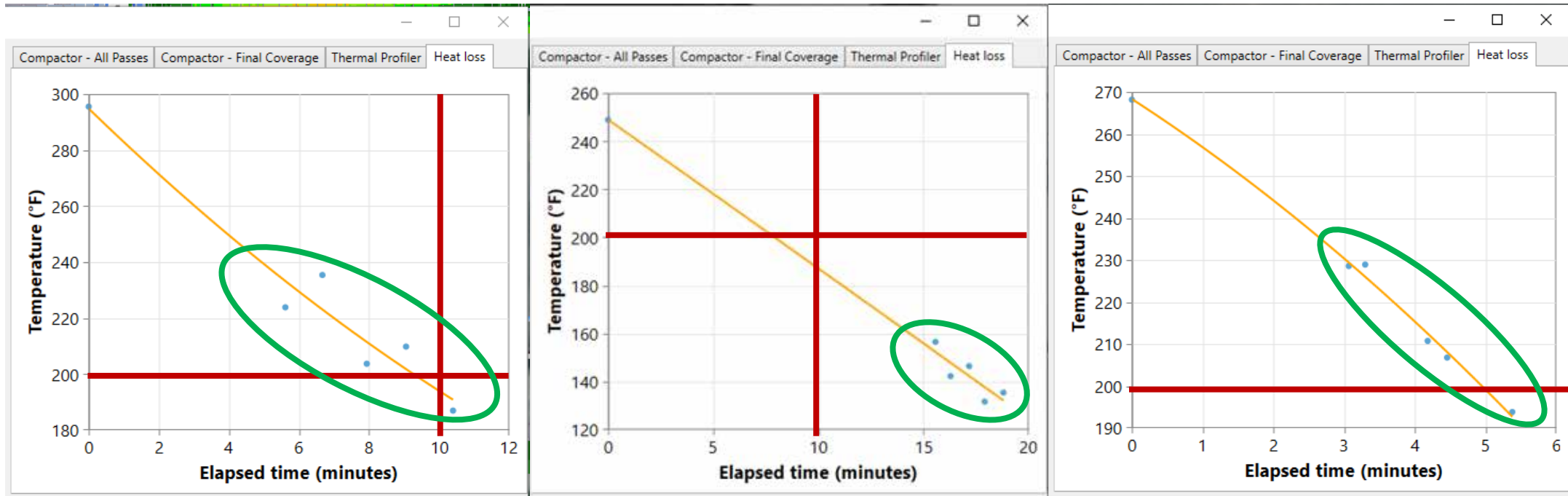


Compaction occurs outside the recommended window.

Check Balanced Rolling Patterns

Same paving day

Axes vary - reference bars at 200°F, 10 minutes



~300°F at the paver

Start rolling at:

- ~5 minutes after paver
- ~230°F

~250°F at the paver

Start rolling at:

- ~15 minutes after paver
- ~160°F

~270°F at the paver

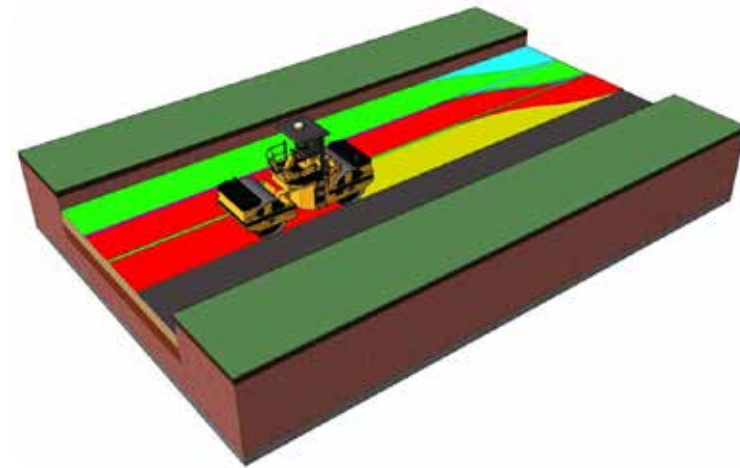
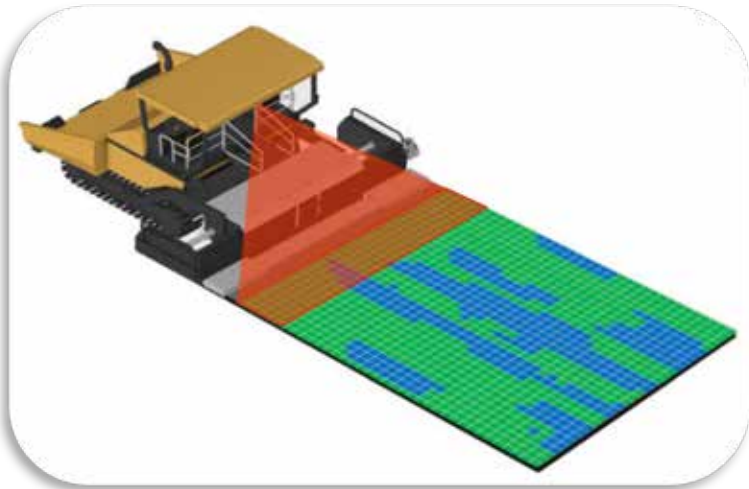
Start rolling at:

- ~3 minutes after paver
- ~230°F

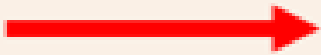


Rolling operation does not appear balanced. Mix temps vary.

Case Study: PMTP + IC Pass Count + DPS



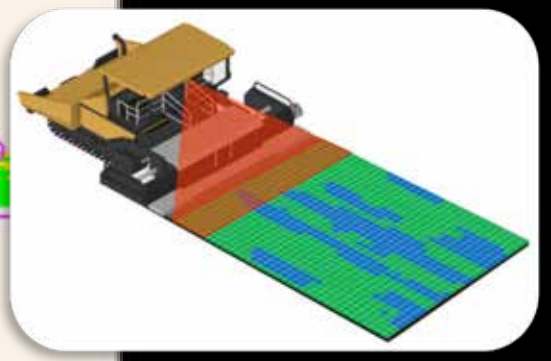
Direction of Paver



Paver Stop
(10 Minutes)



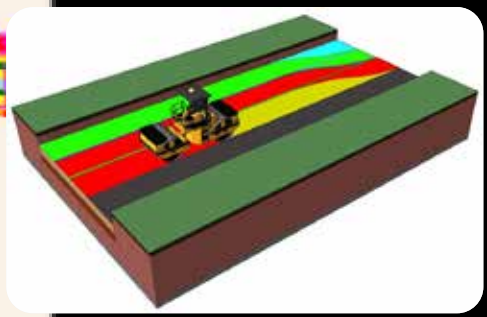
Temperature (°F)



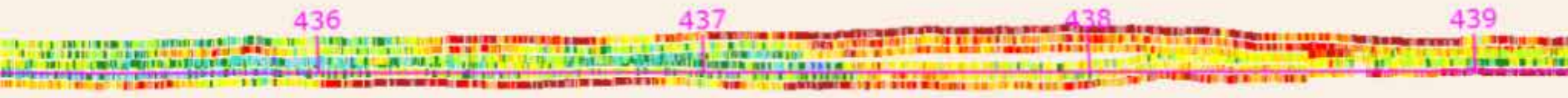
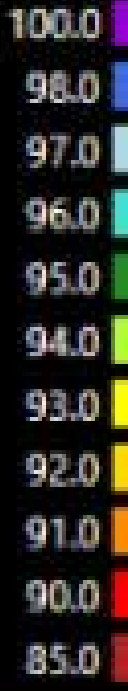
Breakdown Roller Passes



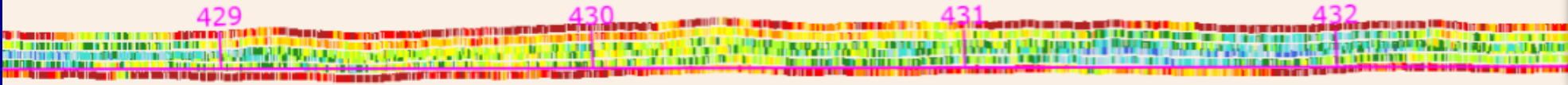
Pass Count



Density, % of Gmm (%)



Direction of Paver

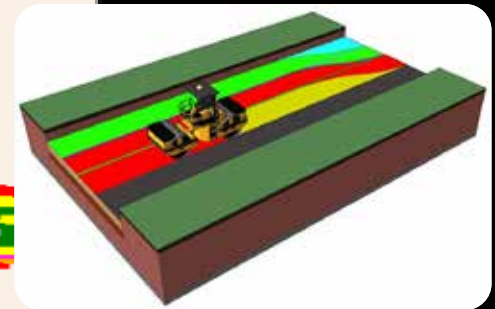


Density, % of Gmm

Density, % of Gmm (%)
100.0
98.0
97.0
96.0
95.0
94.0
93.0
92.0
91.0
90.0
85.0

Northing (ft): 532009.0
Easting (ft): 2762016.7

Breakdown Roller Passes



Pass Count

Pass Count
8
7
6
5
4
3
2
1

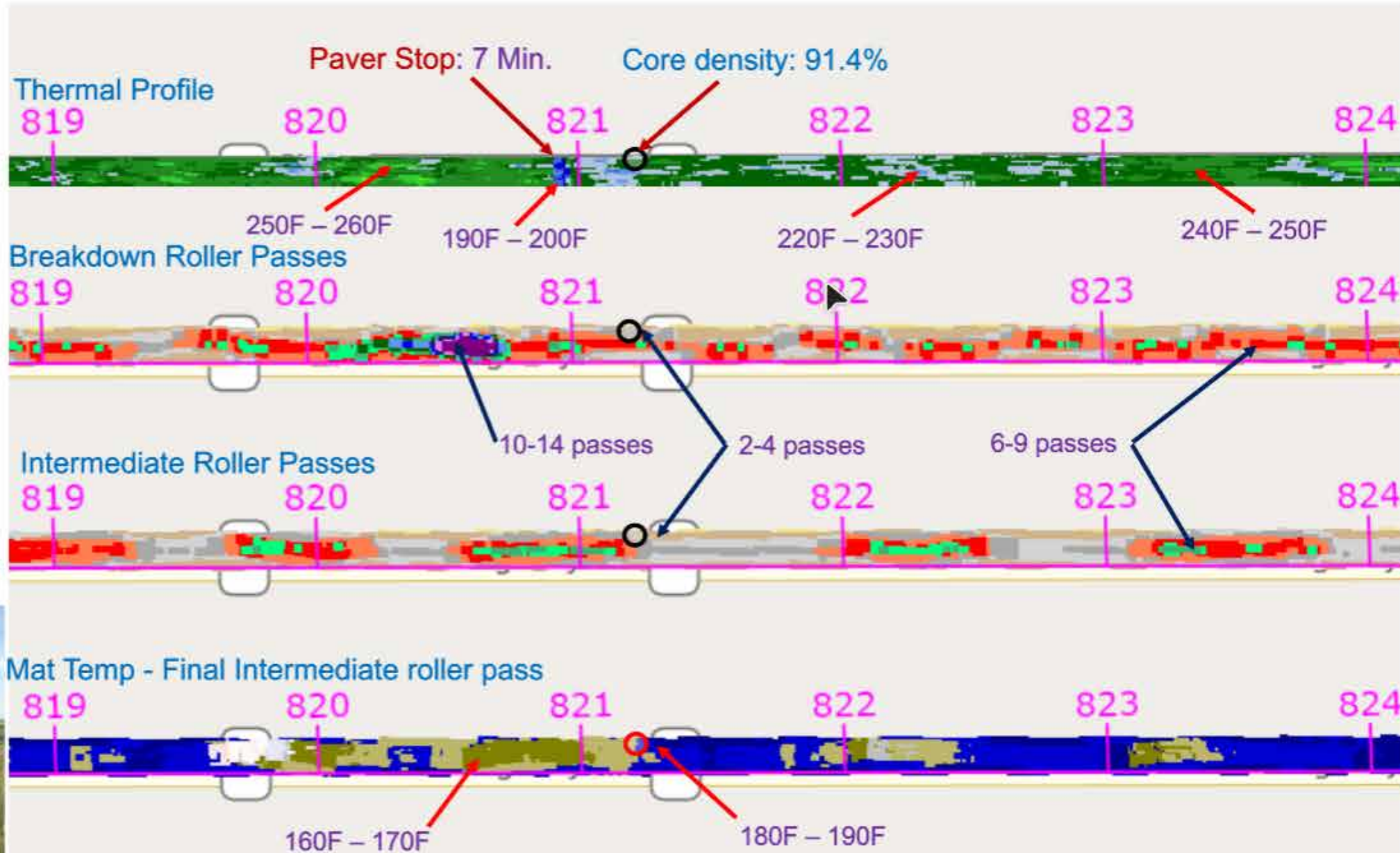
Comparing Technologies

Core Densities
08/04/22

94.5	91.4
95.0	94.4
96.4	95.2
93.5	94.6
96.0	92.0
93.6	97.0
94.8	95.2
95.5	94.4
93.4	96.5
94.8	95.1

Core #
C74

Core # C74
STA 821+23
12.6' LT of
Centerline



Paver Stop Concerns



Information Core
(Density: 88.7%)



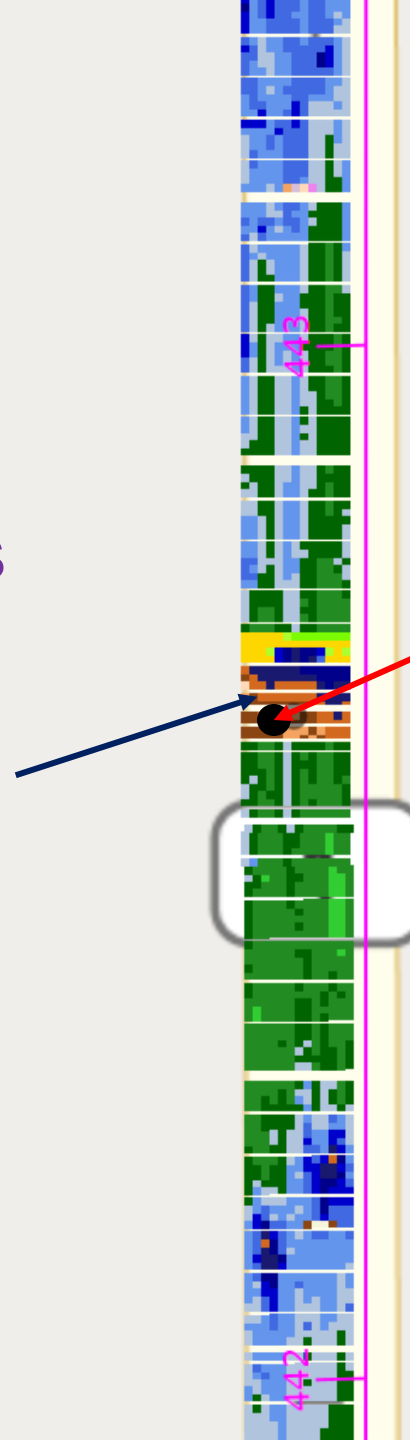
Weather on 09/03/2020

Wind Direction: NNW

Wind Speed: 25mph

Temperature: 49 degrees

155 - 165 °F



Information Core
(Density: 88.7%)

↑
Direction of Paver

Case Study: IC Stiffness



Case Study: IC Stiffness



Case Study: IC Stiffness



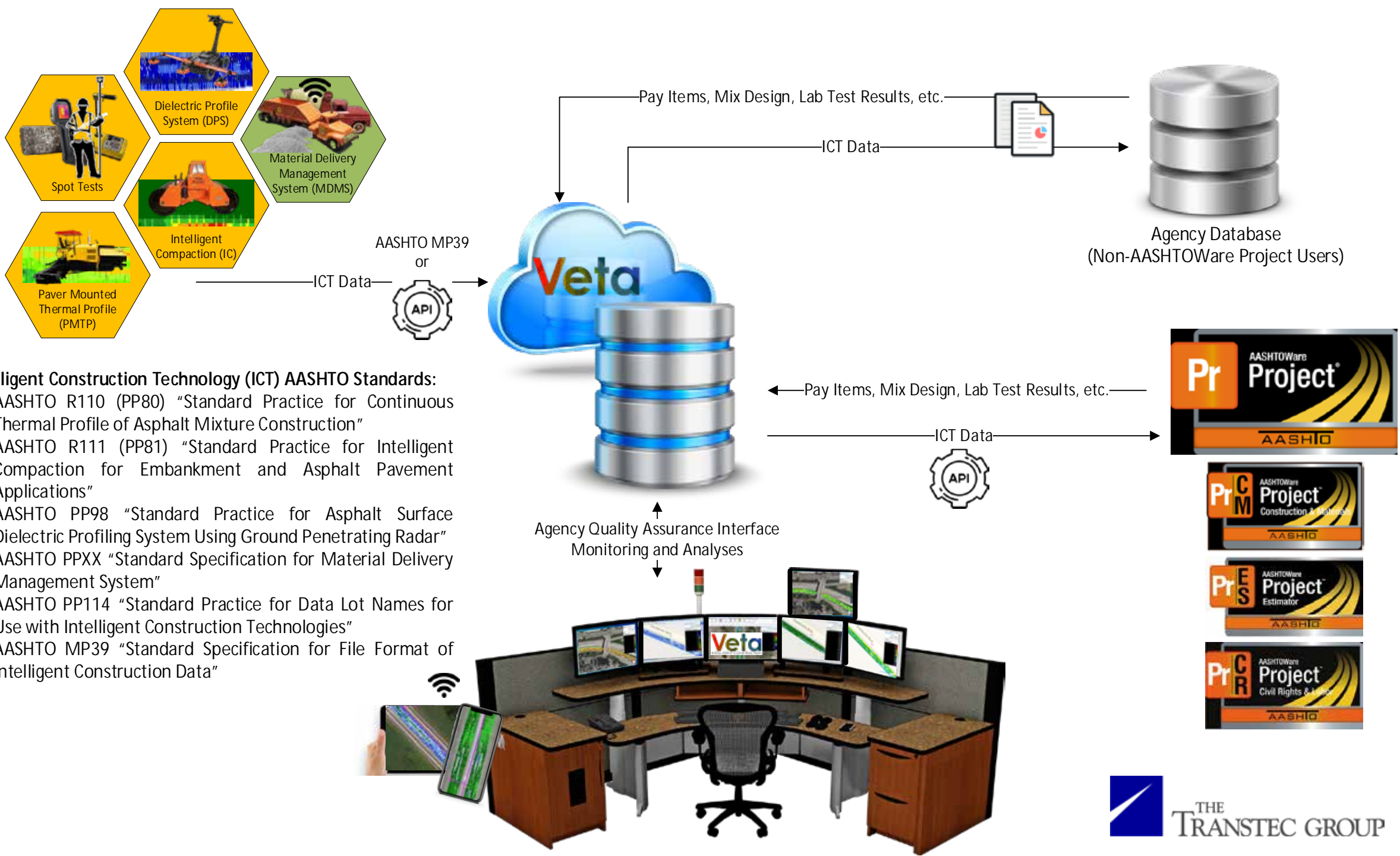
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Intelligent Construction Technology (ICT) AASHTO Standards:

- AASHTO R110 (PP80) "Standard Practice for Continuous Thermal Profile of Asphalt Mixture Construction"
- AASHTO R111 (PP81) "Standard Practice for Intelligent Compaction for Embankment and Asphalt Pavement Applications"
- AASHTO PP98 "Standard Practice for Asphalt Surface Dielectric Profiling System Using Ground Penetrating Radar"
- AASHTO PPXX "Standard Specification for Material Delivery Management System"
- AASHTO PP114 "Standard Practice for Data Lot Names for Use with Intelligent Construction Technologies"
- AASHTO MP39 "Standard Specification for File Format of Intelligent Construction Data"

LEGEND

Yellow hexagon: In Veta

Light green hexagon: Funded & Under Contract

Red hexagon: Funding Approved

Blue hexagon: Future Ideas

Interface with AASHTOWare Project, MDMS, GPR Thickness/Depth

As-Built/3D Models for Milling/Paving, Excavation, Surface

IC, PMTP, DPS, Geospatial Spot /Core Tests

Smoothness (ProVAL), Concrete Paving Vibrational Monitoring



Virtual Roadway Digital Twins

Thank You!



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www.IntelligentConstruction.com

