Ground Penetrating Radar Replacing Cores in Determining In-Place Density

2021 NEAUPG Annual Meeting – Albany, NY
October 27, 2021

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Agenda

- History/What is it?
- Features
- Calibration using Cores
- Calibration using Pucks
- System QA Procedures
- Export Range
- Lane Extents
- PWL Report
- Linear and Area Defects
- Output – Google Earth

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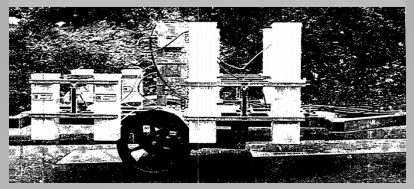
History

How it started with the DOT/FHWA?

1992: SHRP1 Initiative with TTI and GSSI



30 yrs: Pavement and Highway R&D

TTI, MnDOT, others with GSSI

2009:SHRP2 RO6C Initiative with

TTI/MnDOT and GSSI

PaveScan RDM 2.0 – What is it?

PaveScan RDM 2.0

It is a complete **Continuous Full Coverage (CFC)** GPR system that will:

- Provide on-site dielectric values of newly laid and compacted asphalt
- Provide continuous full coverage density information
- Provide compaction information in real-time, on-site using a 2D map
- Provide coring locations
- Allow input of core information for calibration and back calculation of %compaction, %void content, and density

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PaveScan RDM 2.0 – What is it?

PaveScan RDM 2.0

Can be used as a:

- **Q/C Tool**
  - Roller Pattern Issues
  - Paver Issue
  - Number of Trucks Issue
  - Asphalt Issue
- **Q/A Tool**
  - PWL Reports
  - Google Earth Reports
- **Forensic Tool**

Features

PaveScan RDM 2.0

Rugged Deployment Cart

- Modular assembly for easy deployment and transport
- Foldable deployment arms with high-visibility for work site safety
- Foot-activated brake on rear wheel
- Easy to attach and remove sensors

Integrated Concentrator Box

- Accommodates up to 3 sensors
- Housing for cable management
- Hot-swappable, dual batteries

Sensor Design

- Built specifically for the extremes of the asphalt paving environment
- Green laser to aid in location accuracy and collection guide

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Features

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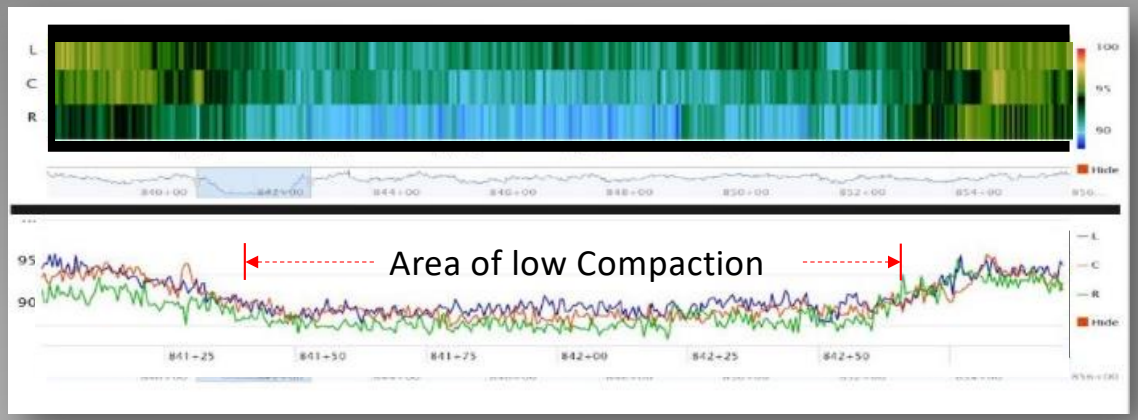
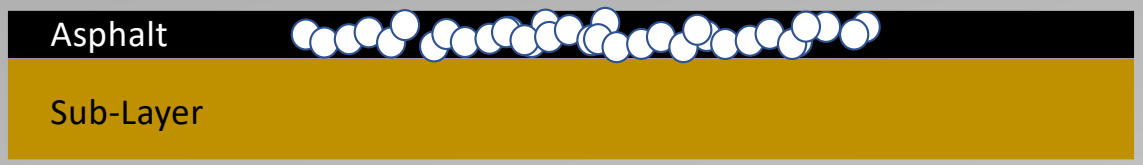


PaveScan RDM



Air Voids

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Features

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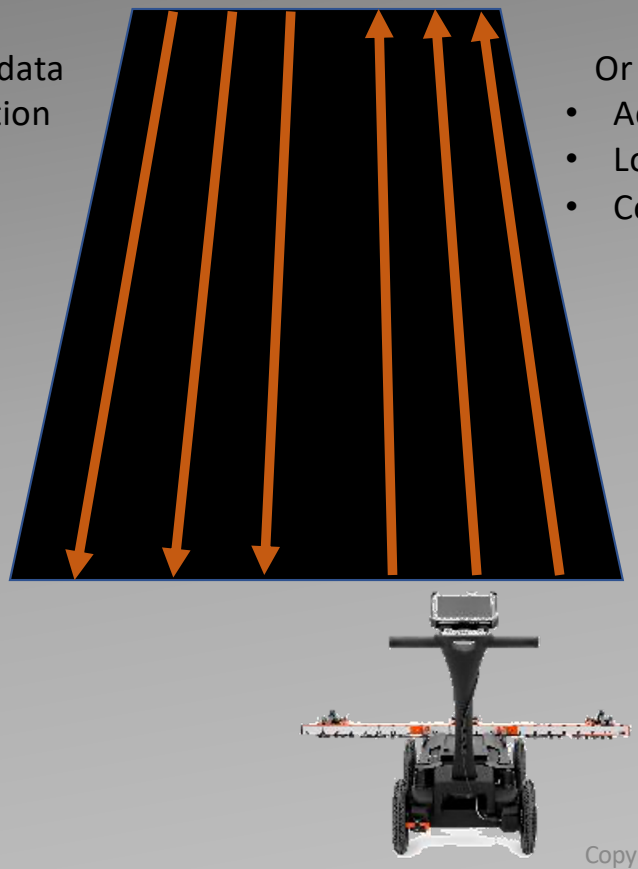
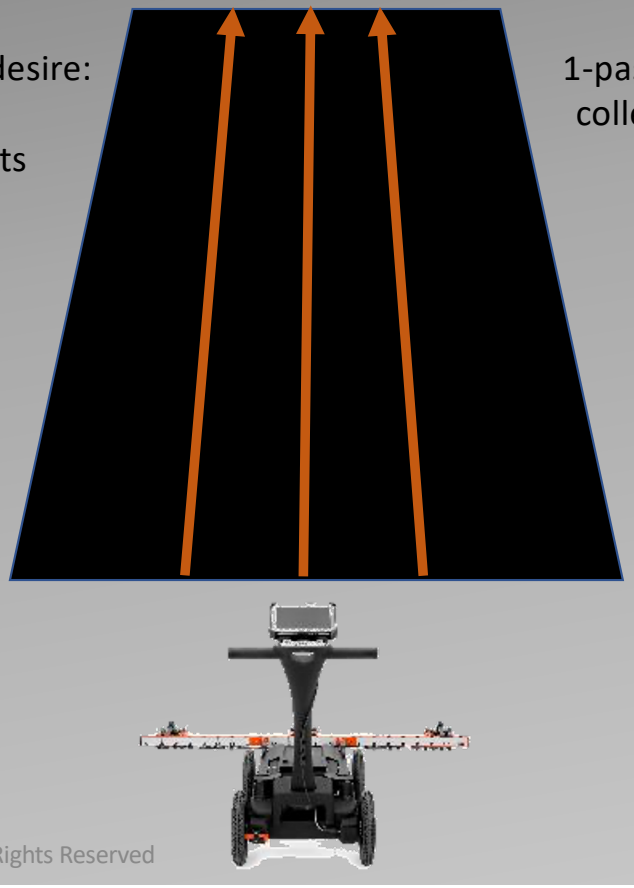
2-pass data collection



Or whatever you desire:

- Across the lane
- Longitudinal Joints
- Combination

1-pass data collection



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Calibration using Cores

PaveScan RDM 2.0

- Field Cores are used for the correlation of dielectric to density (% void or % compaction)
- Field cores can come from a test strip or after one day of on-site data collection

- Core locations are determined by the system or DOT
- Dielectric is taken at the core location PRIOR to coring
- Cores are taken to the lab for density measurement (% void or % compaction)

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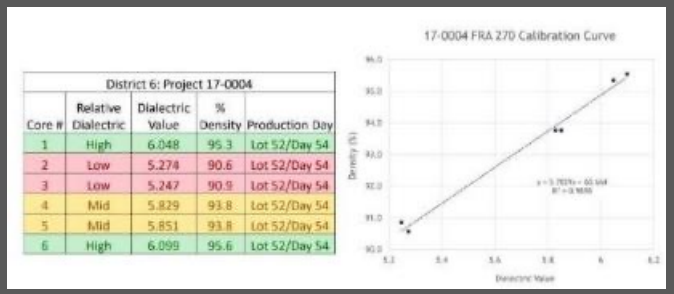
Calibration using Cores

PaveScan RDM 2.0

Values are entered into the system



District 6: Project 17-0004				
Core #	Relative Dialectric	Dialectric Value	% Density	Production Day
1	High	6.048	95.3	Lot 52/Day 54
2	Low	5.274	90.6	Lot 52/Day 54
3	Low	5.247	90.9	Lot 52/Day 54
4	Mid	5.829	93.8	Lot 52/Day 54
5	Mid	5.851	93.8	Lot 52/Day 54
6	High	6.099	95.6	Lot 52/Day 54

Courtesy Ohio DOT

- Multiple mixes can be entered, named, and saved onto the system.
- Every project can have a specific mix calibration attached to it, even for day-to-day changes of mixes.

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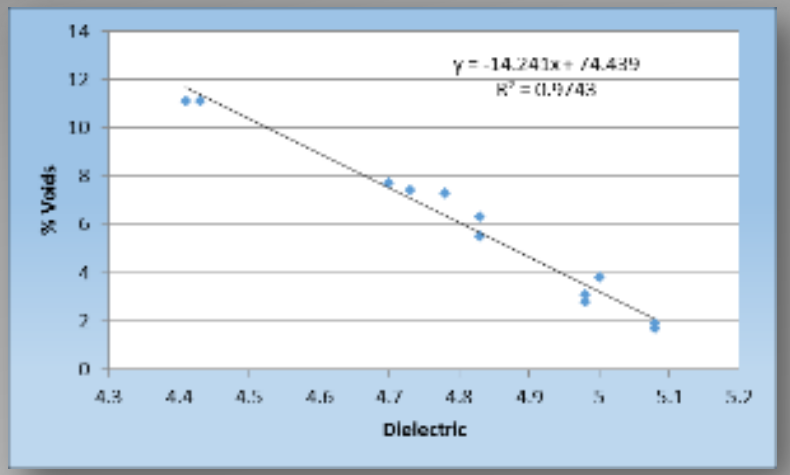
Calibration using Cores

PaveScan RDM 2.0

Excel Example

Dielectric	% Voids
4.78	7.3
4.98	2.8
4.73	7.4
4.98	3.1
4.83	5.5
5.08	1.7
4.83	6.3
4.7	7.7
4.41	11.1
5.08	1.9
5	3.8
4.43	11.1



Calibration using Pucks

PaveScan RDM 2.0

- In an effort to reduce (or even eliminate) coring, pucks* can be used from the plants to calibrate the PaveScan RDM 2.0 system.
- Minimum of 3 pucks is recommended
- Each mix (calibration) is named and stored in the system and can be attached to a specific project.
- Future projects, if a mix was used in a prior job, can simply be attached to an existing calibration.

Input Information

* Other Terms – Pills, Biscuits, Bulks

Calibration using Pucks

PaveScan RDM 2.0

4-Step Process

Calibration using Pucks

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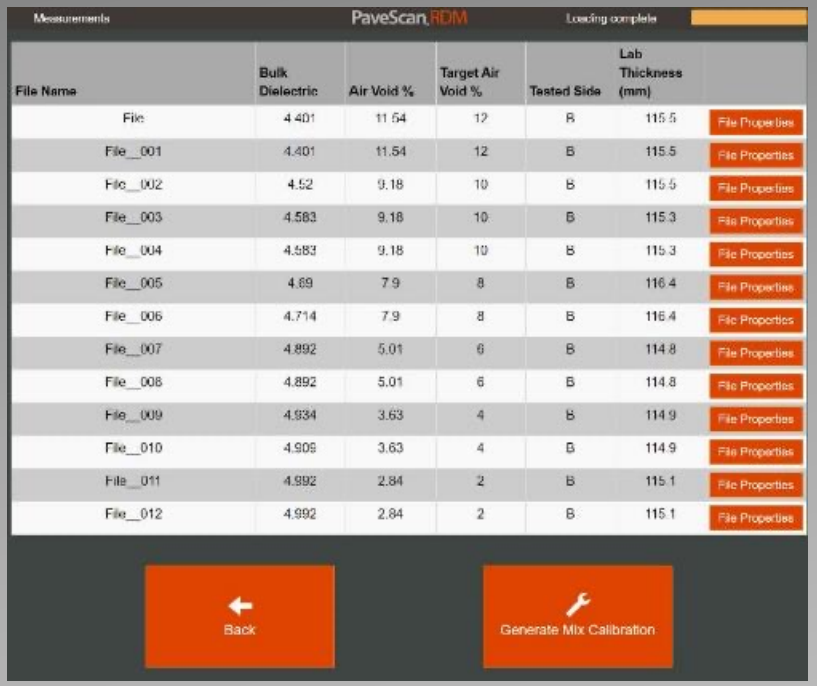

Results

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System QA Procedures

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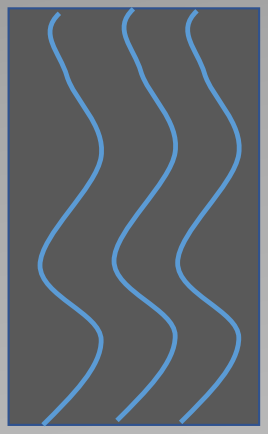
Procedures were developed to assure the accuracy of the sensors.

- HDPE Block
- Swerve Method
- Repeat Line Method

HDPE Block

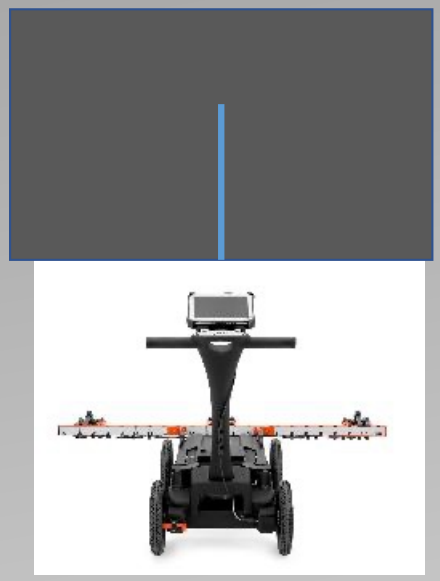
Each Sensor, Dielectric = ~2.35, +/- .05

Swerve Method



1. Suggested On-Site, walk about 250 feet using a swerve pattern
2. Outside sensors no closer than 1 foot from the longitudinal joint
3. Turn around and walk back 250 feet using the swerve pattern
4. Dielectric of sensors should be about .05 of each other

Repeat Line Method



1. Suggested On-Site, draw a single line about 6-10 feet across the lane
2. Walk each sensor, one at a time, *perfectly* along the line
3. Dielectric of sensors should be about .05 of each other

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Export Range

PaveScan RDM 2.0

Throughout the day or project, multiple data files are collected and saved.
This feature allows the user to combine chosen files to create a single file.

Playback Range screens allow the user to select which files to combine for displaying and exporting.

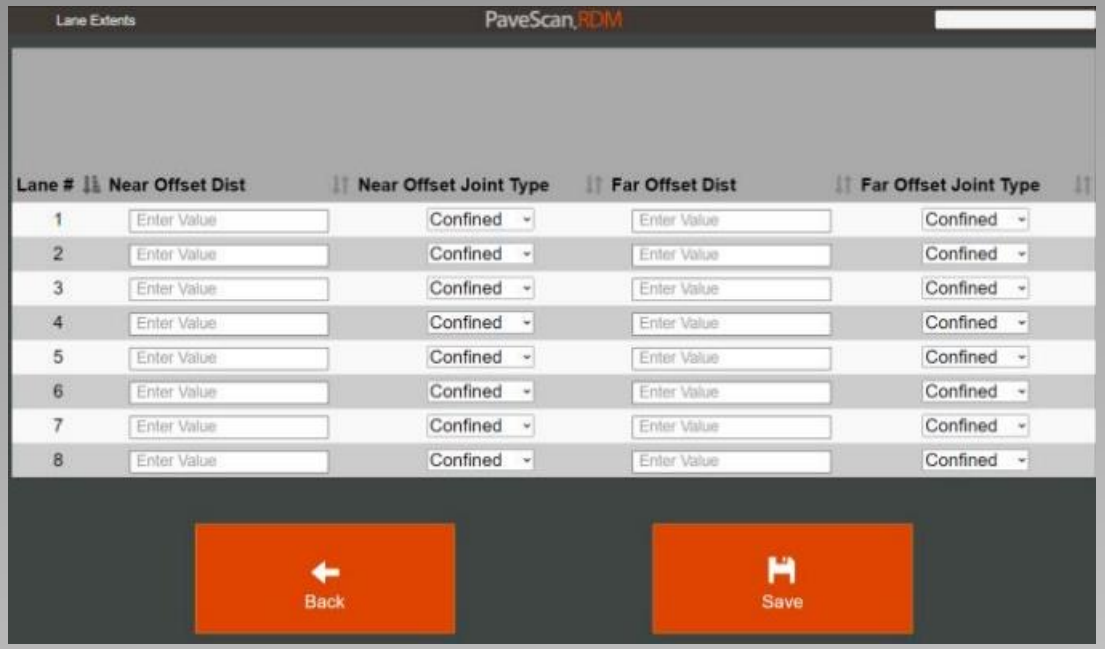
Lane Extents

PaveScan RDM 2.0

The user has an option to define lane extents for each lane.

- Near and Far Offset Distance
- Near and Far Joint Type

This information is used if using the PWL option.

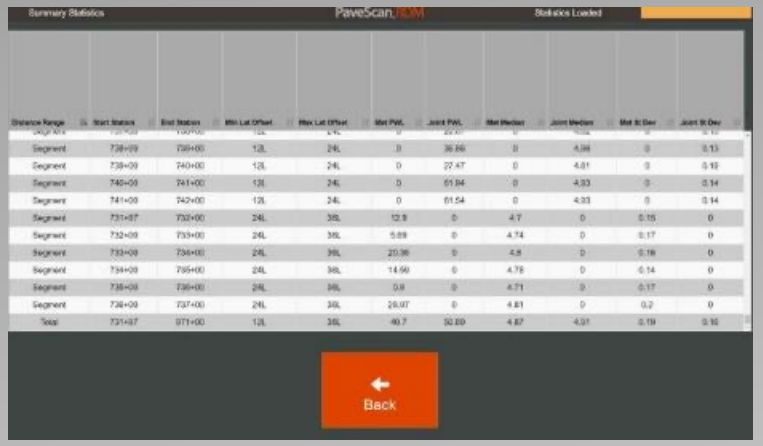


PWL Reports

PaveScan RDM 2.0

The user has an option to produce PWL reports by entering user specified limits that will be used to produce the reports.

User-selected upper and lower limits

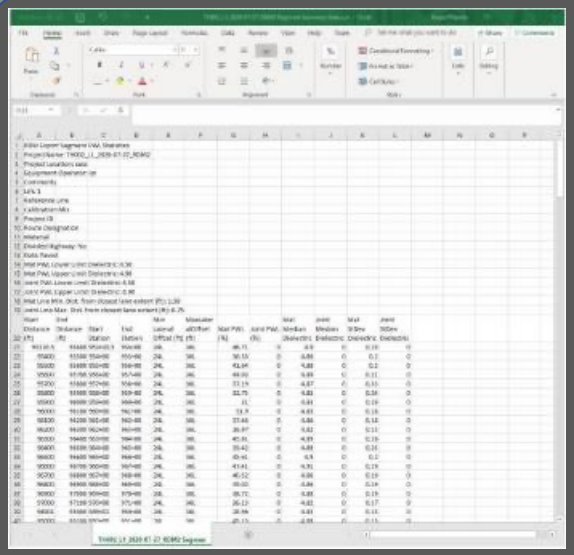


Displayed Report

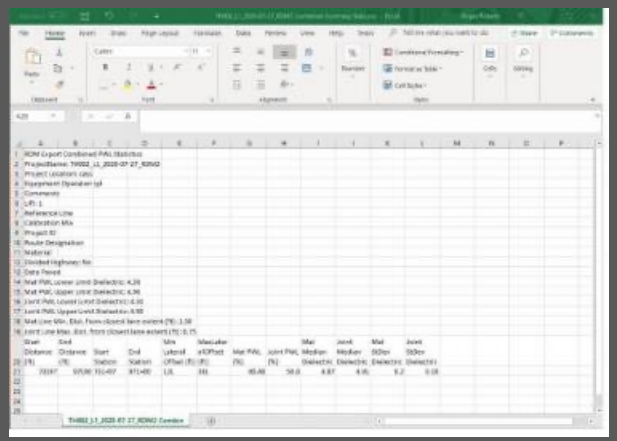
PWL Reports

PaveScan RDM 2.0

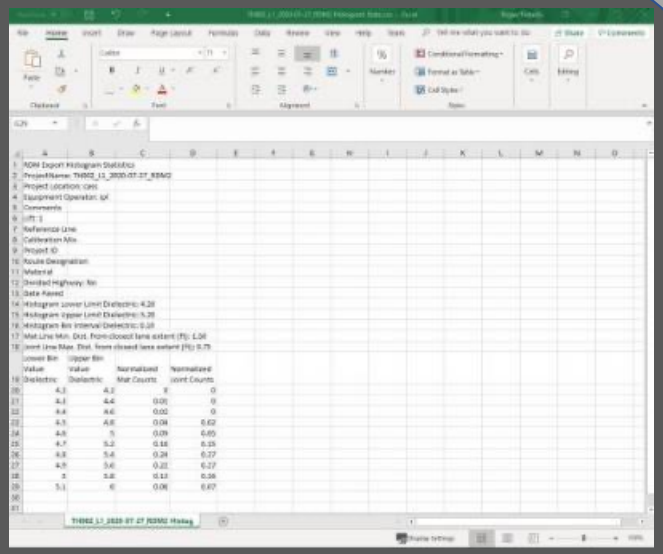
Exported PWL Reports (.csv format)



Mat & Joint PWL, Median Values, and Standard Deviation for each segment



Summary Statistics for mat and joint measurements for the entire project

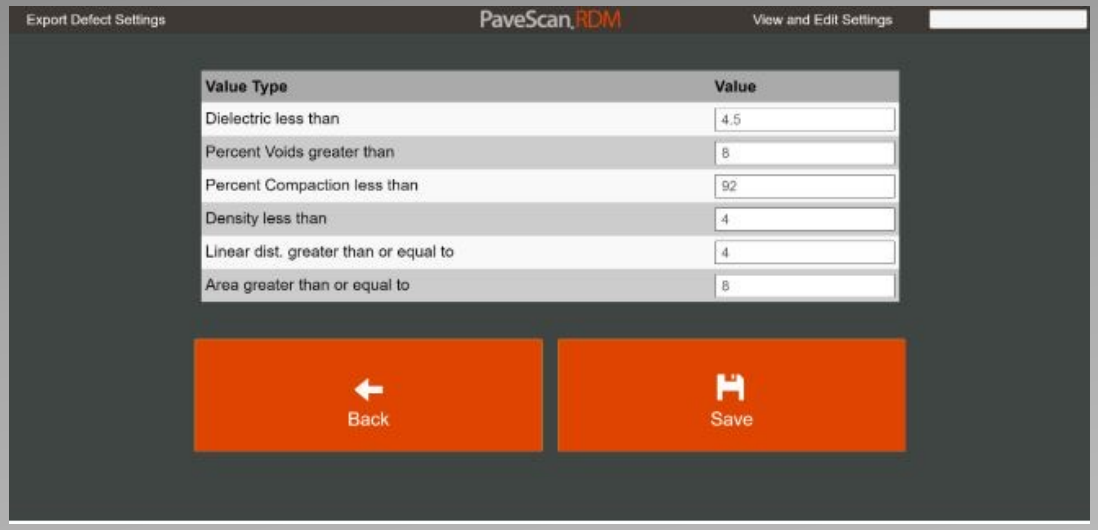


Histogram distribution of values

Linear and Area Defects

PaveScan RDM 2.0

If checked, all defects are exported to .csv and .kml files



User-selected criteria

Linear and Area Defects

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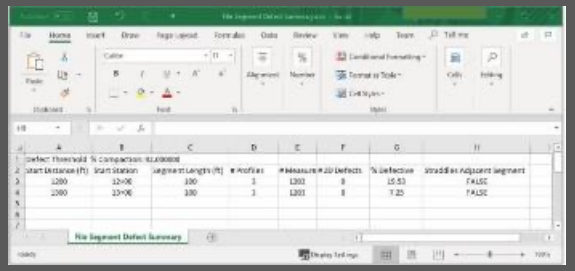
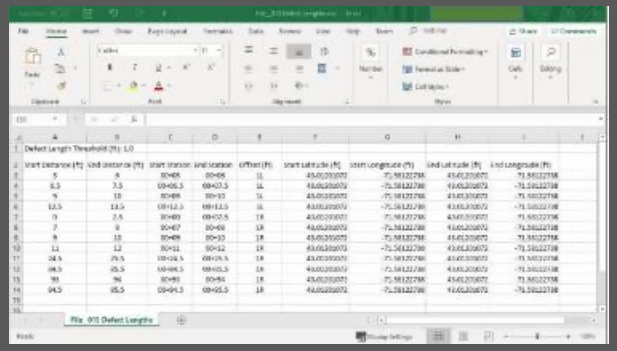
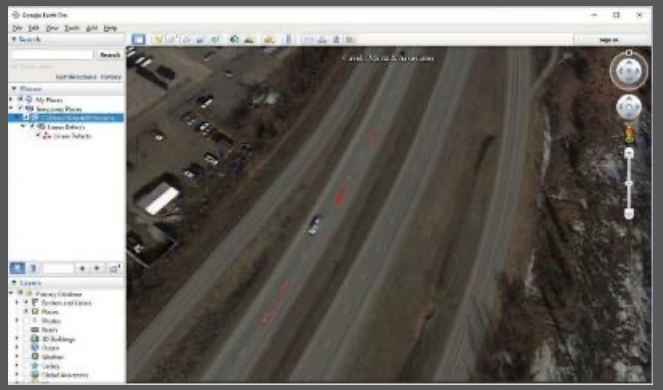
Exported Reports (.csv format)



Segment Summary



Linear Defect File

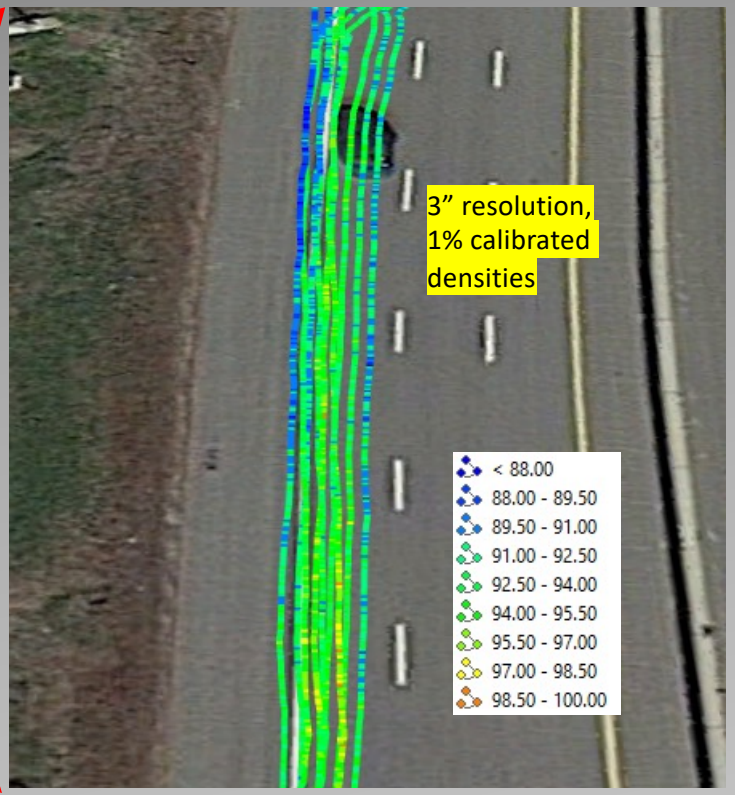


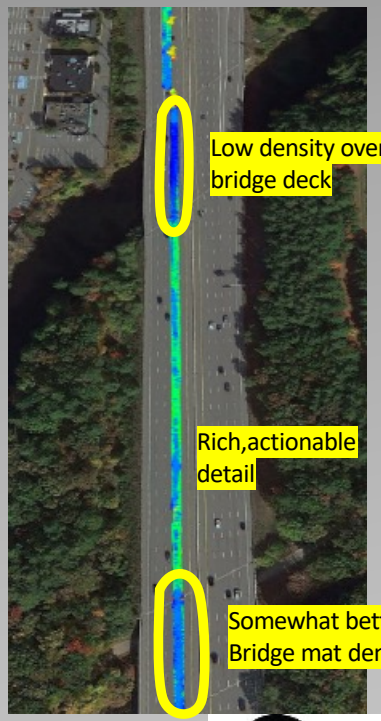
KML File (display using Google Earth

KML file (Google Earth)

PaveScan RDM 2.0

Examples





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KML file (Google Earth)

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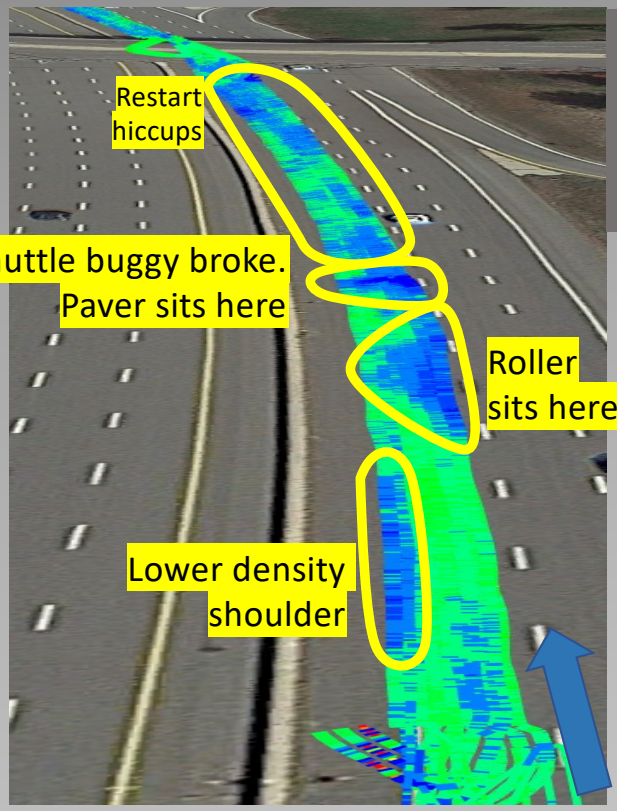
Examples

Densities correlate to known issues which can be mapped and perhaps rolled out.



1000ft section
12 lines = 2mi. of GPR data
~50k points

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KML file (Google Earth)

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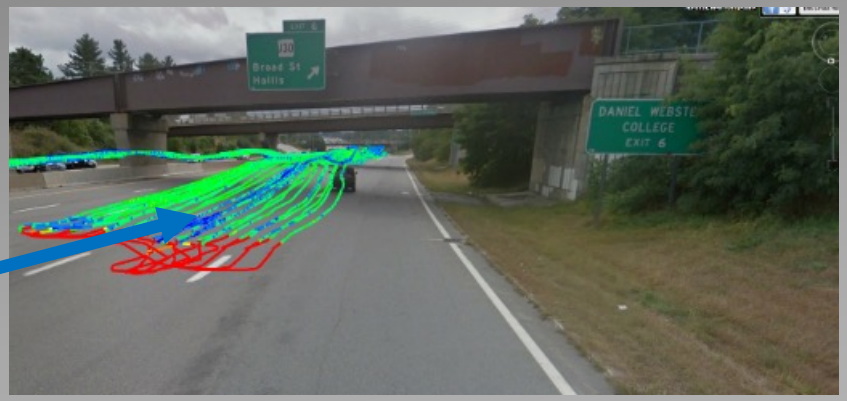
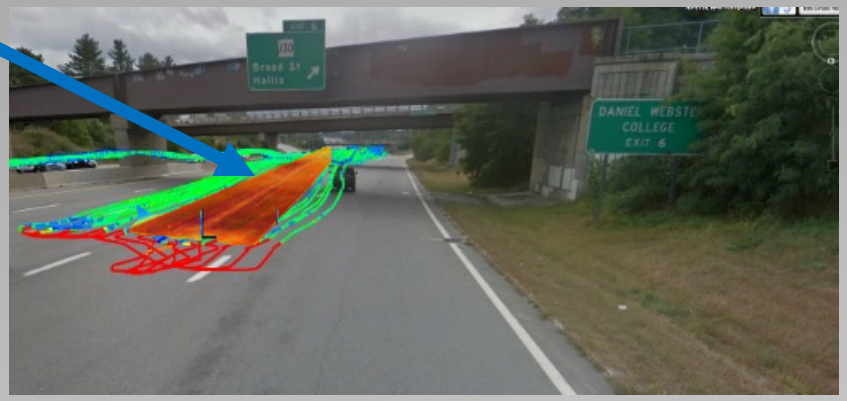
Examples

Correlation:
Lower density vs IR Map





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Questions

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Thank You!!