Alaska Department of Transportation & Public Facilities

No Pothole Left Behind

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July 26, 2018

Outline

1. Motivation
2. Asphalt Failure Modes in Alaska
3. Asphalt Pavement Goals
4. Three CFC Technologies for achieving nearly defect free Asphalt Pavements

Continuous Full Coverage (CFC)

Motivation

<u>Alaska DOT&PF Core Values</u>

- Integrity
- Excellence: Commitment to continually improve
- Respect

More Motivation

<u>Alaska DOT&PF Vision Statements</u>

- We will be known for continuous learning, improvement, and innovation
- We will be the national leader among state transportation departments

Failure Modes of Asphalt

Major Failure Modes:

1. Studded Tires (a political problem)
2. Poor Compaction (a construction problem)
3. Poor Tack Bond Between Layers (a pay item problem)

Minor Failure Modes:

- Stripping (a surface chemistry problem)
- Rutting & Shoving (a mix design problem)

Avoidable Failure Modes

Avoidable Failure Modes:

2. Poor Compaction
3. Poor Tack Bond Between Layers

Our focus will be on Enhancing Compaction

Asphalt Pavement Goals

- Perpetual Embankments
- Defect-Free, well compacted asphalt mat and longitudinal joints.
- New pavement layers well bonded to base layers
- Pavement Surfaces that last 20-30 years with very little maintenance.

Required Shift in Philosophy

- Abandon Random Testing (Burmister 1948)
- Adopt current state-of-practice technology to achieve 100% testing & inspection coverage
  - Intelligent Compaction Rollers provide 100% pass coverage
  - Pave-IR provides 100% thermal mapping of mat
  - GPR provides 100% Mapping of compaction

Expected Outcomes

- No potholes or raveling joints
- Longer-life pavements
- Much less maintenance
- Lower life-cycle cost

Available Methodology

- Subgrade/subsurface improvement
- Intelligent Compaction of all layers
- IR mapping of Thermal Segregation in HMA
- Improved mat compaction with IC Rollers, compaction aides in the asphalt mix
- Improved joint compaction by use of joint heaters, echelon paving, joint sealants

Newest Methodology

- Ground Penetrating Radar (GPR) Dielectric Mapping with Readout as % Voids, % Compaction, or Density in asphalt mat in real-time once core data has been entered.

(Testing equipment became commercially available in May 2016 with FCC approval)

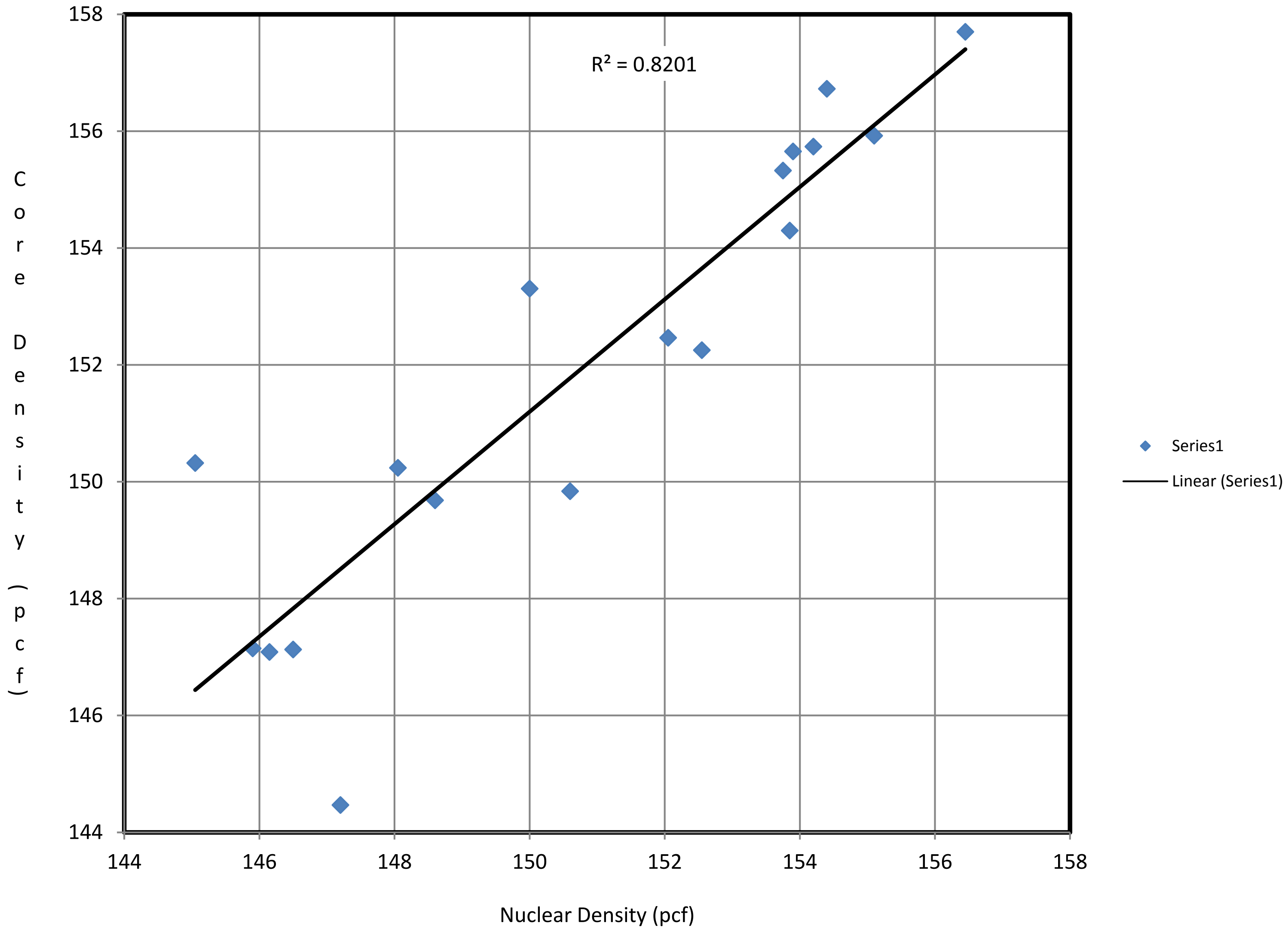
Fritz Cove Dielectric

Fritz Cove % Compaction

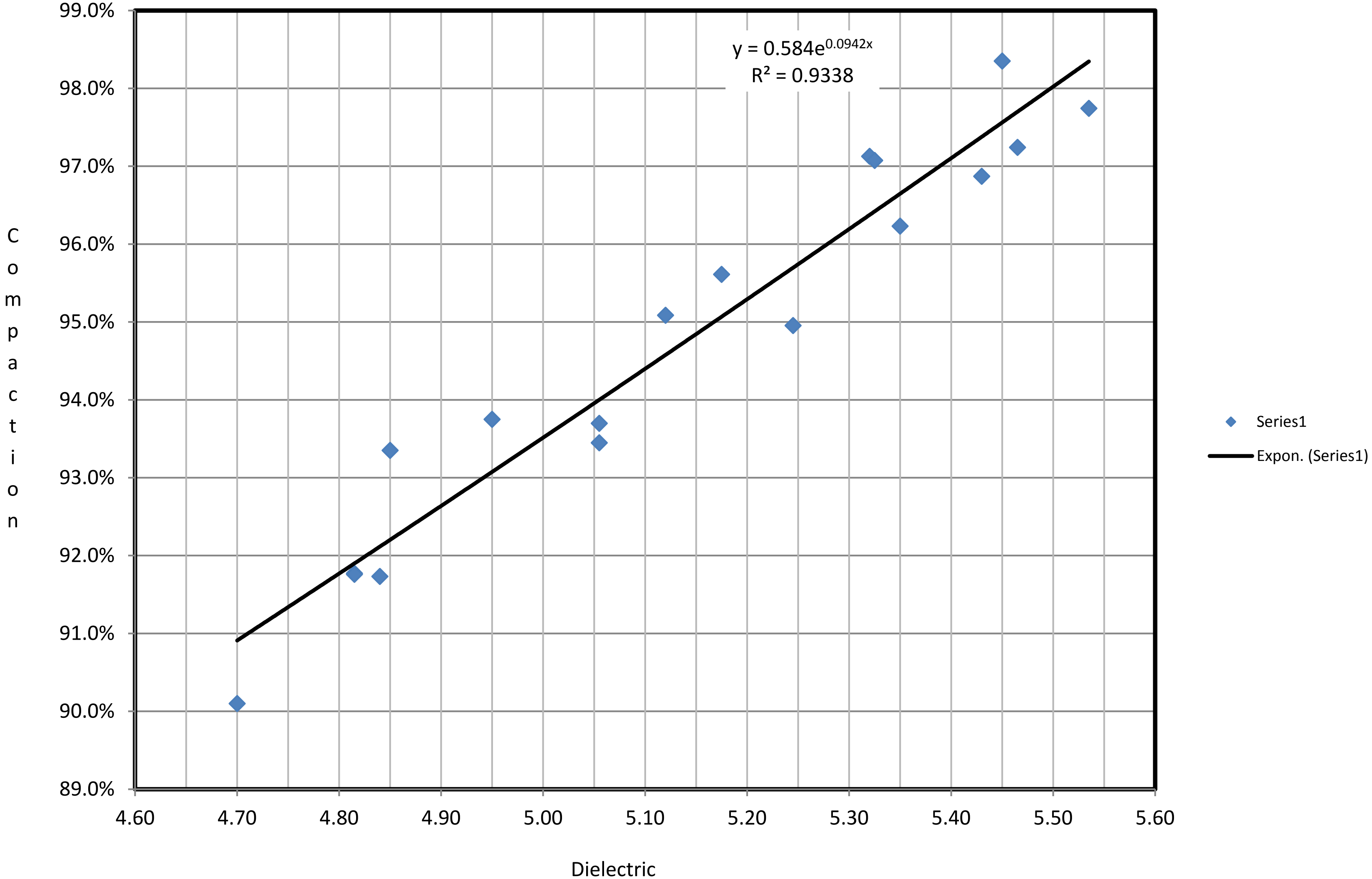
IC Implementation in Alaska

- Intelligent Compaction Rollers required at Sitka Airport. (Bruce Brunette 2013)
- Echelon Paving also employed to reduce longitudinal joints from 11 to 3.

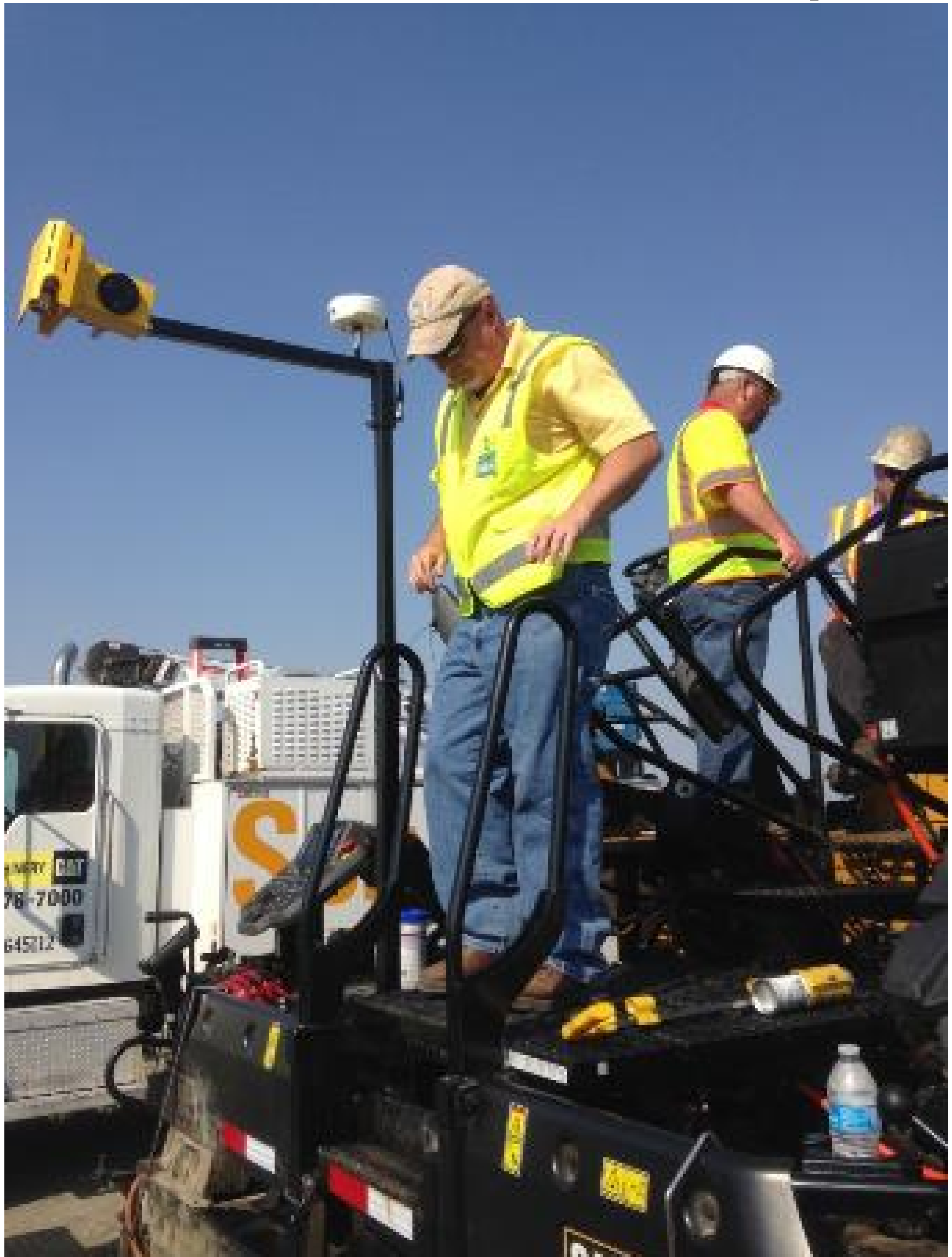
Calibration: Cores vs Nuke, R^2 = 0.82



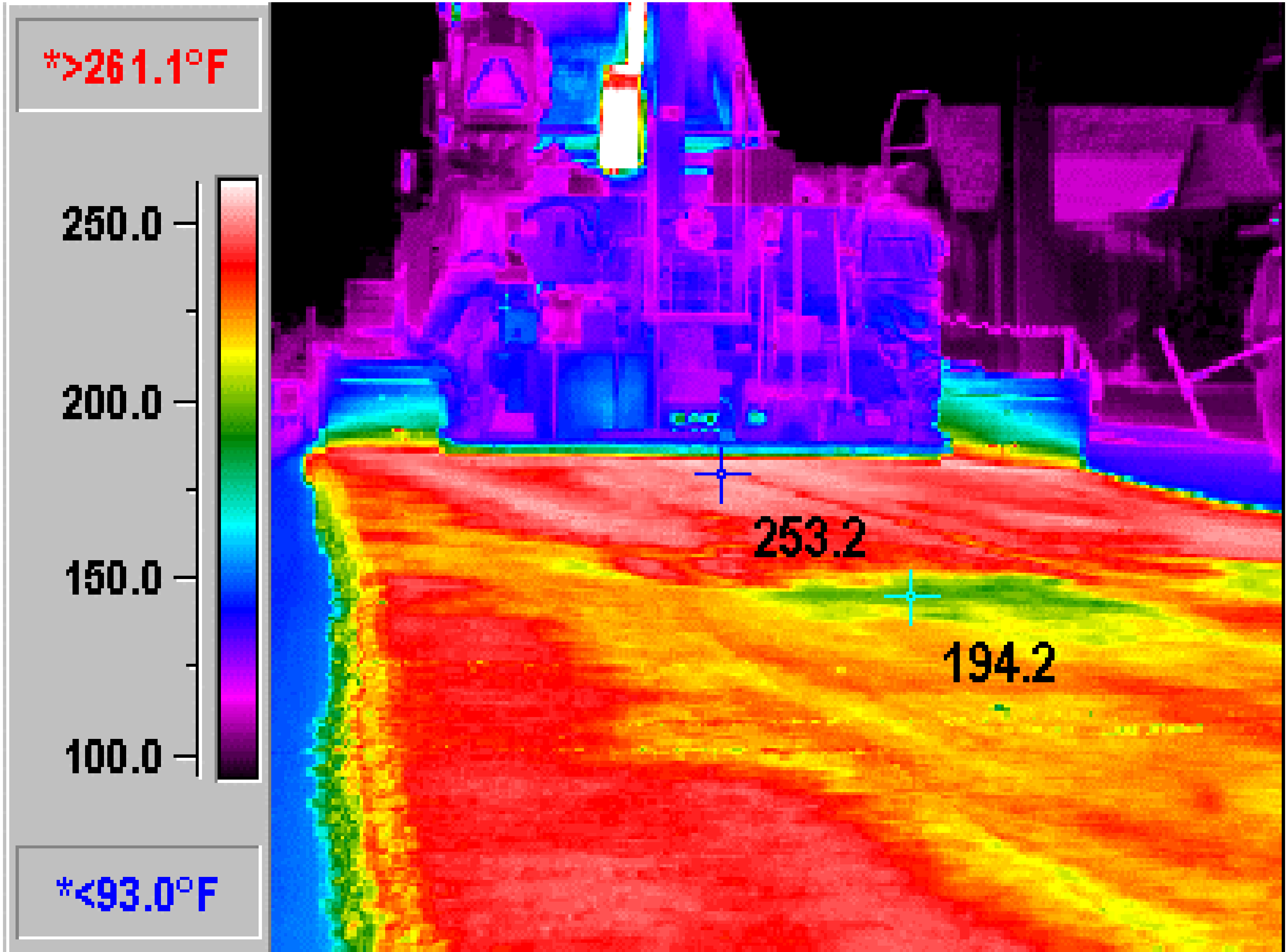
Calibration: Cores vs RDM, R^2 = 0.93



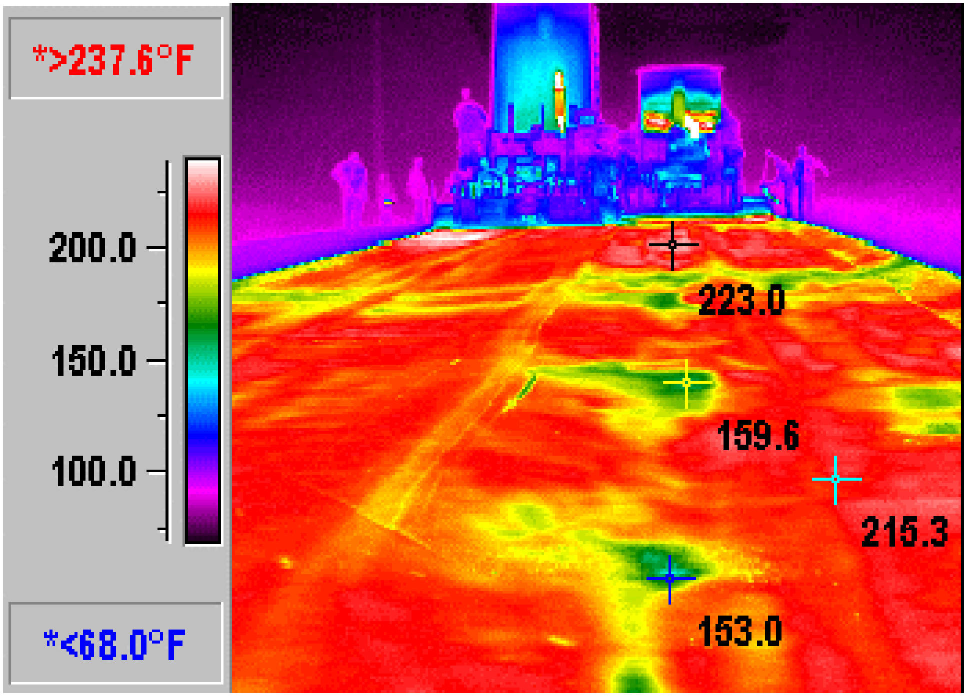
PaveIR Scanner (2015)



Tarped vs Not Tarped



Cold Spots - Infrared vs Photo



Glenn Hwy Incentive

- Pay a $75 Bonus for each 150’ segment with No Thermal Segregation (0-25^0 F variation)
- 2140 each 150’ segments = $160,500 potential bonus on 15 miles of 4 lane highway

No Incentive

- No bonus for 150’ segments with Moderate Thermal Segregation ($25-50^{0}$ F)

Penalty or Disincentive

- $75 Penalty (not used on Glenn Hwy) for each 150’ segment with Severe Thermal Segregation (>50^0 F)
- Only used the Carrot☺

Pave IR Rewards Good QC

- Pave IR is an objective tool for rewarding best practices such as:

1. Tarping all loads
2. Steady delivery of material to project with a minimum number of paver stops
3. Tying loads together when dumping
4. Use of Material transfer vehicle to homogenize temperature and smooth material flow to paver

PaveScan RDM (2017)

PaveScan RDM

- PaveScan Rolling Density Meter Provides:
  - Geo-located Data
  - 400,000 pulses per second processed with equivalent time sampling to produce 60 scans/sec
  - 60 scans (dielectric readings) per second recorded to Raw Data File
  - =10 Dielectric readings per foot of travel at 6 ft/sec (~ 4 mph walking speed) per antenna

What is Dielectric?

- Related to Speed of RADAR through a Material

$$e = C^2 / V^2 \quad \text{or} \quad V = C / \sqrt{e}$$

Where: V = Speed of RADAR in material

C = Speed of light in a vacuum

e = Dielectric

Relative Speeds of RADAR

RADAR is fastest in Air e = 1

RADAR is slowest in Water e = 81

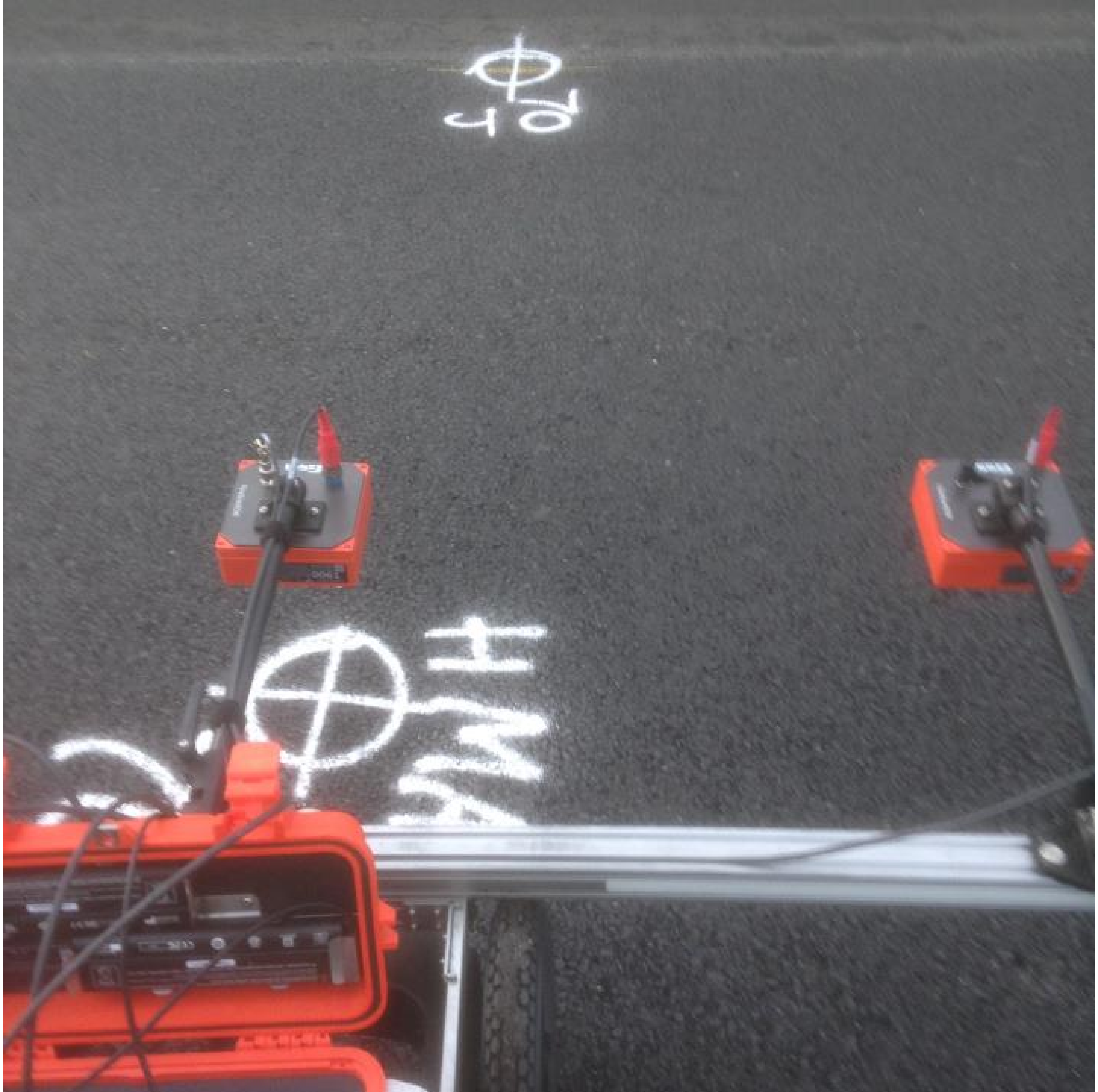
Asphalt Concrete e = 4 to 7

(note more air gives lower dielectric, i.e. RADAR passes through porous asphalt faster)

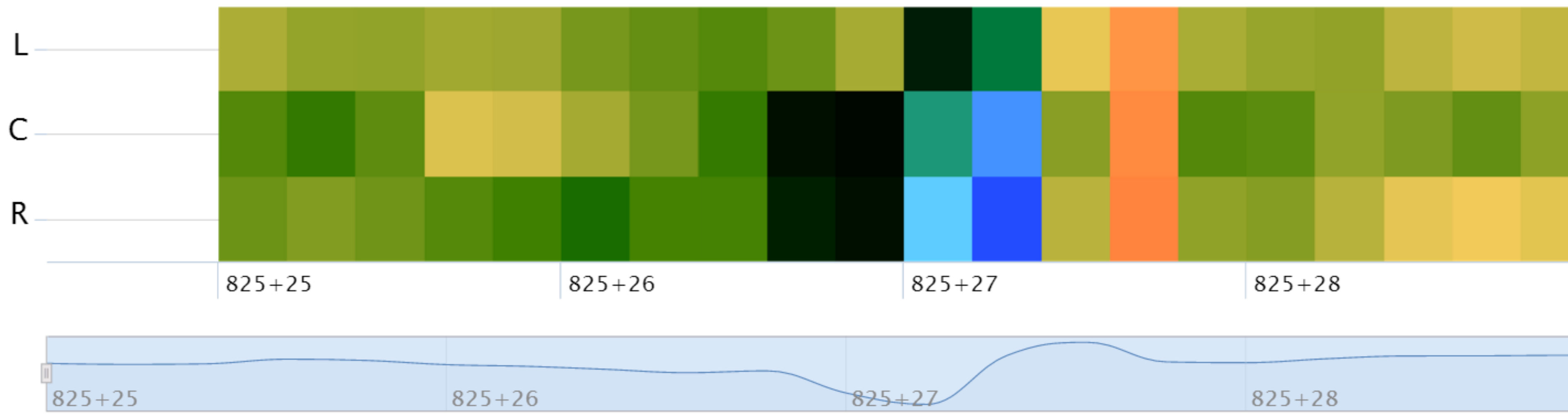
LOW DIELECTRIC = LOW DENSITY

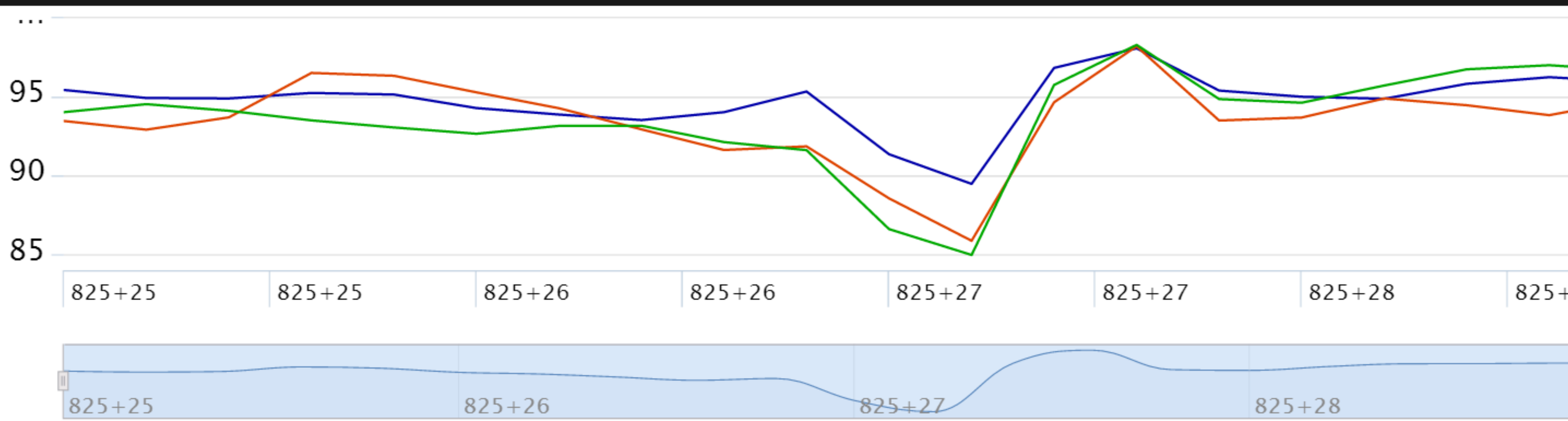
What can we "SEE" with GPR?

- Answer: Defects we have never "SEEN" before
- For example, density variation across a longitudinal joint

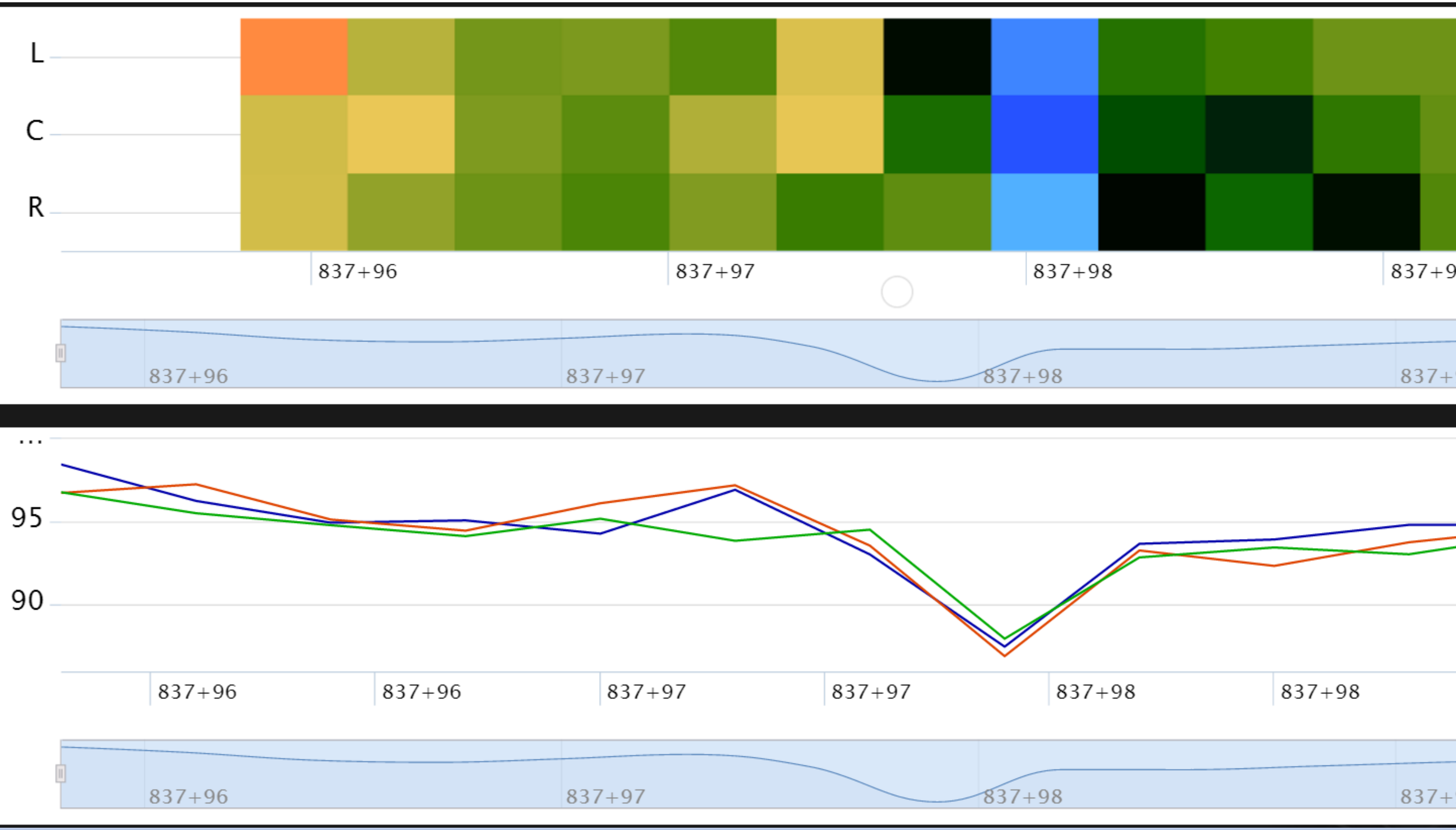


Core 70J (91.7%) – Resolution 0.25 ft

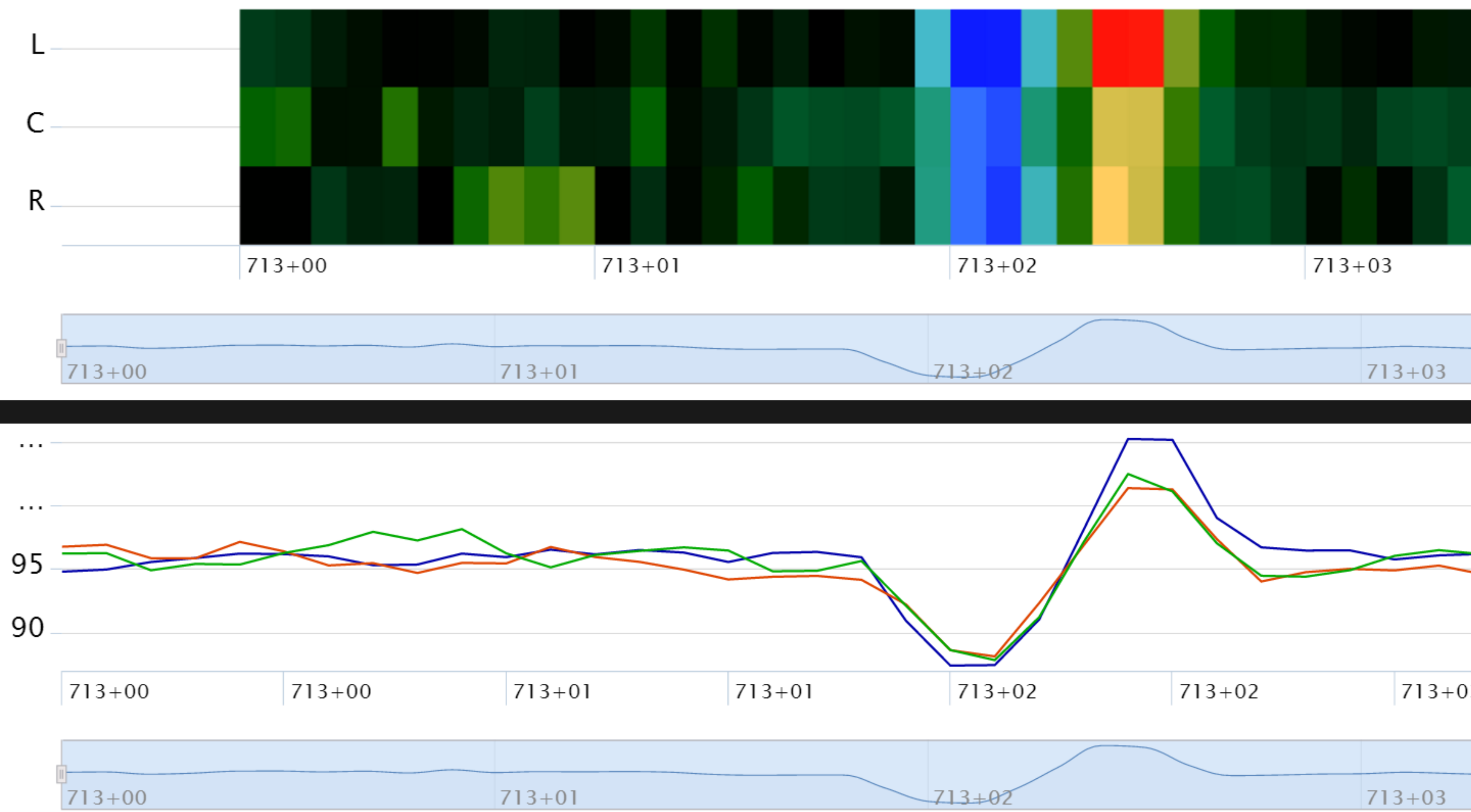




Core 69J (92.9%) – Resolution 0.25 ft



Core 87J (94.9%) – Resolution 0.10 ft



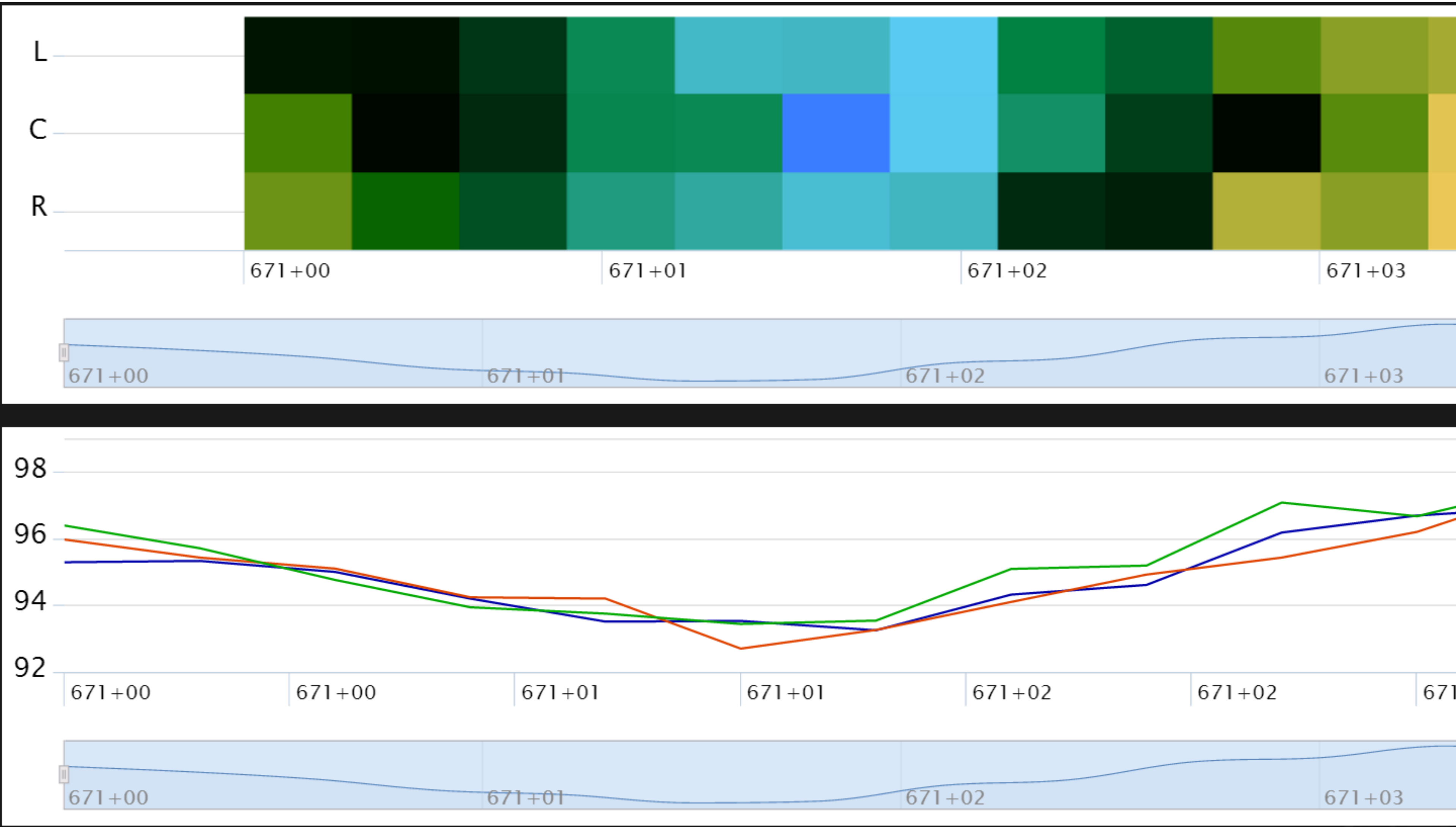
Core 87J – Distance Statistics

Sensor Position	Total Dist	Median	Average	Min	Max	Standard Dev
Center	4.2	95.2647	95.2054	88.1275	101.343	2.28774
Left	4.2	96.161	95.9437	87.4141	105.199	3.10059
Right	4.2	96.0255	95.6037	87.8418	102.452	2.49736

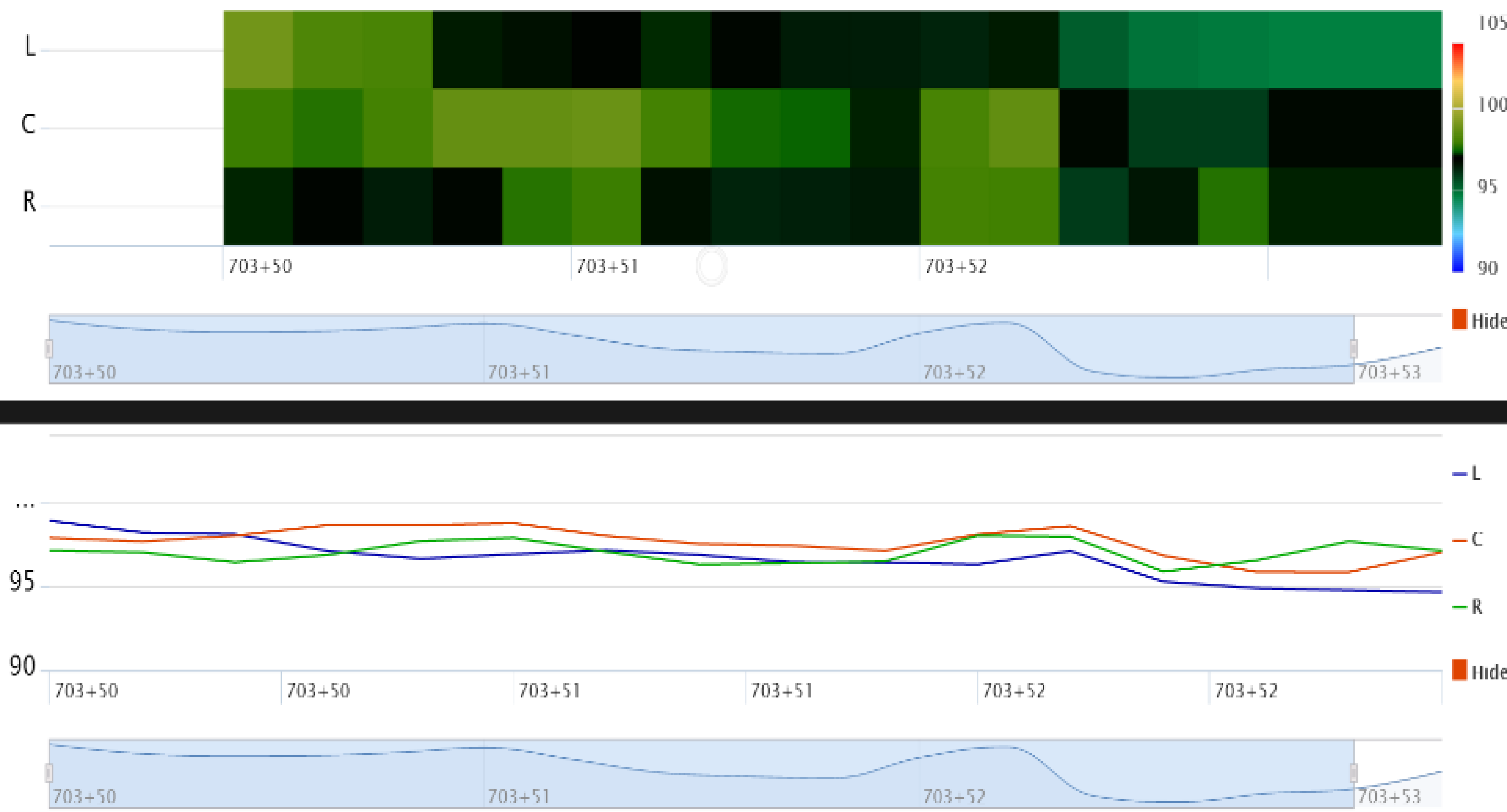
Core 87J – Time Statistics

Sensor Position	Total Dist	Median	Average	Min	Max	Standard Dev
Center	1269	87.8607	87.8692	86.8951	88.8963	0.306642
Left	1269	86.557	86.5422	84.4503	87.6718	0.34858
Right	1269	88.985	88.9778	87.8945	90.2777	0.352063

Core 85J (92.4%) – Resolution 0.25 ft



Calibration Core 19J (96.2%) 0.25 ft

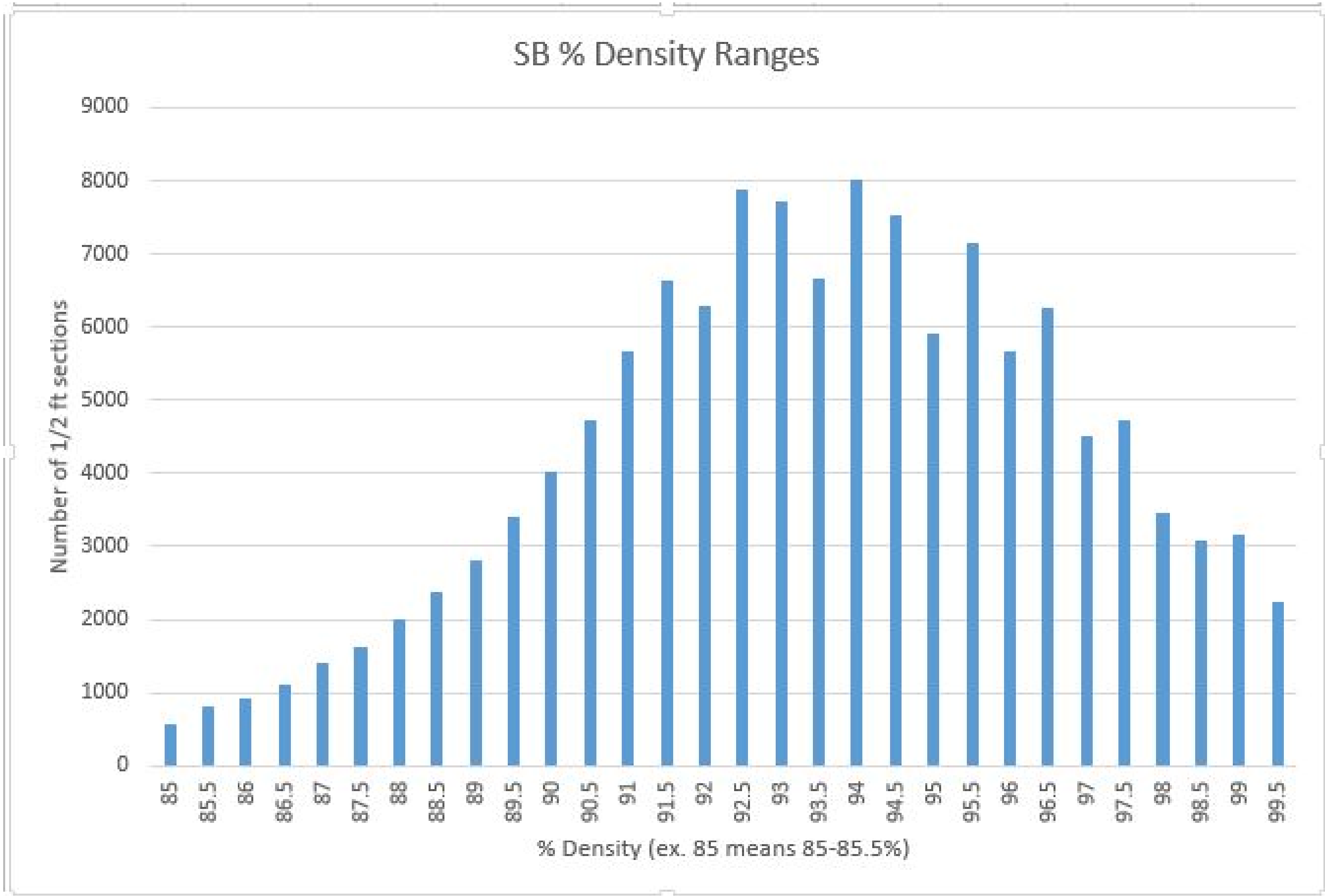


Longitudinal Joint at Core 19J

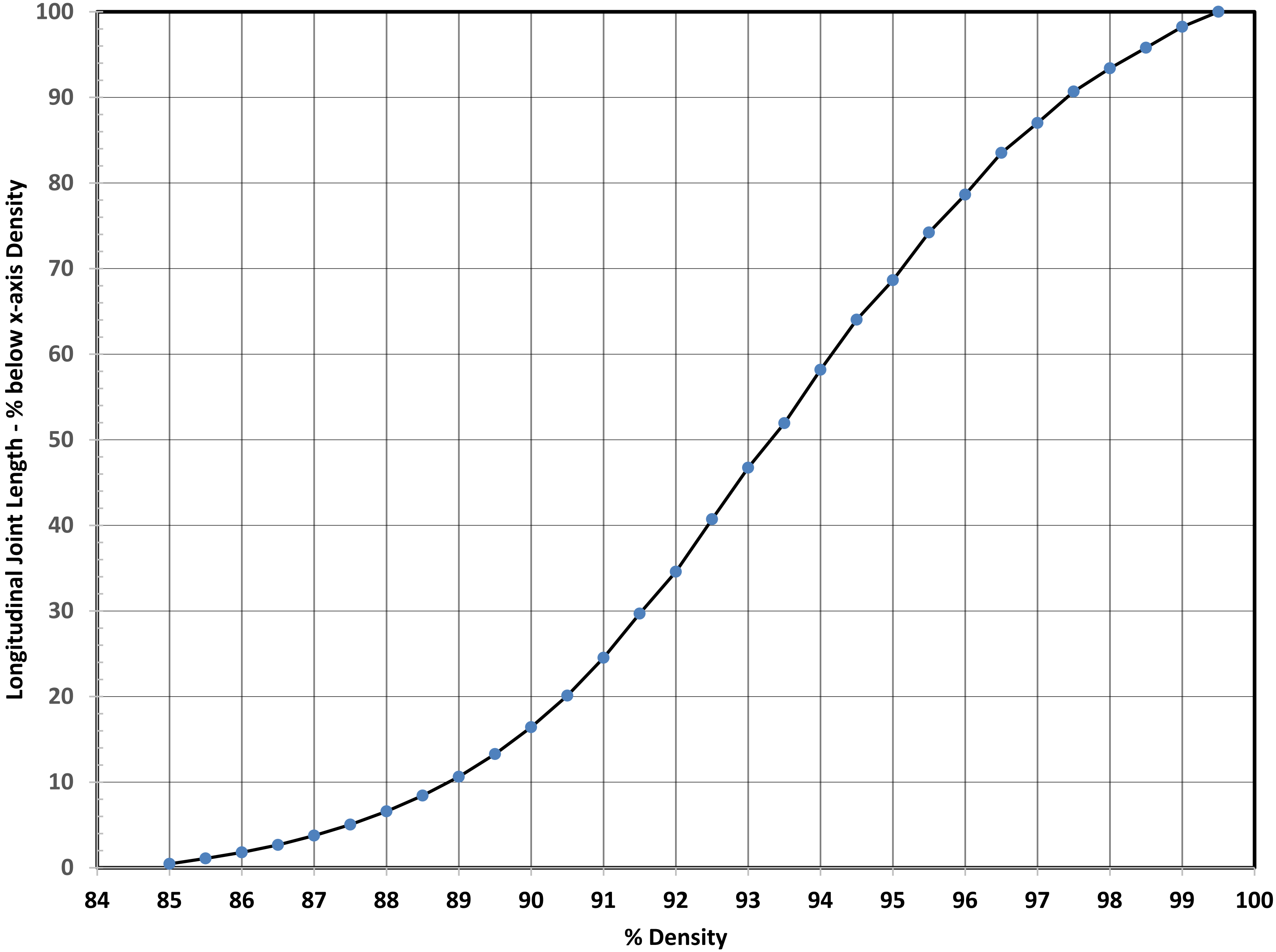
165 Core Densities: 90.9 to 97.8%

Compaction Summary - 2017 Data		
	% Compaction	
	Bulk/MSG	Bulk/MSG
	Panel	**Joint**
SB-L1 Average Panel Density (20 Cores)	94.8	
NB-L1 Average Panel Density (17 Cores)	95.4	
SB-L2 Average Panel and Joint Densities (33 Cores)	94.9	94.1
SB-L3 Average Panel and Joint Densities (3 Cores)	95.5	93.4
NB-L2 Average Panel and Joint Densities (28 Cores)	94.7	95.0
Project Averages	**94.9**	**94.5**
Max	97.6	97.8
Min	92.3	90.9
Note:		
50 of 101 (50%) of Panel Cores 95.0% or Higher		
26 of 64 (41%) of Joint Cores 95.0% or Higher		

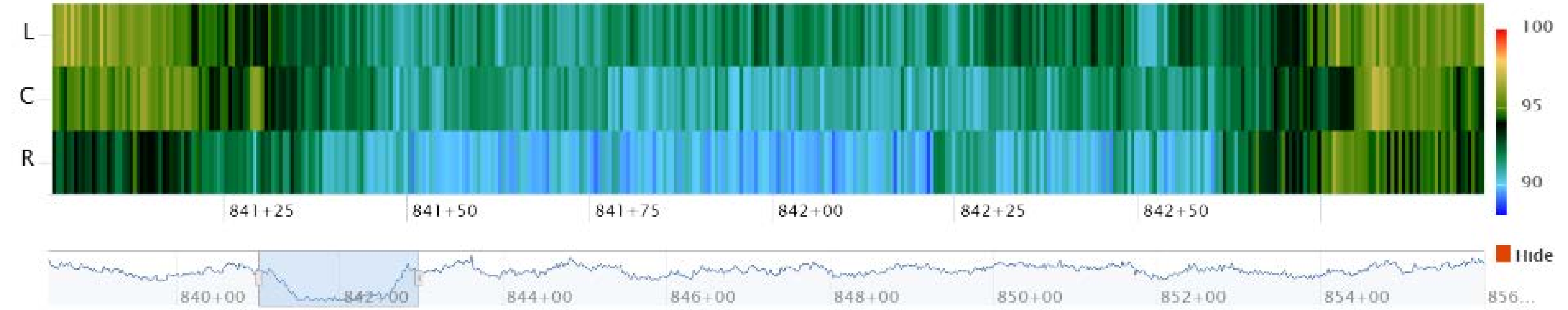
SB(Joint CL) Density Histogram

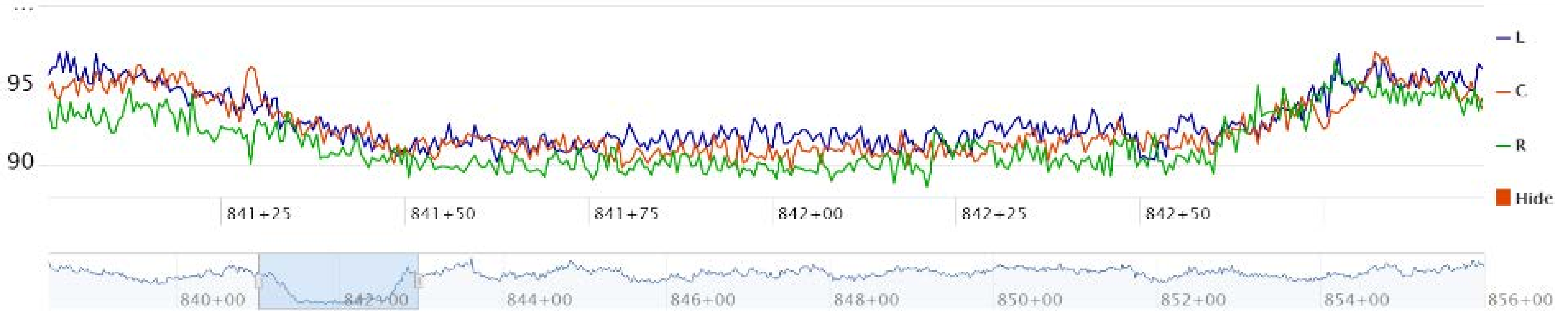


SB Joint Cumulative Densities - 24.5% below 91%

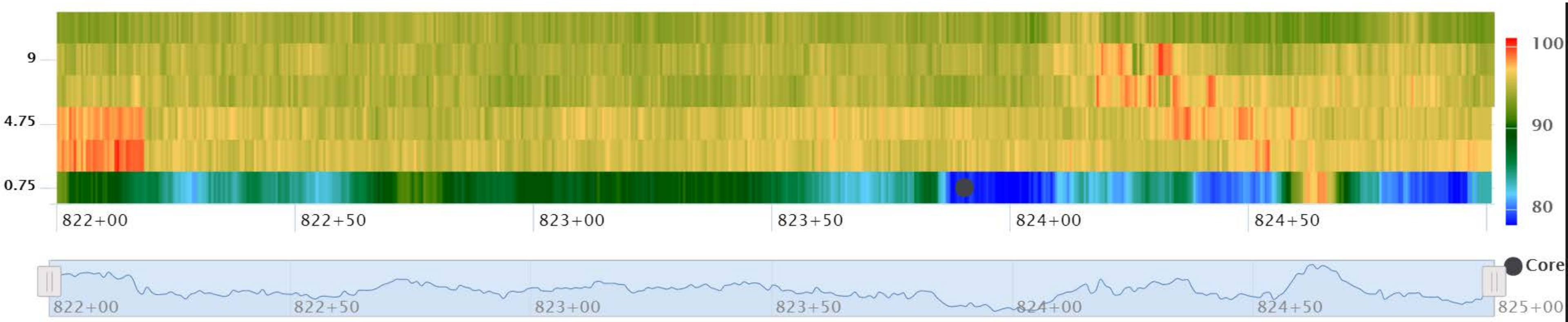


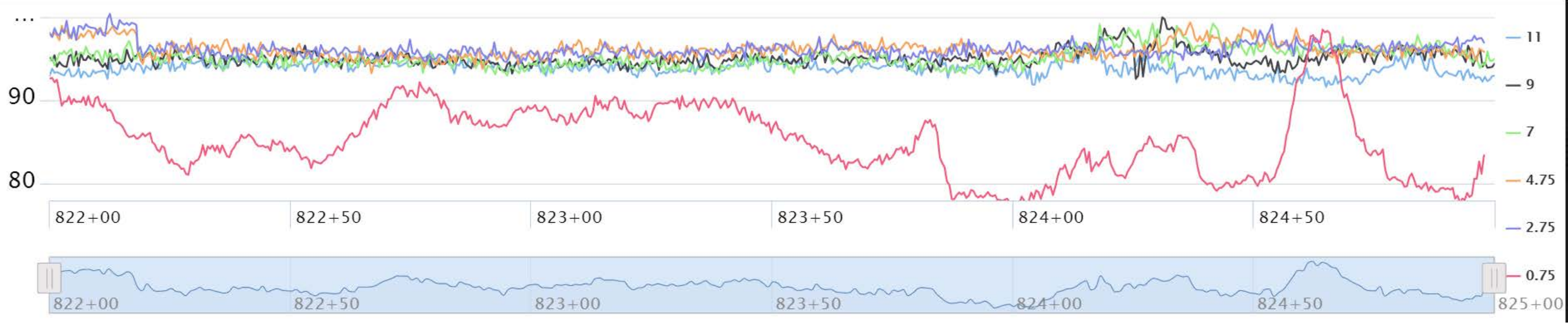
Low Density is Typical at Bridges S. Birchwood Bridge, SB Lane 2, 18-24' LT



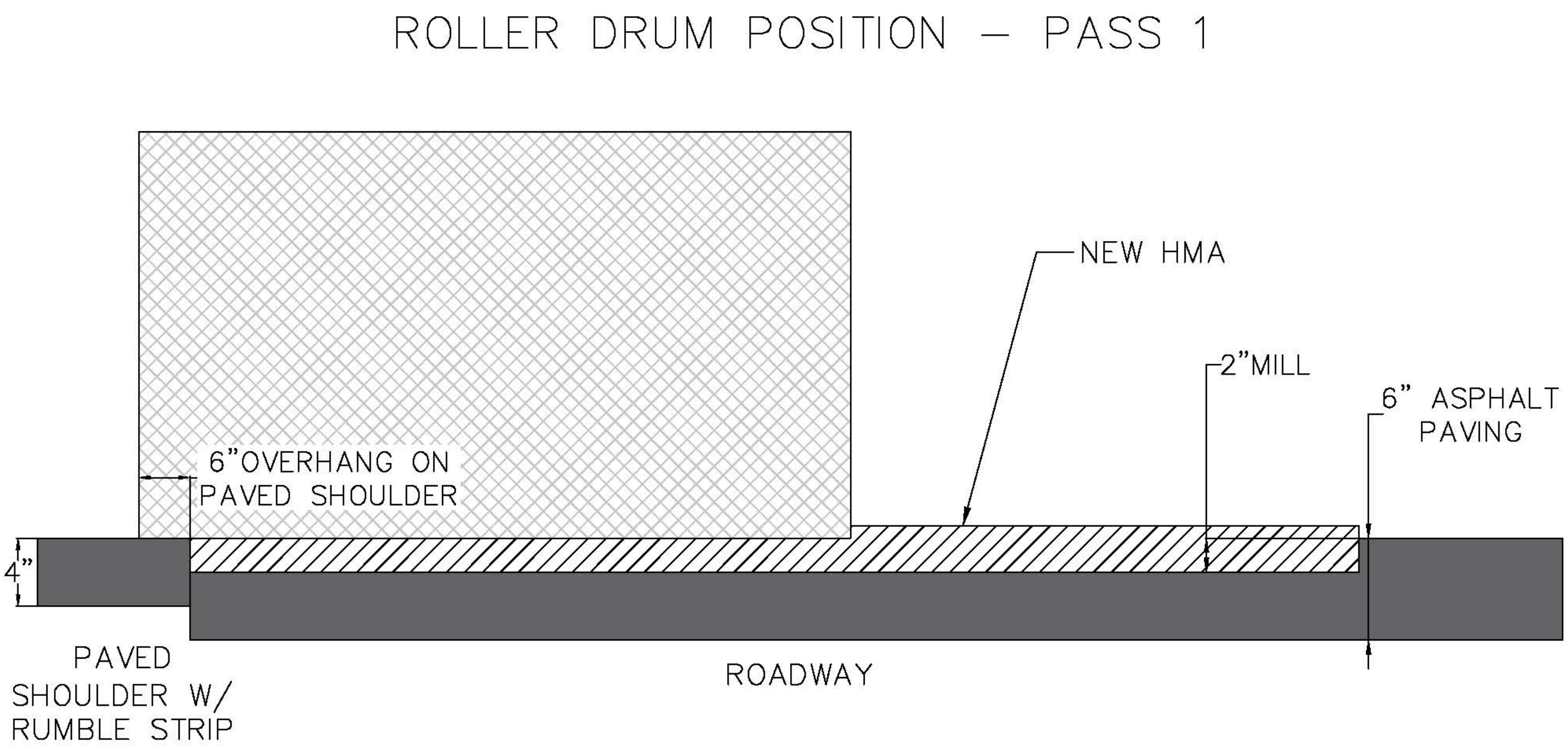


Low Density Adjacent Rumble Strip

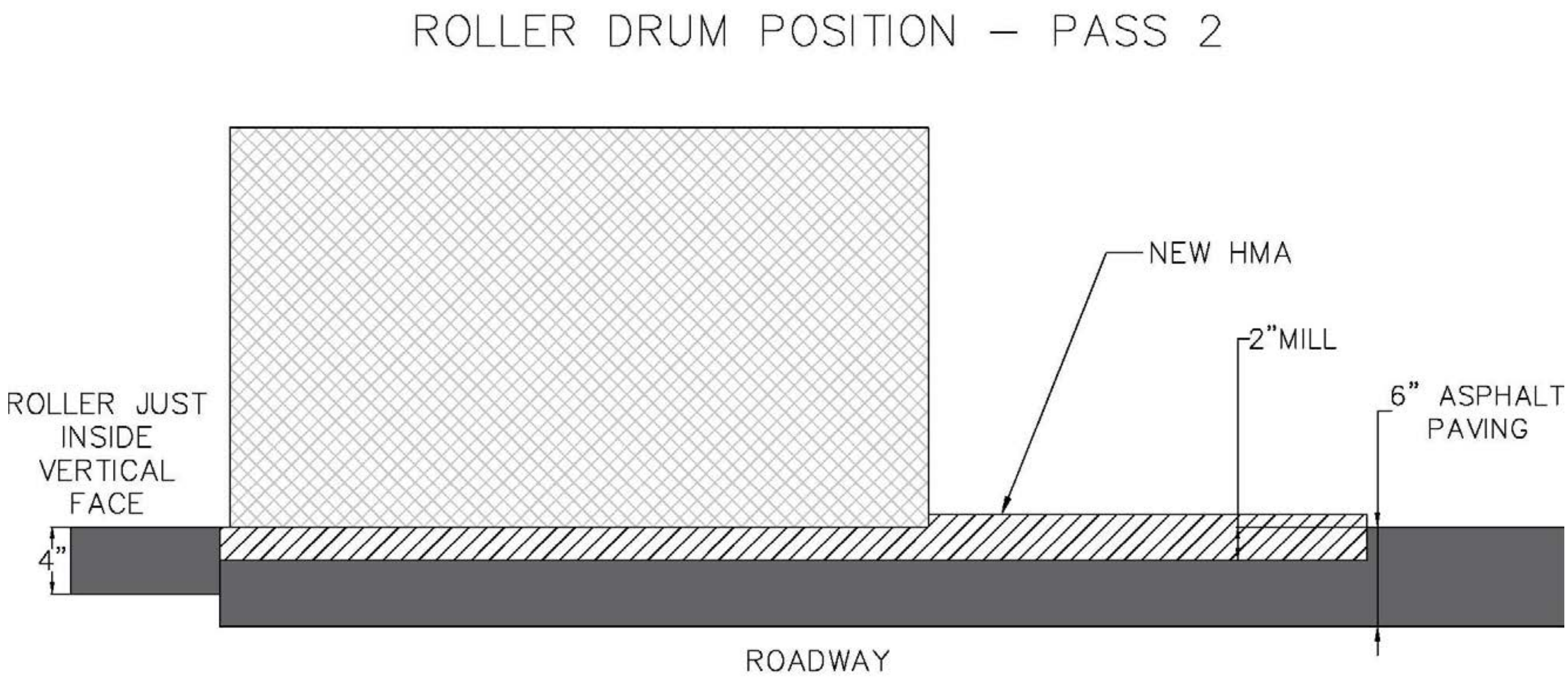




We don't want a "Pretty" edge joint



We Want a “Compacted” edge joint



STIC Mat Density Target

- Mat density target is 96.0% MSG matching typical mix design done at 4% air voids
- Minimum Specification Level for mat density is 93.0% MSG, mat area below that value will require remediation
- Proposed PWL Mat density incentive: Pay Factor = 0.55 + PC/200, where PC is % conforming to ≥93% MSG

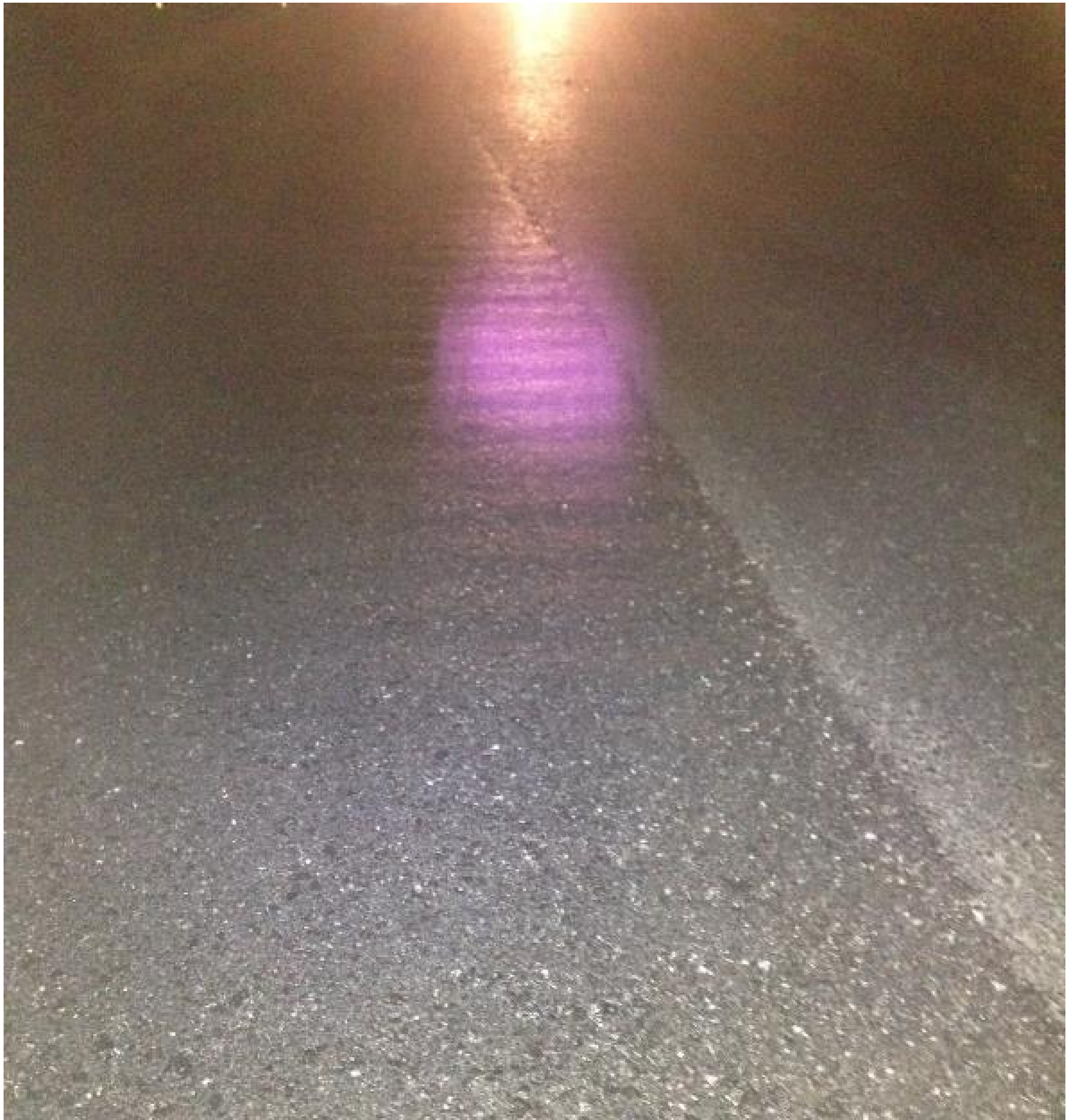
STIC Joint Incentive

- Lot incentive of $0.05 per lineal foot for each 0.1% above 92.0% up to a maximum incentive of $2.00 per lineal foot for achieving an average joint density of 96.0%

What equipment might one see when incentives are given for superior joint compaction?


16-8527
E650

What you don’t want to see



Exporting Defects to Maps


Portage Glacier Road
File 008 Area Defects
Legend
Area Defect
Feature 1
Linear Defects
Portage
Portage Glacier Cafe and Gallery
Google earth
Image © 2018 DigitalGlobe
© 2018 Google
Image Municipality of Anchorage
N
4000 ft


Portage Glacier Road
Linear Defects - Longitudinal Joint
Legend
Area Defect
Feature 1
Linear Defects
Portage
Portage Glacier Cafe and Gallery
Google earth
Image Municipality of Anchorage
1000 ft
N


Portage Glacier Road
Linear Defects - Longitudinal Joint
Legend
Area Defect
Feature 1
Linear Defects
Portage
Portage Glacier Cafe and Gallery
Google earth
© 2018 Google
Image Municipality of Anchorage
N
100 ft

REPAIRING DEFECTIVE JOINTS

- If more than 5% of joint density readings are below 92.0% within any station (100’ segment) then that station will require repair with application of joint sealant.


Portage Glacier Road
Sta. 191-181, 11-17' Right
Area defects
Legend
Area Defect
Portage
Portage Lake & Byron Glacier -Portage Valley AK 6-20-2010
Google earth
Image Municipality of Anchorage
N
200 ft

REPAIRING DEFECTIVE AREAS

1. Apply Sand Seal to the mat of an entire lane station that contains low density (Bulk density less than 92.0% of MSG) areas that are small (less than 8 ft^2), discontinuous, and total more than 2% of a lane station area [(2%)(12’x100’) = 24 ft^2]

2. Apply Sand Seal to the mat of an entire lane station that contains a large (equal to or greater than 8 ft^2) contiguous low density area

Number and % Defective – File 001

Station	Starting Distance	Segment (ft)	% Defective	# of 2-D Defects	Defect Straddles Segments
181	0	89.5	4.07	1	No
182	0	100	10.95	2	No
183	0	100	3.65	0	No
184	0	100	0.17	0	No
185	0	100	15.92	3	Yes
186	0	100	16.09	2	Yes
187	0	100	51.08	3	Yes
188	0	100	62.02	1	No
189	0	100	32.84	2	Yes
190	0	100	31.51	5	Yes
191	0	0	33.33	0	No

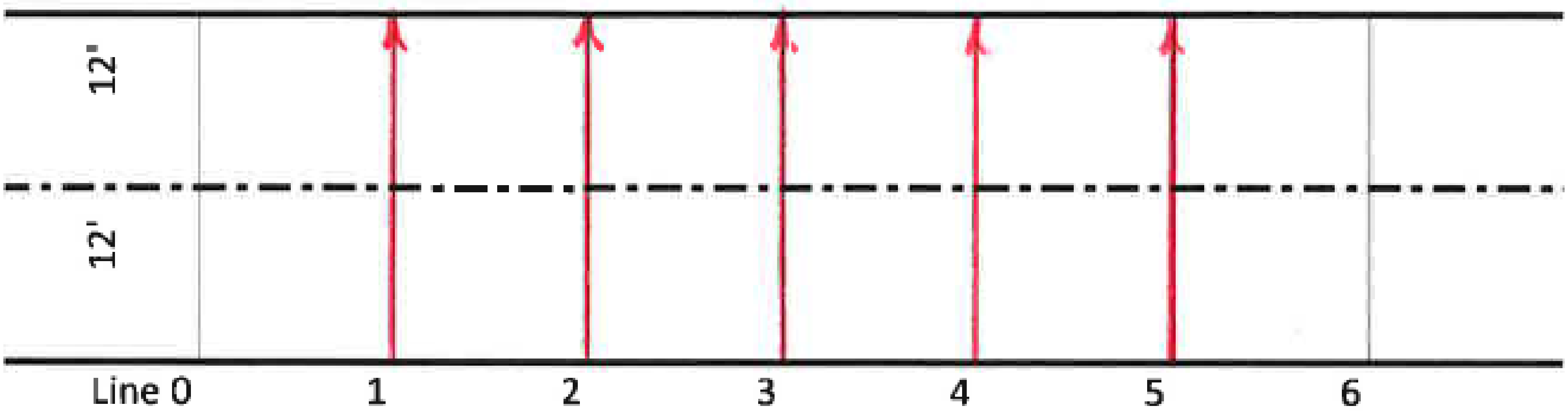
Defect Locations – File 001

Starting Station	Start Distance (ft)	Ending Station	End Distance (ft)	Start Offset (ft)	End Offset (ft)
181	11.75	181	15.75	17.75	15.75
182	48.25	182	52.75	17.75	15.75
182	65.25	182	73.75	17.75	15.75
185	62.75	185	73.25	17.75	15.75
185	73.75	185	91.75	17.75	15.75
185	97.75	186	2.25	17.75	15.75
186	80.25	186	86.75	17.75	15.75
187	6.25	187	14.25	17.75	13
187	16.75	187	21.25	17.75	13
187	22.75	189	93.25	17.75	13
189	96.75	190	7.25	17.75	15.75
190	8.25	190	17.75	17.75	15.75
190	18.25	190	42.75	17.75	13
190	49.25	190	89.25	17.75	13
190	91.25	190	95.75	17.75	15.75

Portage Glacier Rd - Sta 139-144

Antenna Validation w/Mat Data

Cart Path for Antenna Check



Plan for collecting Antenna Verification Data

Center Antenna on Lines 1-5

Antenna check:

Left - #60	Center - #61	Right - #63	Average Values

3 Antenna Overlap lines (Lines 2–4)

	Line 0	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Run 1			5.31				
Run 2			5.22	5.31			
Run 3			5.19	5.21	5.27		
Run 4				5.24	5.18		
Run 5					5.16		
		High	5.31	5.31	5.27		
		Low	5.19	5.21	5.16		
		Delta	0.12	0.09	0.11		

Left - # 60 Lines 2, 3, 4, Average =	5.20
Center - # 61 Lines 2, 3, 4, Average =	5.21
Right - # 63Lines 2, 3, 4, Average =	5.29
High	5.29
Low	5.20

Delta 0.09 **FAIL** < 0.08 is Passing

Antenna check:

1. Before beginning data collection, set the antennas at the spacing to be used for that day.
2. Make certain that antenna check area is protected by traffic control.
3. Make 5 marks at the antenna spacing (2' is typical) along the antenna check area.
4. Layout 5 equal length parallel lines transverse to the paving direction across one or more newly paved lanes.
5. Snap a chalk line, or otherwise mark, the 5 parallel lines so they are easy to see. Also mark both ends.
6. Name a file "Anenna Check" and set offset equal to "0".
7. Position PaveScan with center antenna right at the marked starting point of Line 1.

Note: Left antenna will be on Line 0, right antenna will be on Line 2 (see graphic).

8. Collect distance file across lane. Stop right at the marked end point and save data.
9. Increase file offset setting by 2 feet or the antenna spacing selected for that day.
10. Back up and index over to the right one Line such that the center antenna is now on Line 2, (right antenna will be on Line 3).
11. Repeat this procedure until center antenna has travelled on Lines 1-5.
12. In walk mode dielectric reading variations among the three antennas should be within ± 0.08

(If variation is greater than ± 0.08 then recalibrate the PaveScan RDM with new Air and Metal plate readings.)

13. Repeat this antenna check at the end of data collection each day.
14. Compare antenna reading variation between beginning and end of data collection to assure validity of data.

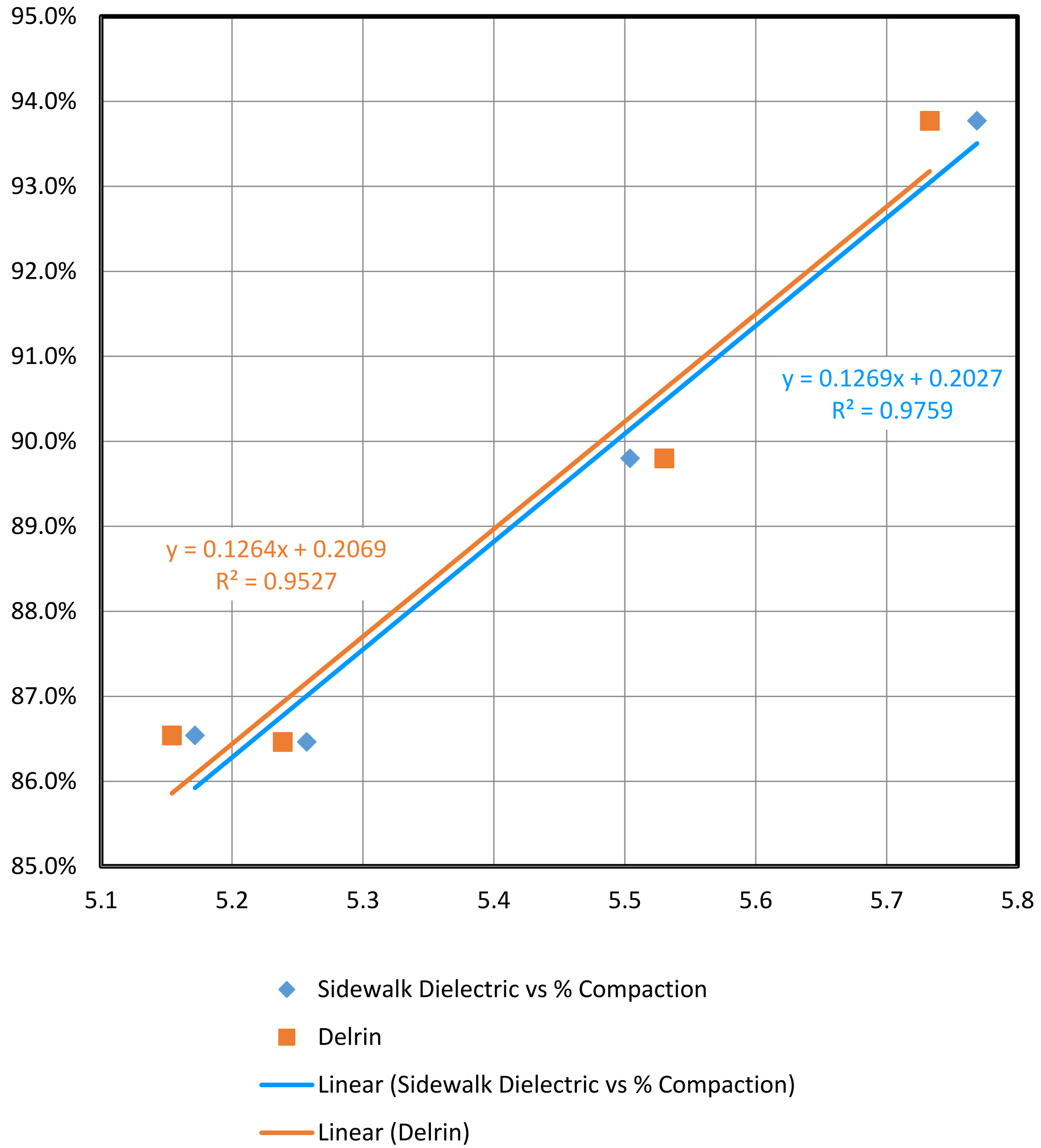
(Dielectric reading variations among the three antennas should remain within ± 0.08)

Lab Calibration w/Delrin Blocks, Metal Plate and Field Cores

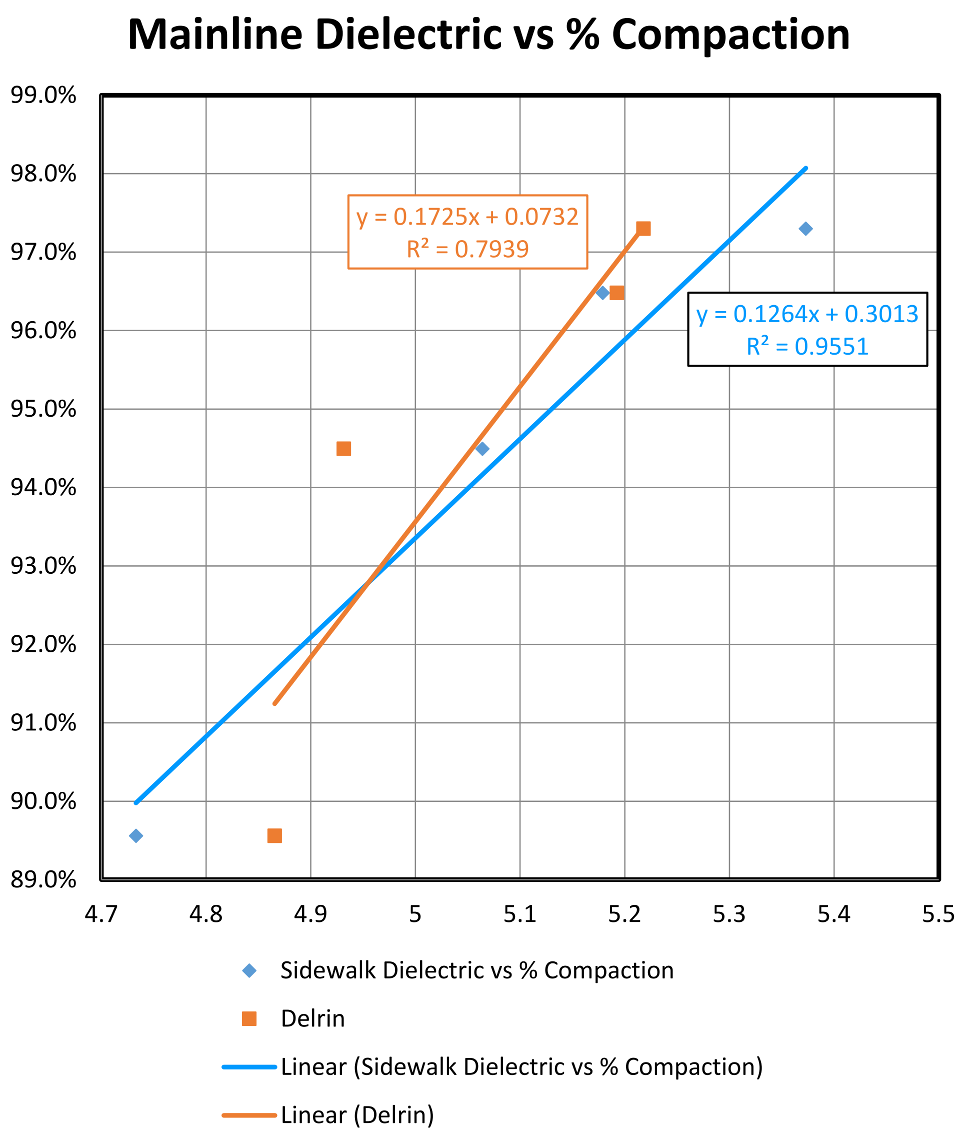

GSSI
PaveScanRDM
ASCENT


PaveScanRDM
0061
IMPORTANT:
Plate Care
1. Keep this side clean and free of scratches.
2. Do not bend, stand or drive on.
During Calibration
1. Ground surface must be smooth, flat and free of debris.
2. This side up with this edge closest to mount arm. Sensor centered +/- 1".
3. Do not move sensor while a calibration measurement is in progress.
Panasonic FZ-G1
TOUGHPAD
Surface Measurement
PaveScan
Cancel
DELL

Calibration with Field Cores



Calibration with Field Cores



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