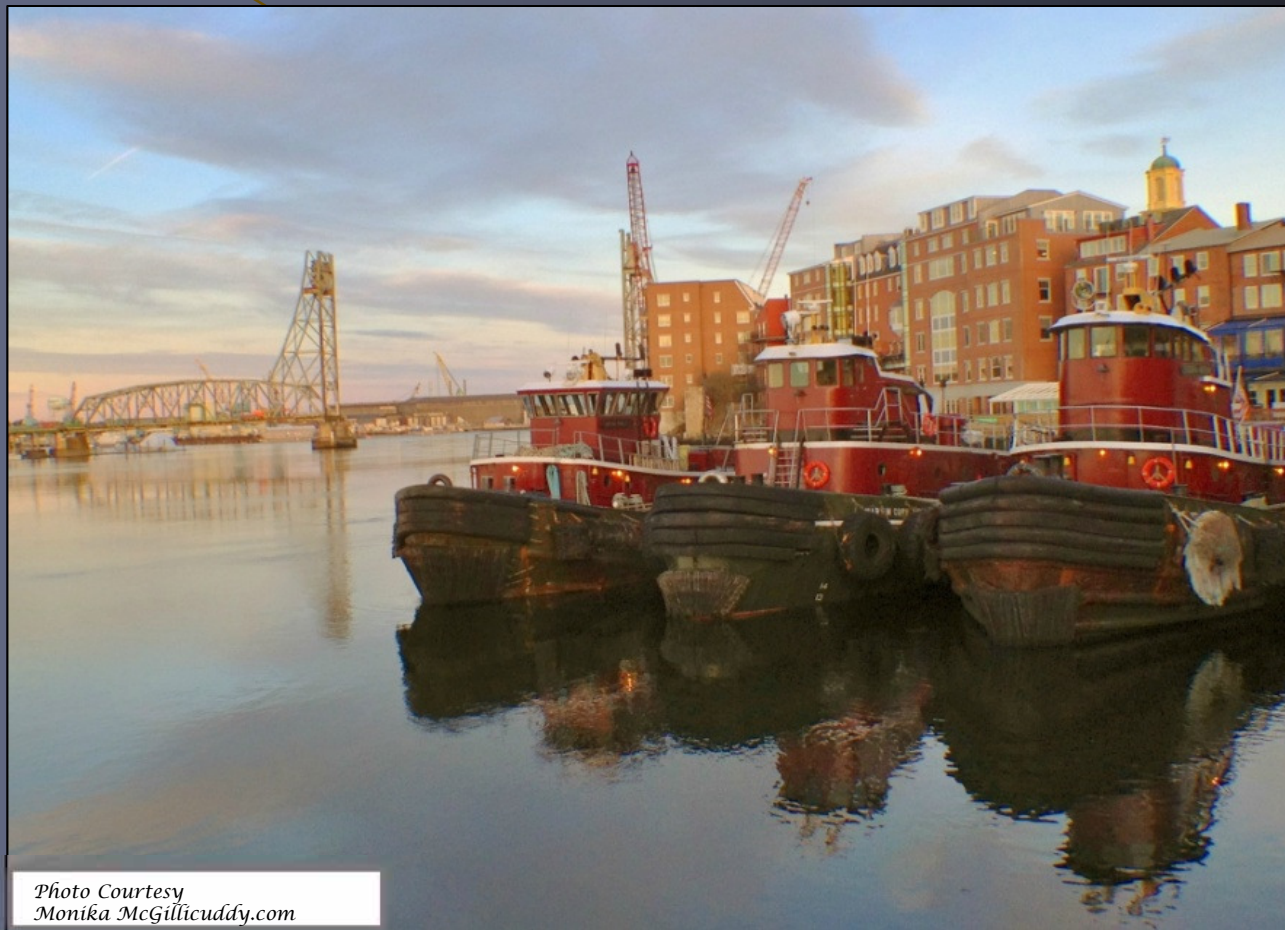


# *Measuring In-Place Density of New Roadway Pavements in Connecticut*

*NESMEA 2013 – Portsmouth NH*



*Photo Courtesy  
Monika McGillicuddy.com*

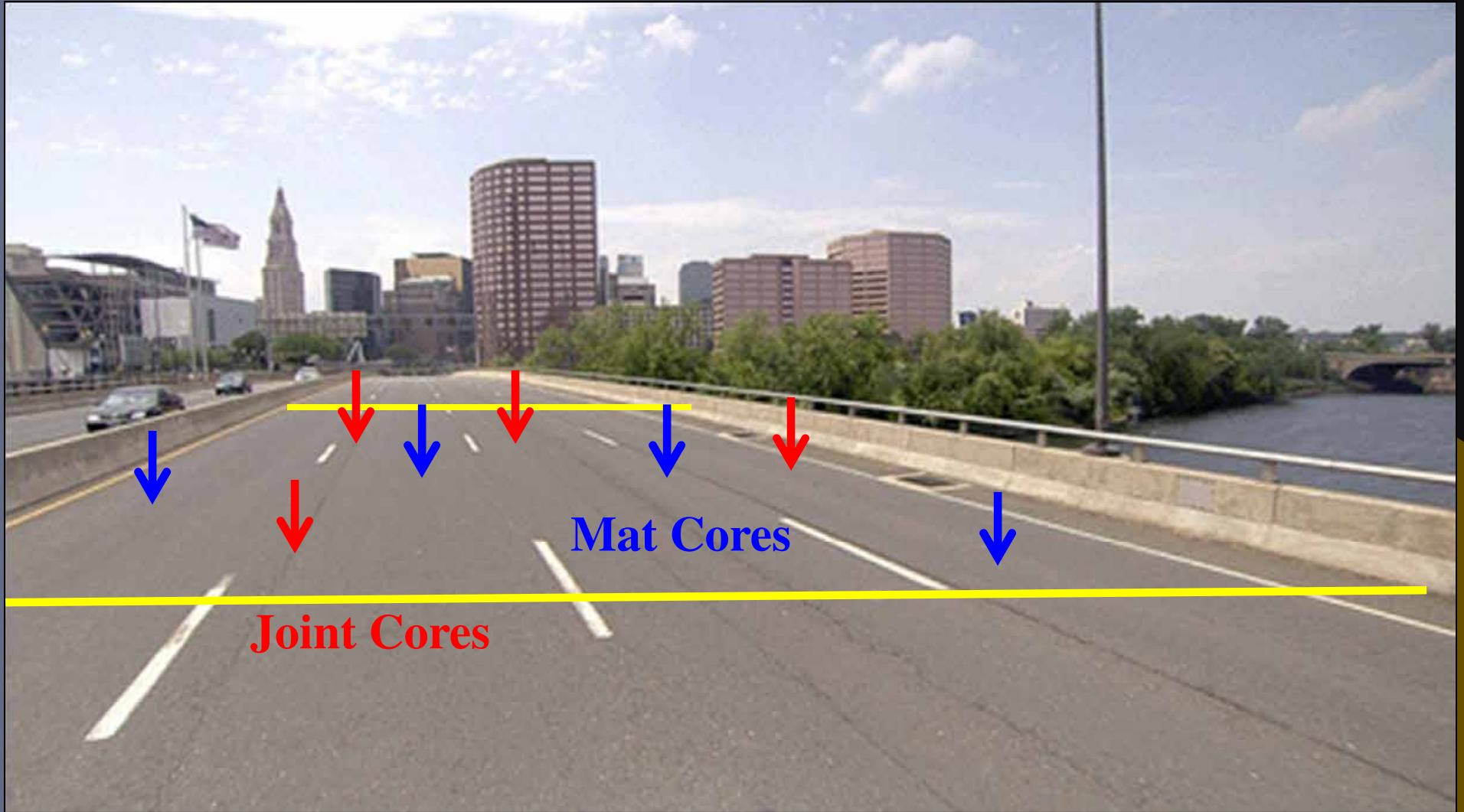


# Connecticut HMA Pavements

- 3719 miles State maintained roads (20% of total).
- 1.2 million tons HMA placed in 2012.
- In-place density is measured for all lifts designed to be 1.5” thick or more.
- 4838 Core Samples in 2012.
- Use of 15% RAP is typical.
- AASHTO T-331 “...Automatic Vacuum Sealing Method” is used to determine density.



# Lot limits - sample locations

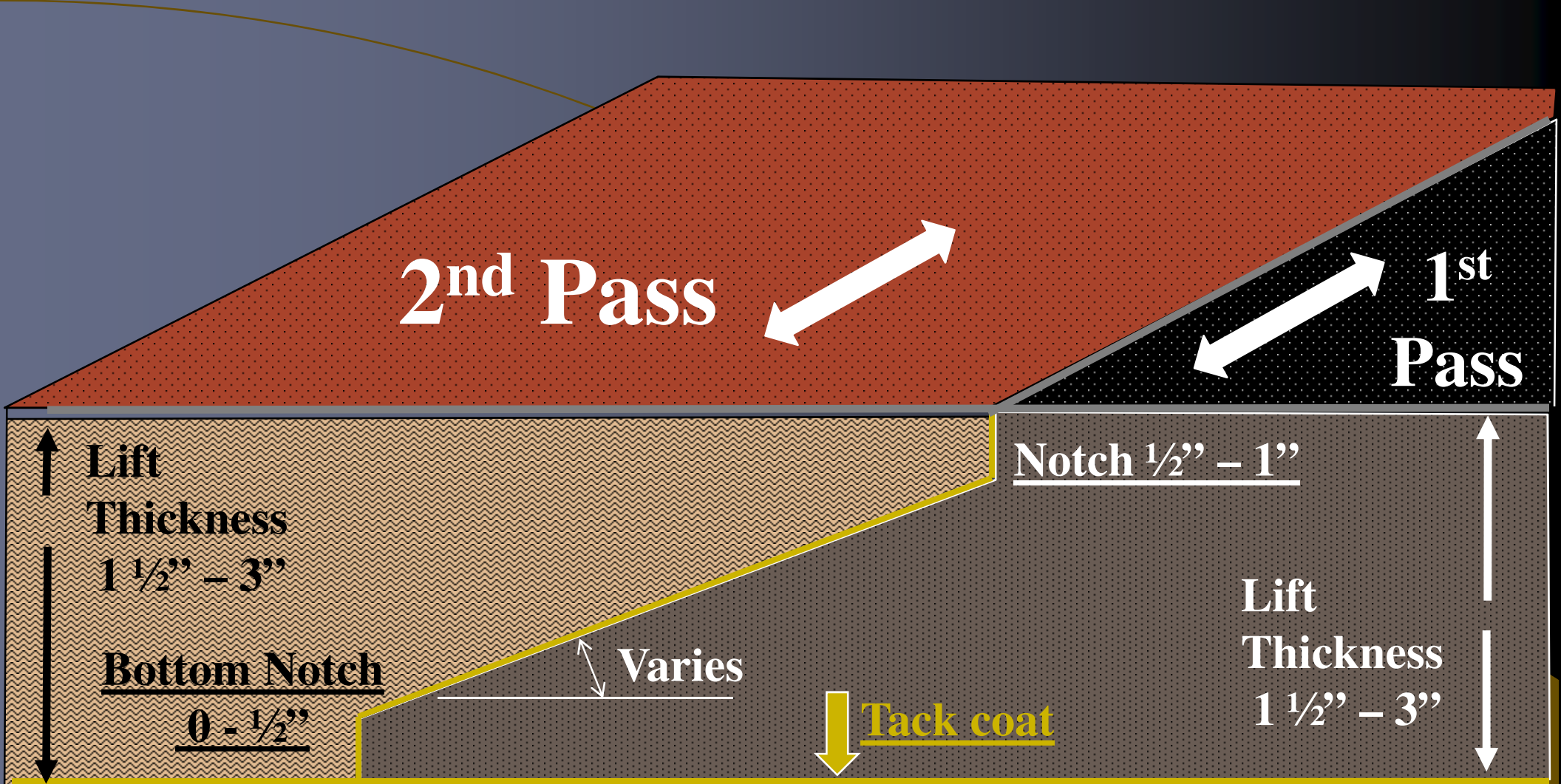


# Lot types

- **Roadway**
- **Bridge**
- **Combination** (for 2013)
  - *Roadway and Bridge <500'*

# Notched Wedge Joint





8" - 12" Taper

# Notched Wedge Joint



JOINT Core



08/30/2013

Visible edge of notched wedge joint



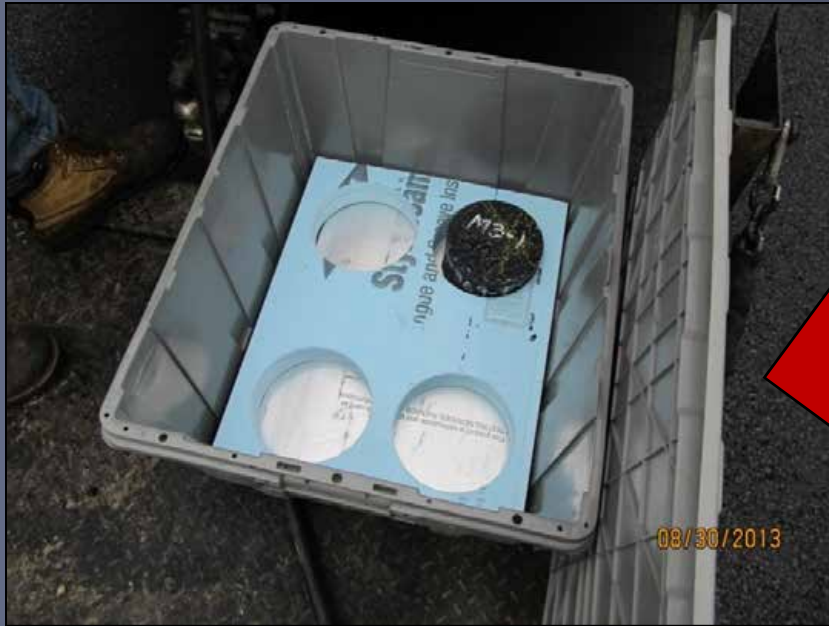
# Core Removal and Labeling





# Core Transport and Documentation

Project



Laboratory



# Core Receiving and Sorting



# Core Sorting and Storage



Secured cores ready for testing



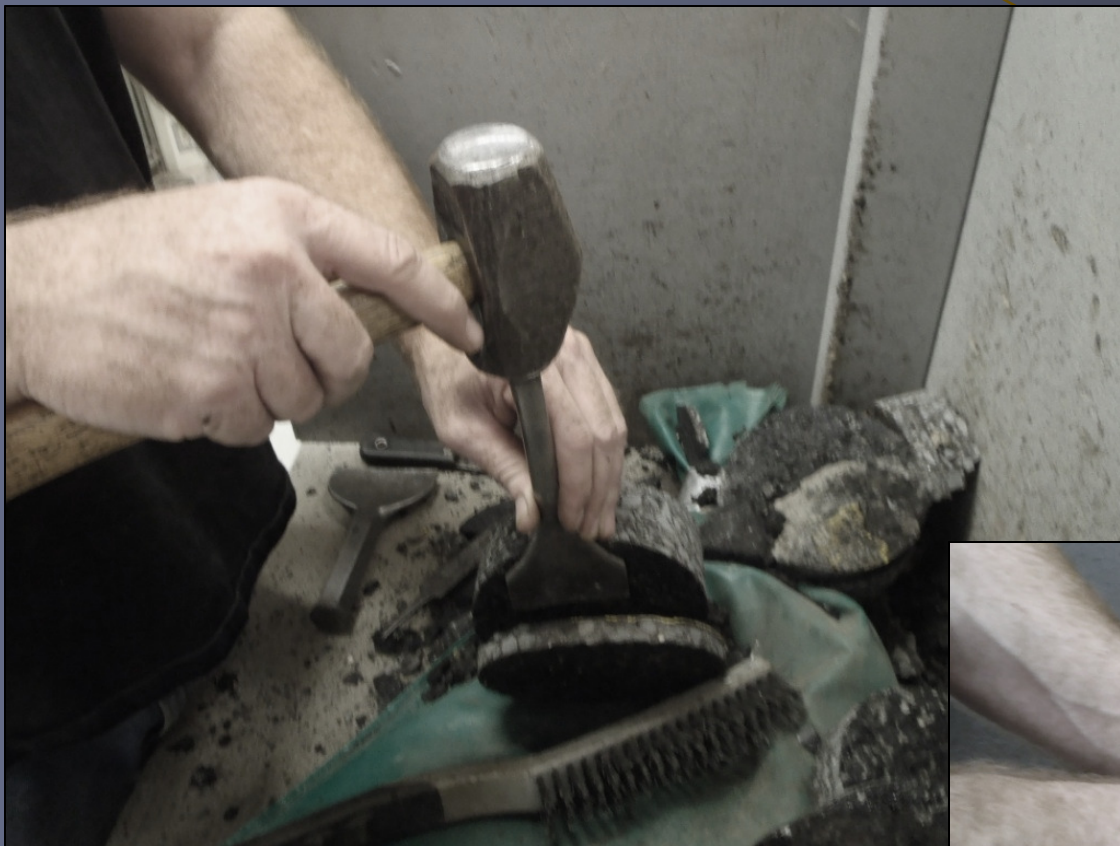
Cores stored after testing



# Core Preparation



# Core Preparation



# Core Sawing



# Core Drying and Sealing



# Density Results per Lot

PROJECT		171-364G3		LOT #		5									
ROUTE		I-84 <th colspan="2">MIX</th> <td colspan="2">W0.5 (4058)</td>		MIX		W0.5 (4058)									
TOWN		Manchester		LEVEL		3									
DISTRICT NO.		1		HMA PRODUCER		628									
PAVING CONTRACTOR		Tilcon				Tilcon Plainville									
<b>Pavement Density Adjustment Detail</b>															
<b>MAT DENSITY CORES</b>								<b>JOINT DENSITY CORES</b>							
AASHTO T-331 Bulk Specific Gravity and Density of Compacted HMA Using Automatic Vacuum Sealing Method	SAMPLE ID	BRIDGE NUMBER	DATE PLACED	THICKNESS (IN.)	BULK SPECIFIC GRAVITY	THEORETICAL GRAVITY	COMPACTION (%)	SAMPLE ID	BRIDGE NUMBER	DATE PLACED	THICKNESS (IN.)	BULK SPECIFIC GRAVITY	THEORETICAL GRAVITY	COMPACTION (%)	
	M5-1		9/22/13	2.000	2.446	2.669	91.6	J5-1		9/22/13	2.250	2.465	2.669	92.4	
	M5-2		9/22/13	2.000	2.470	2.669	92.6	J5-2		9/22/13	2.125	2.468	2.669	92.5	
	M5-3		9/19/13	2.500	2.524	2.671	94.5	J5-3		9/22/13	2.250	2.447	2.669	91.7	
	M5-4		9/19/13	2.125	2.590	2.671	97.0	J5-4		9/22/13	2.000	2.500	2.669	93.6	
AVERAGE LOT COMPACTION %							<b>93.9</b>	AVERAGE LOT COMPACTION %							<b>92.6</b>
MAT BONUS %							<b>1</b>	JOINT BONUS %							<b>1</b>
TONS ADJUSTED FOR DENSITY (T <sub>D</sub> )															
DENSITY ADJUSTMENT COST (T <sub>D</sub> x UNIT \$)															





# Dispute Resolution Results

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
39															
40															
41		<b>Dispute Resolution Adjustment</b>													
42		<b>MAT DISPUTE DENSITY CORES</b>						<b>JOINT DISPUTE DENSITY CORES</b>							
43		<b>SAMPLE ID</b>	<b>BRIDGE NUMBER</b>	<b>DATE PLACED</b>	<b>THICKNESS (IN.)</b>	<b>BULK SPECIFIC GRAVITY</b>	<b>THEORETICAL GRAVITY</b>	<b>COMPACTION (%)</b>	<b>SAMPLE ID</b>	<b>BRIDGE NUMBER</b>	<b>DATE PLACED</b>	<b>THICKNESS (IN.)</b>	<b>BULK SPECIFIC GRAVITY</b>	<b>THEORETICAL GRAVITY</b>	<b>COMPACTION (%)</b>
44	AASHTO T-331 Bulk Specific Gravity and Density of Compacted HMA Using Automatic Vacuum Sealing Method								J3-1D		7/28/13	2.375	2.339	2.673	87.5
45									J3-2D		7/28/13	2.000	2.454	2.673	91.8
46									J3-3D		7/23/13	2.250	2.388	2.670	89.5
47									J3-4D		7/28/13	2.375	2.271	2.673	84.9
48															
49					NEW AVERAGE LOT COMPACTION % (ALL 8 MAT CORES)							NEW AVERAGE LOT COMPACTION % (ALL 8 JOINT CORES)			<b>87.8</b>
50					MAT NOT DISPUTED							JOINT RESOLUTION DISINCENTIVE %			<b>-30</b>
51															
52															
53															
54															
55															
56															
57															
58															
59															
60															
61															
62															



# Pre-Recycled Core Samples



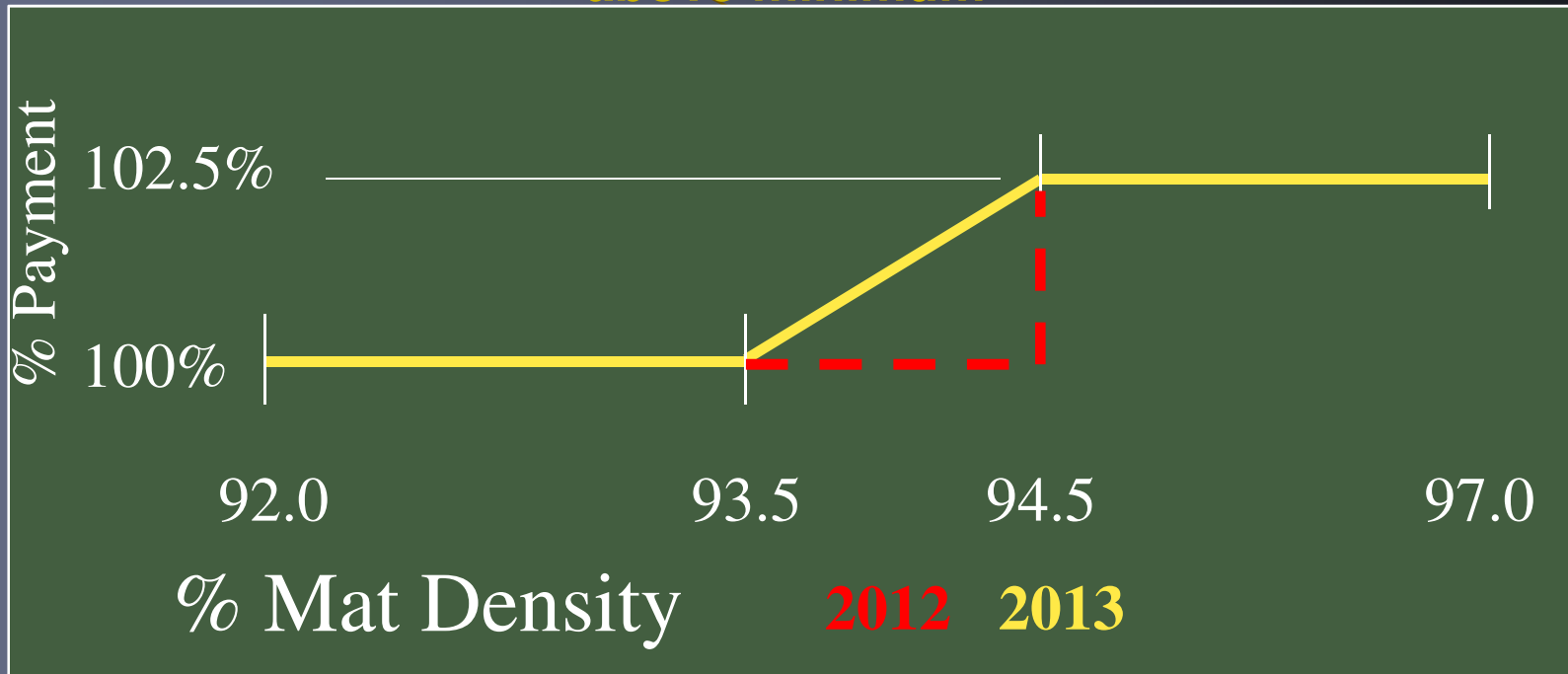
# Minimum Density Requirement Based on Maximum Theoretical Density

- 92 % on the Mat
- 91 % on the Joint



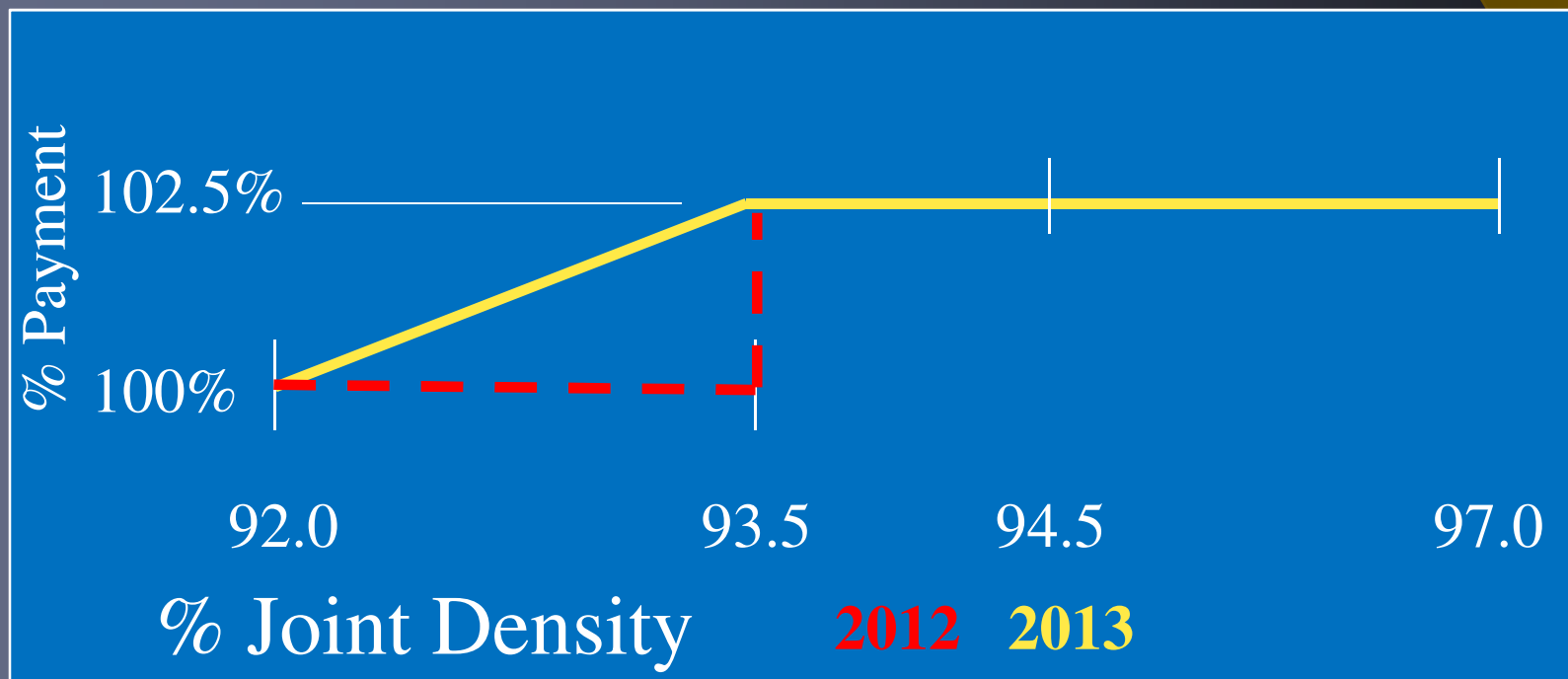
# Density Adjustments

above minimum



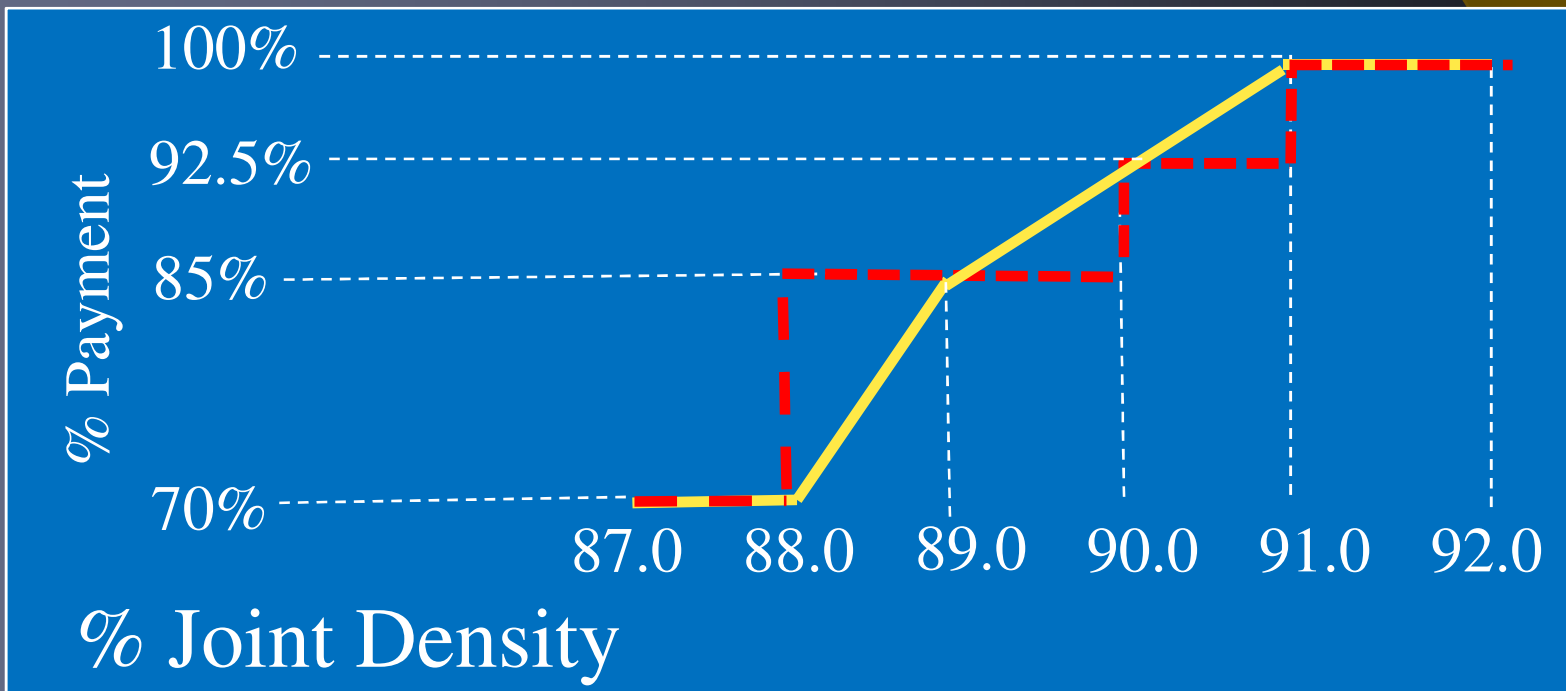
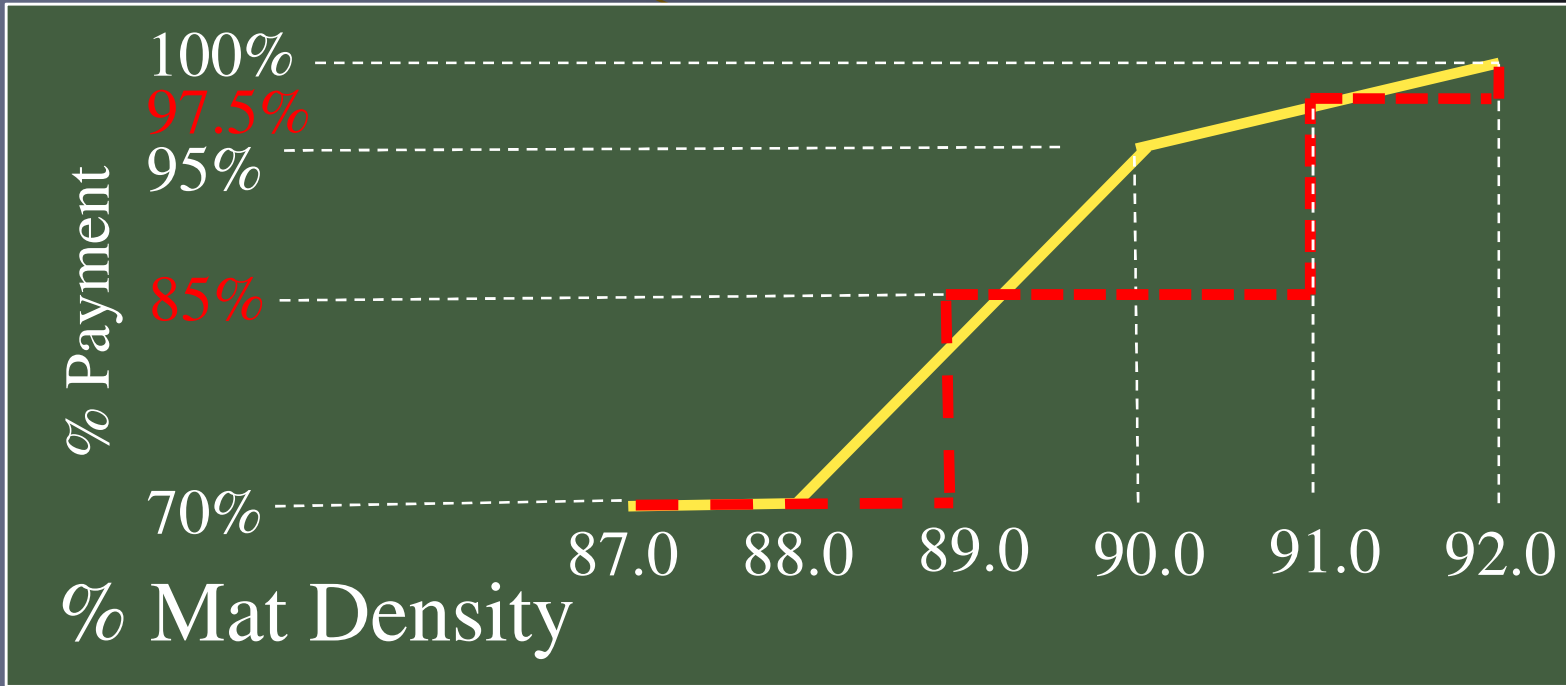
---  
2012

—  
2013



# Density Adjustments

below the minimum



---  
2012

—  
2013



# 2012 Average Density Values

## 2012 Individual Core Results

Bridge and Non-bridge			
	Avg % density	Stdev	Total Samples
Mat	92.81	2.13	2532
Joint	91.23	2.22	2306

4838

Non-bridge			Bridge		
Avg %	Stdev	Total Samples	Avg % density	Stdev	Total Samples
93.02	2.07	2082	91.96	2.17	450
91.35	2.40	1863	90.55	2.16	443

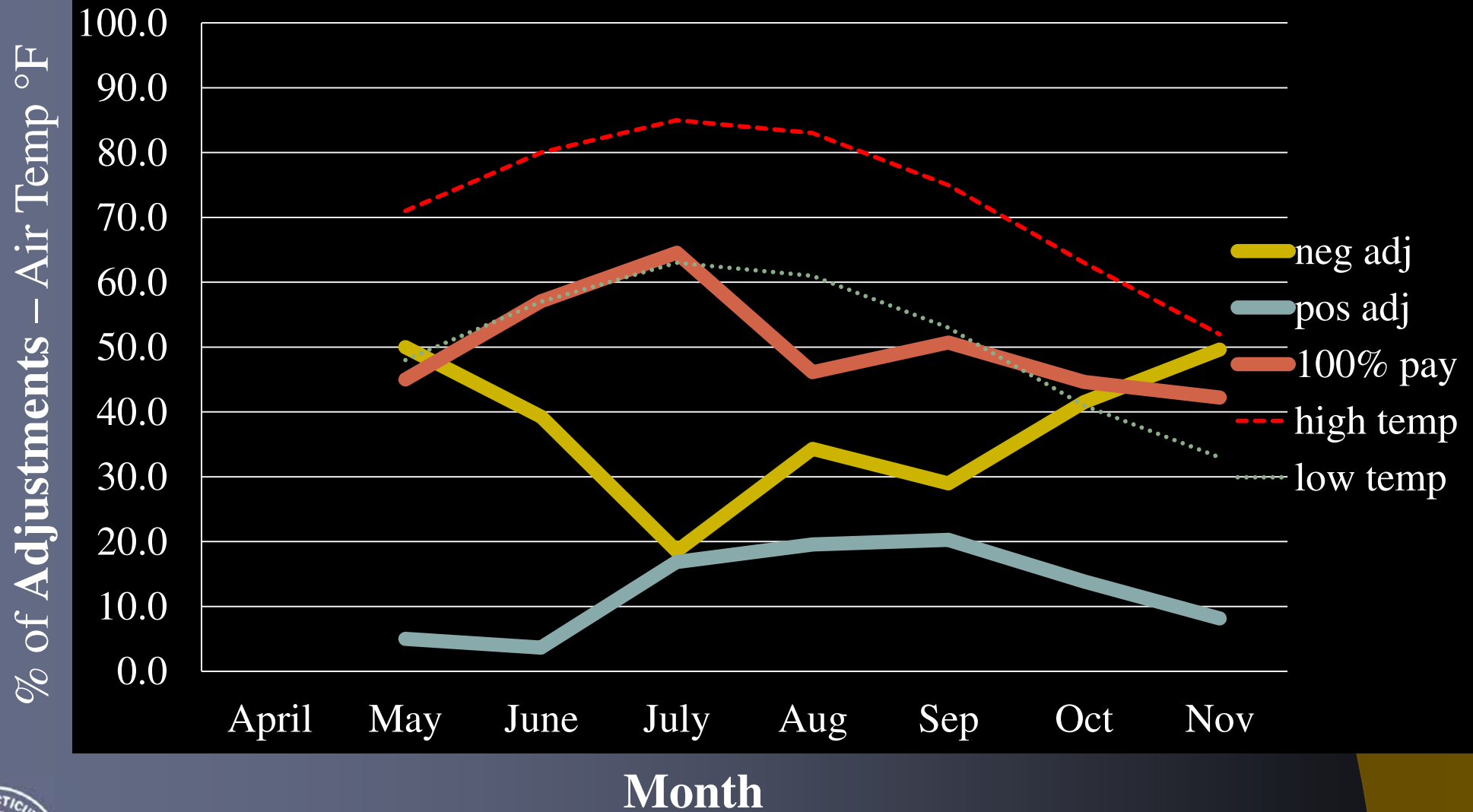
3945

893

Required Minimum Density 92% Mat, 91% for Joint



# 2012 Adjustments by month



# 2013 results last paving input Oct 4, 2013

**IN-PLACE DENSITY (%) BY LOT TYPE 2013 Season based on cores**

	Roadway	Bridge	Combo
MAT	93.10	88.81	92.73
JOINT	91.83	89.00	91.89
# of Lots	368	5	40





# Conclusions

- **Process is working well.**
- **Industry involvement critical.**
- **Data consolidation is very important.**
- **Consistent test method is vital.**
- **Analysis of industry data is priceless!**
  - During the season
  - Year to year
- **More Research is needed.**



**The End**

**Thanks for your attention!  
Questions?**