

LONGITUDINAL JOINTS – AGENCY EXPERIENCES: PENNSYLVANIA

Fall 2023 CAPRI Meeting
October 11-12, 2023
Fairfax, VA

TIMOTHY L. RAMIREZ – OCTOBER 11, 2023

PENNDOT BY THE NUMBERS



*Total miles on all PA roadways



1995 STUDY WITH NCAT

- S.R. 441 in Lancaster County, 2-lane roadway.
- Constructed 1995, Marshall Mix Design, 6.0% AC, Approx. 9.5 mm NMAS Wearing Course
- 8 different joint techniques. Northbound lane paved first.
- Evaluated each year for 6 years (through 7/2/2001) in study.
- NCAT Report 02-03 (February 2002).
- After 6-years best performers:
 - Rubberized Joint Sealant
 - Cutting Wheel
 - Roll from hot side 6 inches away
 - NJ Wedge (No notch, 3:1 taper)



STUDY WITH NCAT + 27 YEARS



PENNDOT SPECS CIRCA APRIL 2000

- Joint Type / Characteristics:

- Vertical Joint
- Tack Coats
 - AET (38% Min Residue)
 - If necessary, apply in 2 coats
 - SS-1 / CSS-1
 - SS-1h / CSS-1h
- Carefully broom or lute the CA onto uncompact lane leaving only FA portion on compacted lane

- Compaction:

- Static Roller – Roll from compacted side overlapping 1-2 in. onto uncompact side & gradually move across uncompact lane.
- Vibratory Roller – Roll from uncompact side overlapping 1-2 in. on compacted side.

- Safety:

- Leave only short sections (< 25 ft.) open/unabutted.



PENNDOT SPECS CIRCA OCTOBER 2000

• Joint Type / Characteristics:

- Tack Coats
 - AET (38% Min Residue) - Apply in 2 coats
 - SS-1 / CSS-1
 - SS-1h / CSS-1h
 - PG 64-22
- Overlap mixture on previous lane by 1.5 in.
- Broom or lute the overlapped material onto unrolled lane. Do not broadcast or fan.
- Vertical Joint
 - Saw cut if distorted by traffic
- Notched Wedge Joint
 - ≤ 19.0 NMAS
 - Compact to 90% of TMD
 - Determine density directly over joint using nuclear gage
 - Revert to vertical joint if min density cannot be achieved

• Compaction:

- Vibratory Roller – Roll from uncompact side overlapping 1-2 in. on compacted side.

• Safety:

- Vertical Joint
 - Leave only short sections (< 25 ft.) open without adjacent lane.
- Notched Wedge Joint
 - Place adjacent lane w/in one day of previous lane
 - If adjacent lane not placed w/in same day – install “Uneven Pavement” signs every 1/2 mile at no cost to Dept.

• Other:

- Superpave Asphalt Mix Design now routinely specified.



PENNDOT SPECS CIRCA OCTOBER 2003

- Joint Type / Characteristics:

- Tack Coats
 - AET (38% Min Residue) - Apply in 2 coats
 - SS-1 / CSS-1
 - SS-1h / CSS-1h
 - PG 64-22
- Overlap mixture on previous lane by 1.5 in.
- Broom or lute the overlapped material onto unrolled lane. Do not broadcast or fan.
- Vertical Joint
 - Saw cut if distorted by traffic
- Notched Wedge Joint
 - ≤ 19.0 NMAS
 - Std Drawing RC-28 for construction

- Compaction:

- Vibratory Roller – Roll from uncompacted side overlapping 1-2 in. on compacted side.

- Safety:

- Vertical Joint
 - Leave only short sections (< 25 ft.) open without adjacent lane.
- Notched Wedge Joint
 - Opposing Traffic – place adjacent lane within 1-working day
 - Traffic in Same Direction – place adjacent lane within 2-working days
 - If adjacent lane not placed w/in same day – install “Uneven Pavement” signs every ½ mile at no cost to Dept.

- Other:

- Superpave Asphalt Mix Design now routinely specified.



PENNDOT SPECS CIRCA 2006

- In 2006, PennDOT specs required joints to be constructed according to a QC plan
- Many QC plans silent about joints
- No measurement of joint density
- Joint quality usually judged by smoothness across the joint
- Some performance issues



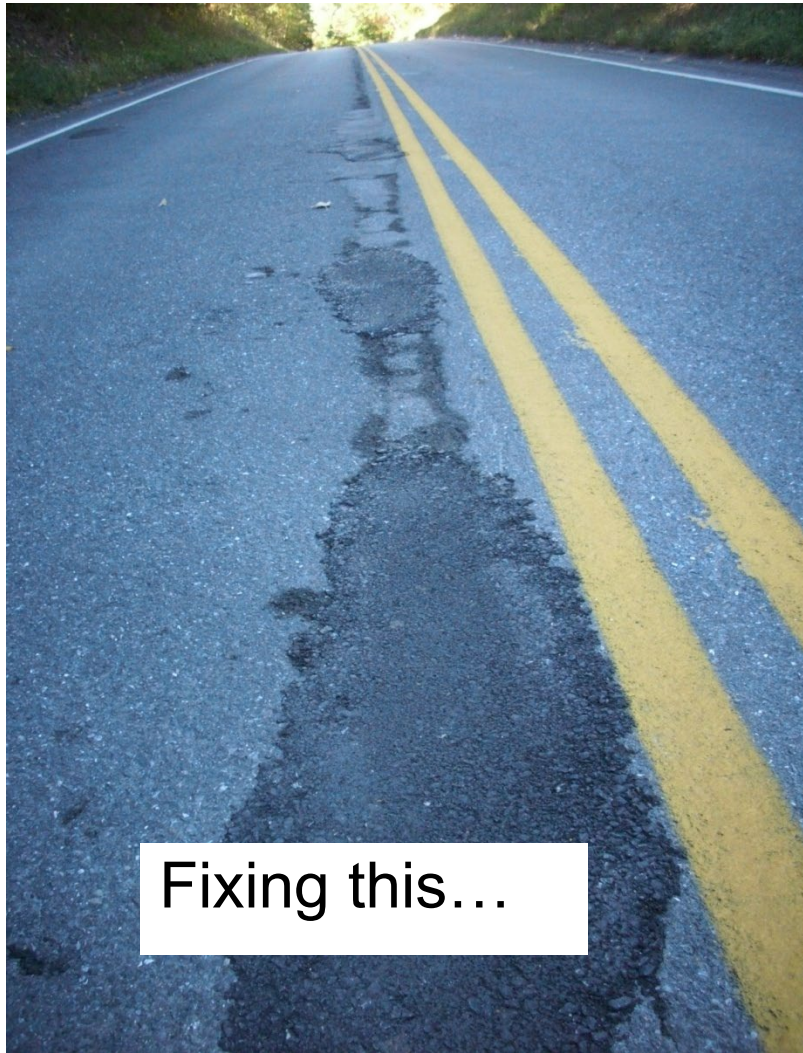
BUT, EVEN VISUALLY GOOD JOINTS CAN BITE!!!



JOINT ISSUES IN THE PAST



VERY COSTLY SOLUTIONS



How much longer would the road have lasted with a good joint?



HISTORY OF PA JOINT DENSITY EFFORT

- Pennsylvania began an effort to improve joint density in 2006-07 with study
- Began measuring joint density in 2007 directly on the joint
- Adopted a best practices (method spec) approach for 2008 construction
 - Done through a standard special provision or project special provisions



HISTORY OF PA JOINT DENSITY EFFORT

- > 1% increase in density in 1st year
- Slight increase in 2009 was less than PennDOT hoped
- By end of 2009, PennDOT was looking for higher density

Longitudinal Joint Data Summary			
Year	Density Lots	Avg. Joint Density	Avg. Roadway Density
2007	18	87.8%	93.9%
2008	43	88.9%	94.1%
2009	29	89.2%	94.1%



KEEPING WATER OUT OF JOINTS

- Most research suggested that
 - densities should be about 92% to minimize permeability
 - Joint densities below 89 to 90% had an exponential increase in permeability
- Bottom line, we needed better joint density than we were achieving on many of the projects



JOINT DENSITY INCENTIVE/DISINCENTIVE

- For 2010 PennDOT began looking to an end result joint density specification
- Financial incentive for high density
- Financial disincentive for low density
- Contractor innovation to provide optimal joint densities (contractor chooses construction method)



HOW PENNDOT SAMPLES JOINTS

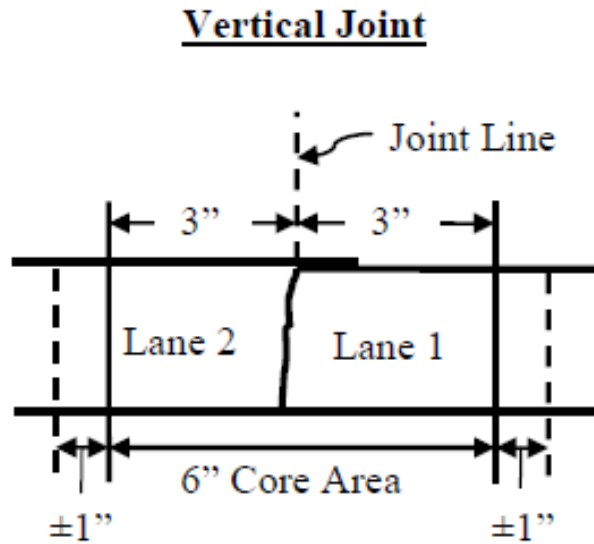
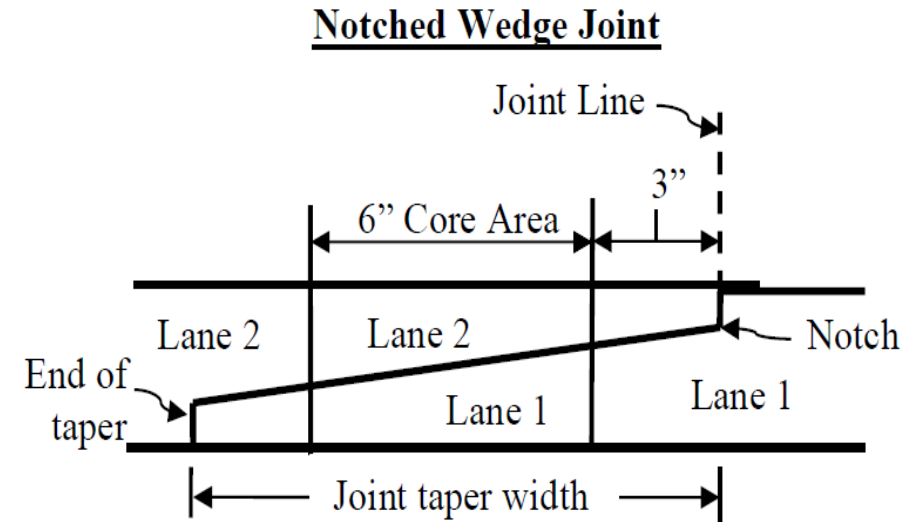


Figure not to scale



- The maximum theoretical specific gravity (Gmm) for each core is the average of Lane 1 and Lane 2



PROJECT SELECTION CRITERIA

Density Specification for:

- Surface courses
- RPS pavements (PA's highest level of projects)
- National Highway System
- 12,500 feet of testable joint
- Pavement on both sides of joint must be cored



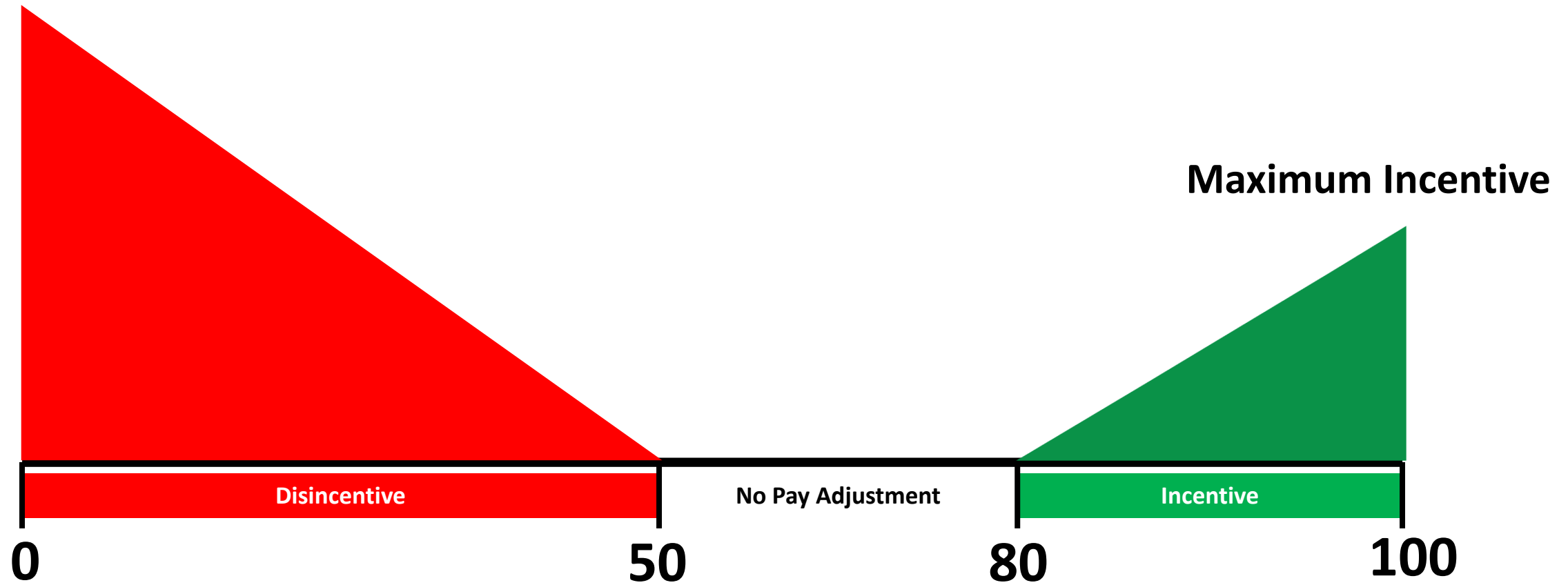
LOT/SUBLOTS FOR INCENTIVE/DISINCENTIVE

- Cores cut directly on finished joints every 2500 ft.
- 1 Lot = five joint cores (12,500 ft)



IMPACT ON LOT PAYMENT

Maximum Disincentive



MIN PWL AND MAX INCENTIVES/DISINCENTIVES

Pub. 408 Year-Change No	Specification Effective Date	PWL Lower Limit (% of TMD)	Maximum Incentive	Maximum Disincentive	Corrective Action Required (Avg. Lot Density % of TMD)
2011-Initial Edition	4/1/2011	89.0	\$5,000	\$12,000	< 88.0%*
2011-5	10/4/2013	90.0	\$5,000**	\$10,000***	< 88.0%*
2020-Initial Edition	4/10/2020	91.0	\$7,500	\$12,500****	N/A^

* Corrective Action = Seal longitudinal joint in lot with PG 64-22 (Width = 4 ± 1 in., Thickness = 1/16 ± 1/32 in.).

** Lots with Avg. Lot Density of ≥ 92.0% of TMD receive maximum incentive regardless of PWL.

*** Lots with PWL ≤ 49 and with Avg. Lot Density of ≥ 89.0% of TMD will be assessed a disincentive up to a maximum of \$1,000 per subplot.

**** Lots with PWL ≤ 49 and with Avg. Lot Density of ≥ 90.0% of TMD will be assessed a disincentive up to a maximum of \$1,000 per subplot.

^ Sealing longitudinal joint with PG 64-22 (Width = 4 ± 1 in., Thickness = 1/16 ± 1/32 in.) is required for all incentive/disincentive lots regardless of density or incentive/disincentive results.



SUMMARY OF RESULTS 2007-2013

Longitudinal Joint Data Summary			
Year	Density Lots	Avg. Joint Density	Avg. Roadway Density
2007	18	87.8%	93.9%
2008	43	88.9%	94.1%
2009	29	89.2%	94.1%
2010	No data, transition to PWL spec.		
2011	137	91.1%	94.1%
2012	162	91.6%	94.0%
2013	168	91.4%	93.9%



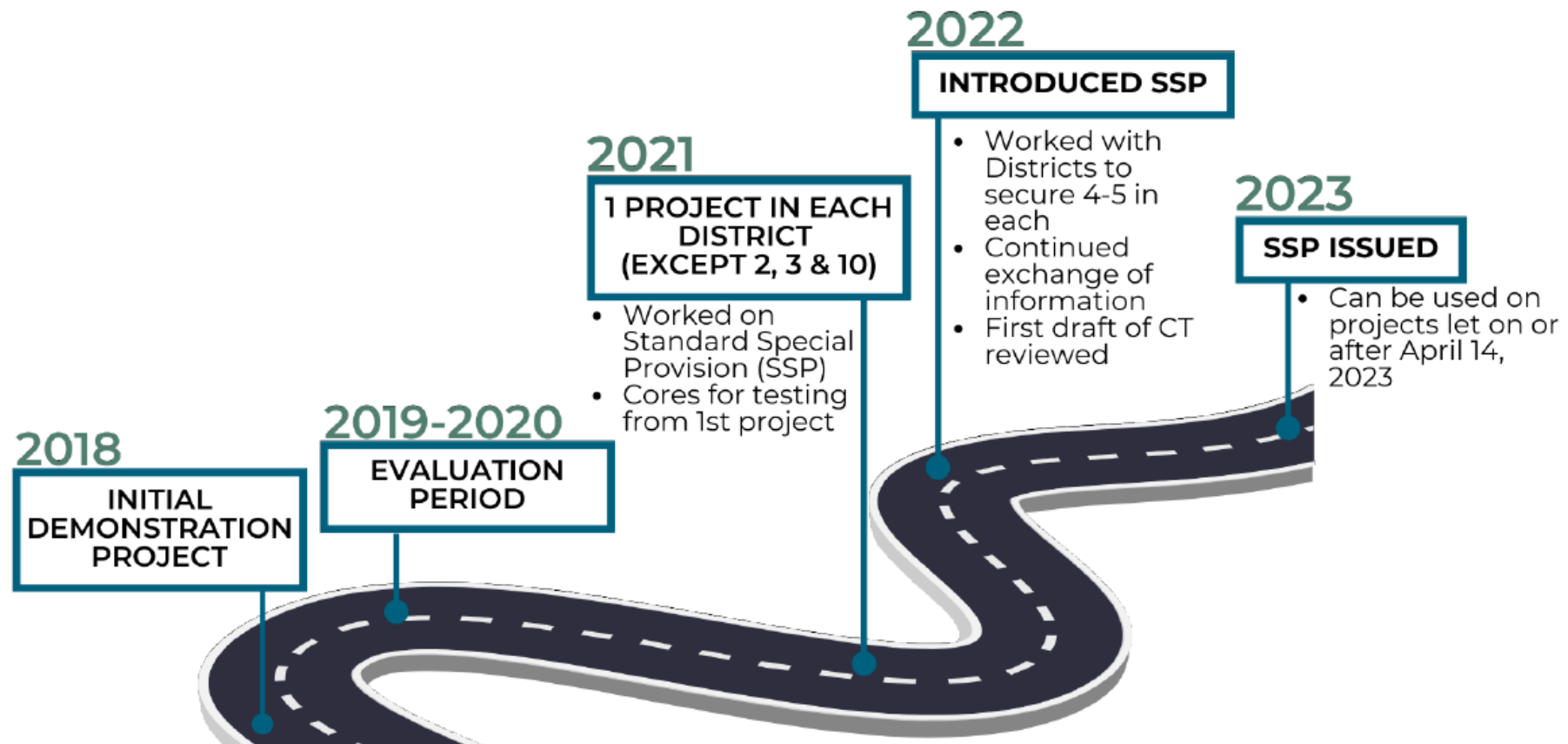
SUMMARY OF RESULTS 2017-2023

Year	2017	2018	2019	2020	2021	2022	2023
Lots Tested	354	394	371	286	294	261	177
% Density Range	85.7-98.5	82.9-98.0	81.9-99.0	85.0-99.5	84.0-99.2	85.2-98.1	83.2-98.7
% Average Density	92.8	92.8	92.8	93.1	93.3	93.0	93.5
Total \$ for Incentive Lots	1,229,450	1,698,808	969,434	1,206,208	1,173,727	1,315,887	733,925
Total \$ for Disincentive Lots	-59,060	-49,120	-29,461	-6,750	-39,318	-14,025	-57,800
Delta (Incentive - Disincentive)	1,170,390	1,649,688	939,973	1,199,458	1,134,409	1,301,862	676,125



OTHER LONGITUDINAL JOINT EFFORTS

- Void Reducing Asphalt Membrane (VRAM)
Pennsylvania's Road to a Special Provision



VRAM

5-Year Visual Assessment of 1st VRAM Trial Project
PennDOT District 5, SR I-81, NB, MP 131.7-133.85
Schuylkill County, PA
Applied October 2018, Pictures Taken April 2023



VRAM ↑

Control ↑

VRAM ↑

Control ↑



PennDOT District 1, I-80



PennDOT District 2, SR 219



QUESTIONS?



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