
VDOT
Virginia Department of Transportation

SURFACE UNIFORMITY OF ASPHALT MIXTURES

VDOT Specifications, Concerns and Expectations

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Specification References to Segregation:

211.08 Acceptance – Last paragraph:

Should visual examination by the Engineer reveal that the material in any load or portion of the paved roadway is obviously contaminated or segregated, that load or portion of the paved roadway will be rejected without additional sampling or testing of the lot. If it is necessary to determine the gradation or asphalt content of the material in any load or portion of the paved roadway, samples will be taken and tested and the results will be compared to the requ/irements of the approved job-mix formula. The results obtained in the testing will apply only to the material in question.

TABLE II-15
Process Tolerance

Tolerance on Each Laboratory Sieve and Asphalt Content: Percent Plus and Minus												
No. Tests	Top Size[1]	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 30	No. 50	No. 200	A.C.
1	0.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	6.0	5.0	2.0	.60
2	0.0	5.7	5.7	5.7	5.7	5.7	5.7	5.7	4.3	3.6	1.4	0.43
3	0.0	4.4	4.4	4.4	4.4	4.4	4.4	4.4	3.3	2.8	1.1	0.33
4	0.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.5	1.0	0.30
5	0.0	3.6	3.6	3.6	3.6	3.6	3.6	3.6	2.7	2.2	0.9	0.27
6	0.0	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.4	2.0	0.8	0.24
7	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.3	1.9	0.8	0.23
8	0.0	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.1	1.8	0.7	0.21
12	0.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.7	1.4	0.6	0.17

[1]Defined as the sieve that has 100% passing as defined in Table II-13.

Adjustment Points for Each 1% the Gradation Is Outside the Process Tolerance Permitted In Table II-15

Sieve Size	(Applied in 0.1% increments)
1 1/2 in	1
1 in	1
3/4 in	1
1/2 in	1
3/8 in	1
No. 4	1
No. 8	1
No. 30	2
No. 50	2
No. 200	3

I wonder how long we have been concerned about segregation and uniformity?

VDOT/VIRGINIA ASPHALT ASSOCIATION
COOPERATIVE COMMITTEE MINUTES
September 25, 1990
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1. SEGREGATION - Mr. Schreck said there has recently been much discussion concerning segregation, both from industry and the Department. It seems there is a difference in interpretation as to what constitutes segregation from one year to the next. He also stated most problems are with the SM-3 mixes, although there are a few with the SM-2, as this mix is somewhat coarser than the old S-5. Mr. Hylton noted he has had problems when using Shell's AC-30, but not with AC-20. Mr. Lanier said he laid 280 lbs. with no problem, but could not lay 200. Mr. Schreck thought a SM-3 mix which was close to the fine side of the gradation band may not cause problems, but one in the center of the band probably would. Mr. Scott detailed some experimental work he has done placing fillets in the back of some haul trucks which he felt minimized segregation. He is considering trying this in the hopper of a paver as well. The use of specialized equipment such as the Materials Transfer Vehicle recently used by Mr. Lanier was discussed. In response to a question by Mr. Horan, it was generally agreed this type of equipment would have to be included as a requirement in the contract to assure its use. Industry did not endorse requiring its use due to increased cost. Mr. Winfrey said he was having some problem with the concept of using specialized equipment to solve segregation problems. He suggested there were other things that should be looked at, such as Industry using ingenuity to minimize the problem, and the Department being more selective in the use of the more segregation-prone mixes.

What is the Definition of Segregation in Mixtures?: Courtesy of PavementInteractive.org:

https://pavementinteractive.org/reference-desk/construction/placement/aggregate-segregation/#:~:text=%E2%80%9CSegregation%20is%20a%20lack%20of,%2C%20aggregates%2C%20and%20air%20voids.

"Segregation" is a term often used in the HMA industry to describe a number of different phenomena. It's most general definition comes from Stroup-Gardiner and Brown (2000[1]):

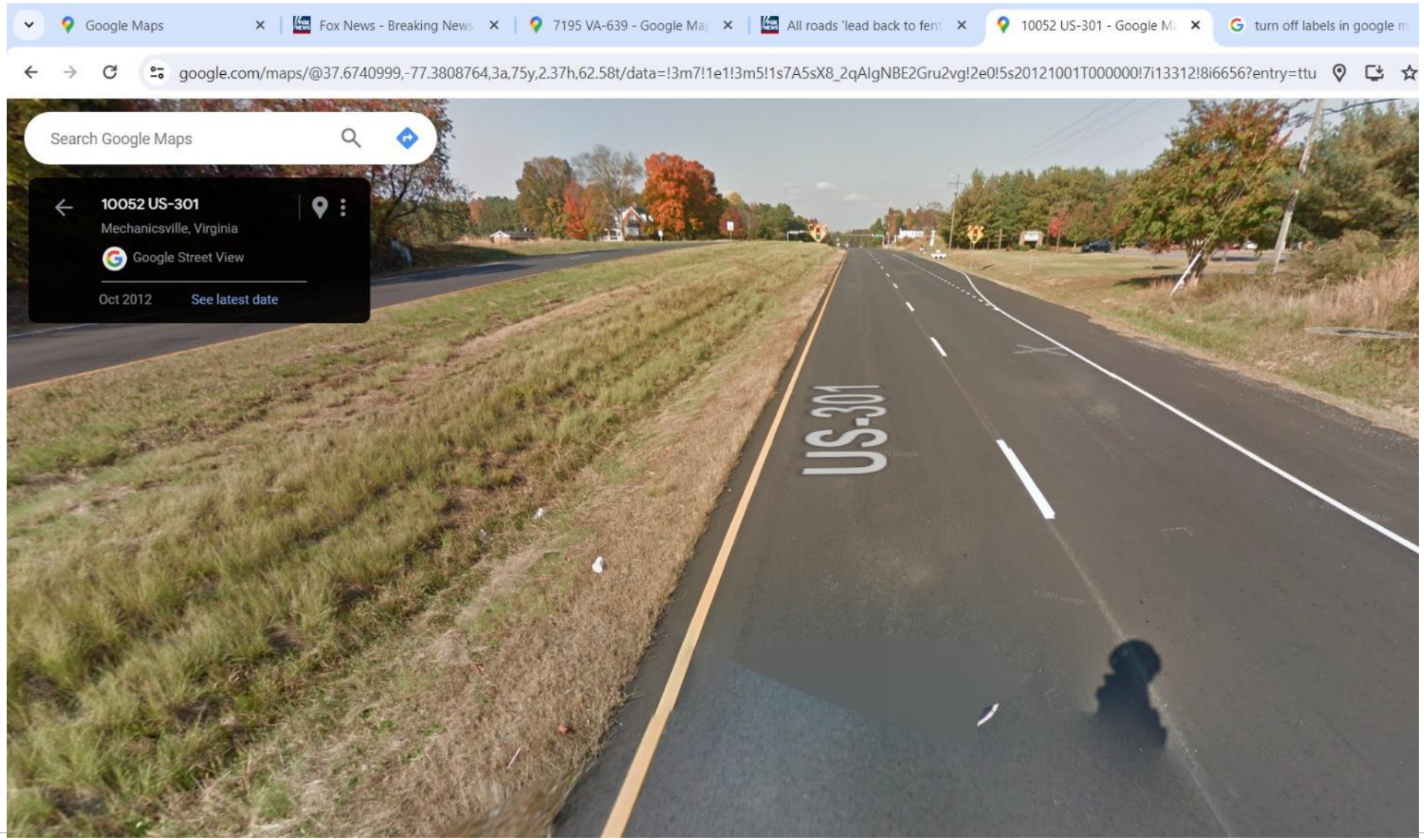
"Segregation is a lack of homogeneity in the hot mix asphalt constituents of the in-place mat of such a magnitude that there is a reasonable expectation of accelerated pavement distress(es)."
They point out that "constituents" should be interpreted to mean asphalt binder, aggregates, and air voids. This would describe a range of segregation found in conventional dense-graded mixtures, SMA, OGFC and large stone mixtures, as well as any other mixtures with unique proportioning or compositional factors (Stroup-Gardiner and Brown, 2000[1]). This definition includes both aggregate segregation and construction-related HMA temperature differentials that can lead to higher than desirable HMA air voids."

Aggregate Segregation

Based on several articles (Kennedy et. al., 1987[2]; Brown and Brownfield, 1988[3]; Williams et. al., 1996a[4] and 1996b[5]; Khedaywi and White, 1996[6]; AASHTO, 1997[7]) the commonly accepted qualitative definition of aggregate segregation is "the non-uniform distribution of coarse and fine aggregate components within the asphalt mixture." There are two basic types of aggregate segregation:

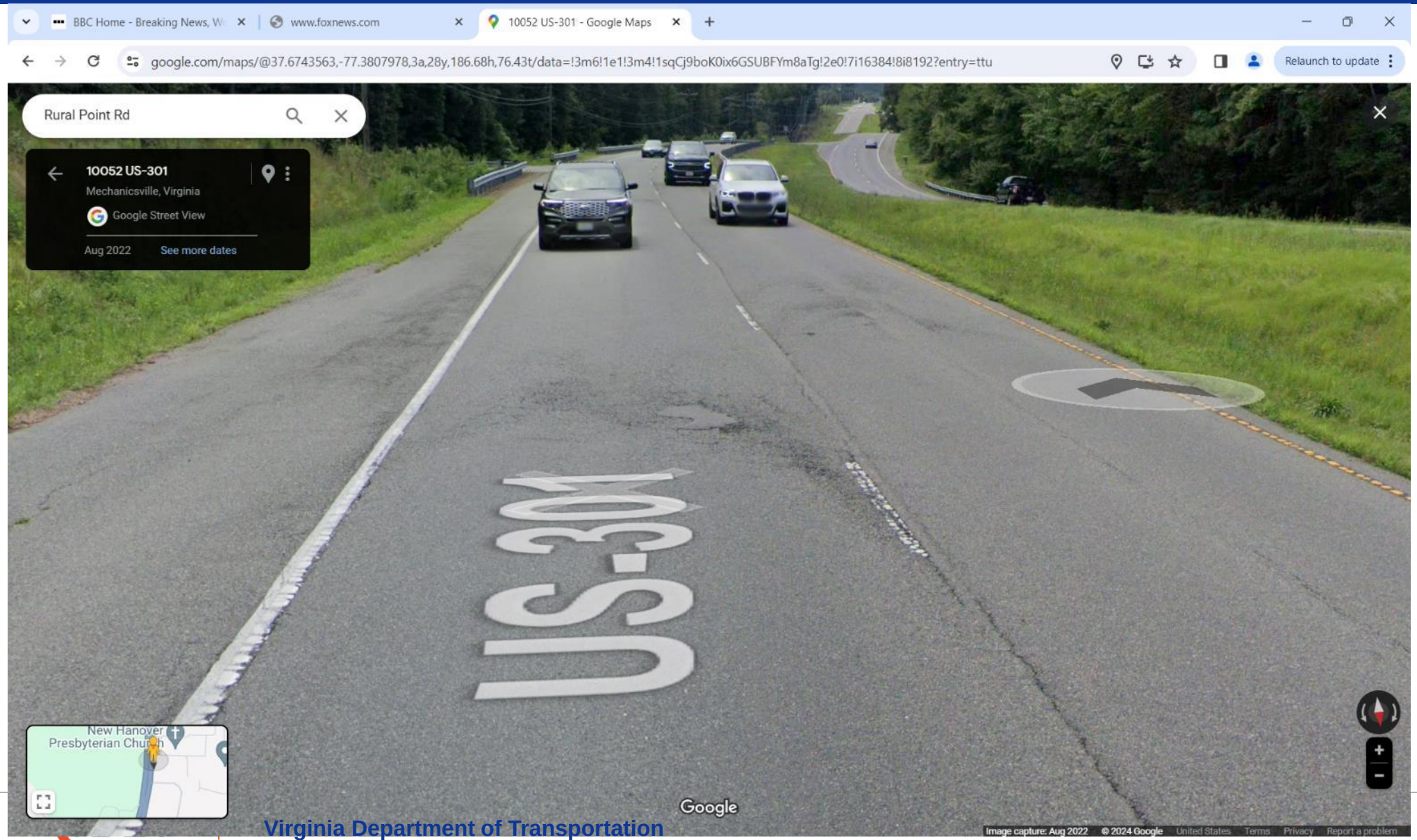
1. *Coarse segregation. Occurs when gradation is shifted to include too much coarse aggregate and not enough fine aggregate. Coarse segregation is characterized by low asphalt content, low density, high air voids, rough surface texture, and accelerated rutting and fatigue failure (Williams et. al., 1996b[5]). Typically, coarse segregation is considered the most prevalent and damaging type of segregation; thus segregation research has typically focused on coarse segregation. The term "segregation" by itself is usually taken to mean "coarse segregation."*
2. *Fine segregation. Occurs when gradation is shifted to include too much fine aggregate and not enough coarse aggregate. High asphalt content, low density, smooth surface texture, accelerated rutting, and better fatigue performance characterize fine segregation (Williams, Duncan and White, 1996[8]).*

The Crux of the Matter – when it comes to quantifying Segregation in the specifcations



Case Study on End of Load Segregation– US 301 in Hanover VA – 3” mill and replace with 2” of SM-12.5 and 1” of SM-9.0 with Trench Widening
Placed in 2012

The next three photos are of the same location, Today, 2022 and as built in 2012: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google.com/maps/@37.6743563,-77.3807978,3a,28y,186.68h,76.43t/data=!3m6!1e1!3m4!1sqCj9boK0ix6GSUBFYm8aTg!2e0!7i16384!8i8192?entry=ttu
Relaunch to update
Rural Point Rd
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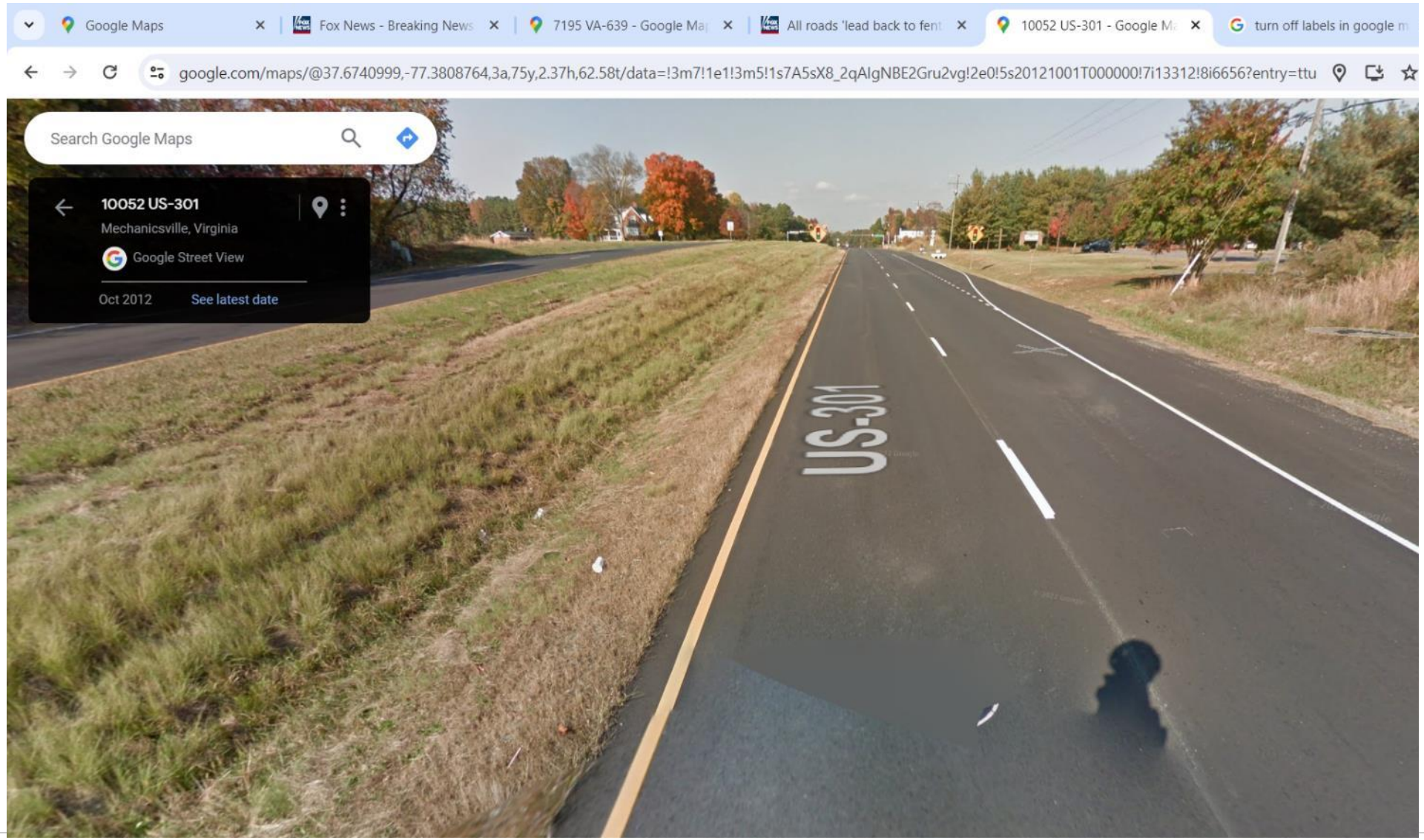
The Crux of the Matter – when it comes to quantifying Segregation in the specifcations



The Life Cycle we should be getting: at year 12, seal the Longitudinal joint and consider a micro-surfacing or THMACO to protect the layer(s)

Now this slide comes back to haunt me, if every load in both lanes in the SM-9.0 are affected, what do you think the SM-12.5 underneath looks like?

Segregation deeper in the pavement structure – BM Placement on I64 in Hampton Roads

Again the Crux of the Specification Issue – How do you develop a corrective action or rejection plan

Service Life impact of segregation Deep in the structure:

The service life of SM in this corridor of I95 was down to Six Years – After FWD and coring selected on the “Base Damage Index” Severely stripped base mix layers were found at re-occurring intervals. BM was placed in the 1980’s

How about SMA - *"constituents" should be interpreted to mean asphalt binder, aggregates, and air voids*

Solutions:

- Education (VECAT and MCS, VAA Quarterly Webinars, District Inspector Training)
- Cooperative Meetings (State and District)
- Clear Expectations in the Specifications
- Industry taking the lead in training and communicating best practices – once it is laid out on the road, It puts both parties in a difficult position to try and rectify
- Thank you to Industry for doing exactly that by partnering w/ VDOT and for attending these Regional Seminars and highlighting the issue on the agenda

Thank you, and Questions?