Reclaimed Asphalt Pavement (RAP) Materials in Pavement Preservation

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Project Objectives

- Providing a framework for determining when to use recycled materials for pavement preservation surface treatments
- Developing guidance for strategic RAP material storage
- Developing RAGG processing and fractionation guidelines
- Developing flexible, generic, and deployable performance-based treatment specifications
- Recommending testing methods and frequencies within typical quality assurance programs to ensure the desired performance targets

Presentation Outline

- Decision to use RAP
- RAP fractionation and storage
- RAP in preservation: testing and specification issues
- Los Angeles County Case Study
- Sustainability, EPDs, and the future of RAP in preservation

Deciding to Use RAP

- **Factors impacting RAP availability**

  - **Supply** – Abundance or lack of RAP supply
  - **Usage** – Mandatory vs Optional usage

  - **Haul Distance** – Distance traveled to transport RAP
  - **Intrinsic Value** – Valuation based on intended RAP use

  - **Sustainability** – Sustainable benefits of RAP vs Virgin Aggregates
  - **Storage** – Formation of stockpiles based on intended RAP use

  - **Salvage Credit** – What's this?

Deciding to Use RAP (continued)

- **Salvage Credit**

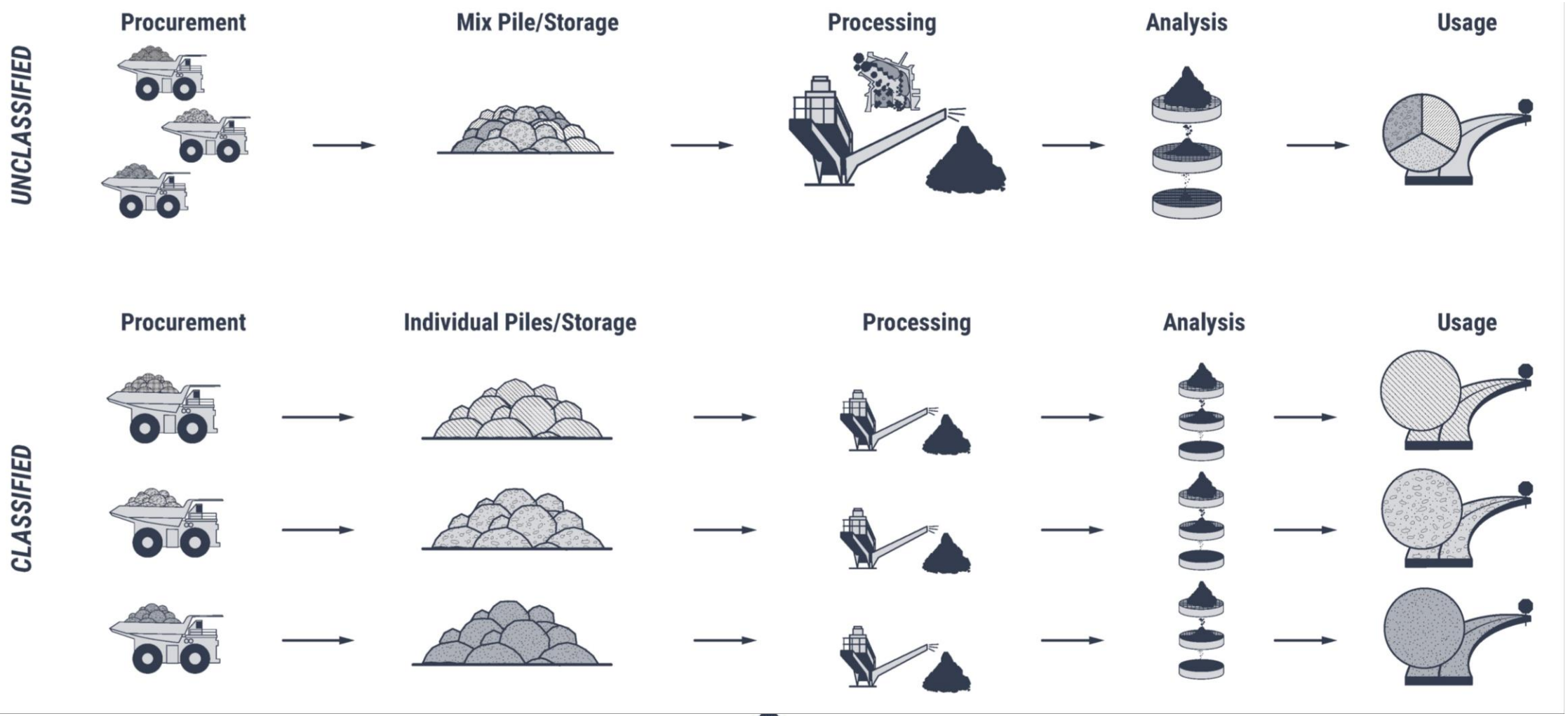
  Governed by **state procedures** (2 CFR 200.313)

  - How will RAP be used?
  - Where is RAP to be used?
  - Inventory maintained/controlled access
  - Quality assurance that material remains uncontaminated

RAP Storage

- **Classified RAP**
  - **Single source RAP** – high confidence source
  - **Minimal processing** – screening only
  - **Testing** – lower-risk of product inconsistency
- **Unclassified RAP**
  - **Multi-source RAP** – all sources mixed into single pile
  - **Additional processing** – crushing and screening
  - **Testing** – higher-risk of product inconsistency

RAP Storage (continued)



SOURCE: APTECH

RAP Storage (continued)

Surface runoff flows to pond

20 - 21 Acres Total Area

6 - 8 Acres RAP Area

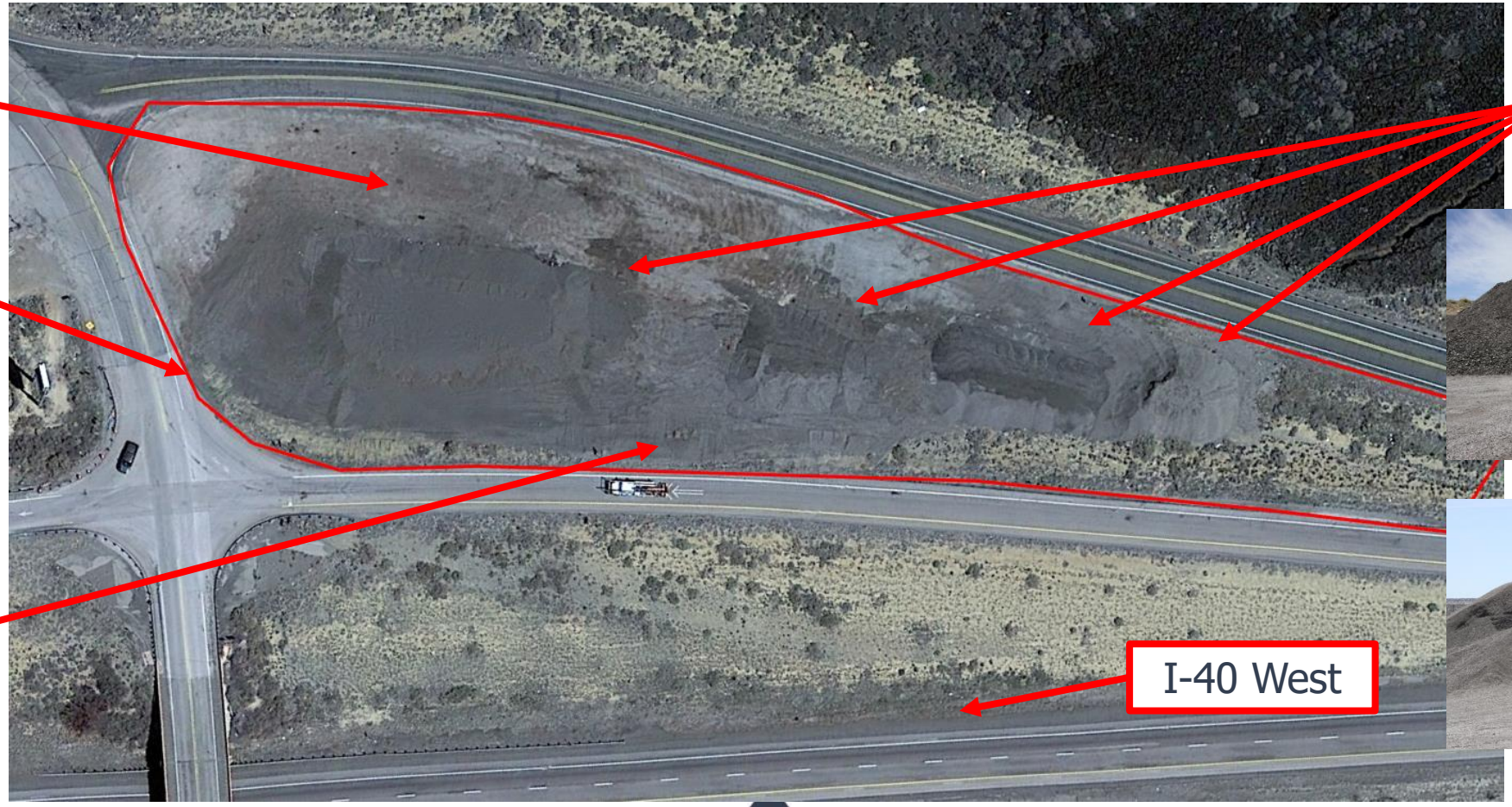
Multiple classified RAP piles (no roof)

Space between piles

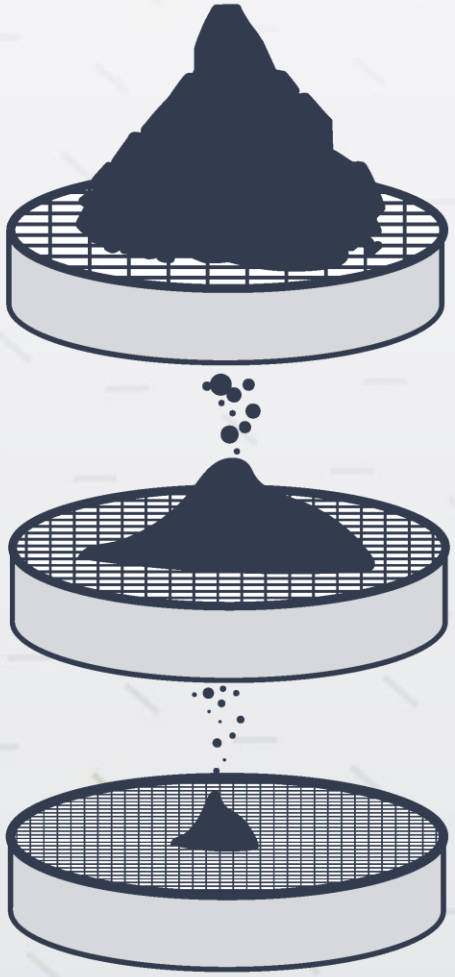
Front loader to feed screen

SOURCE: GOOGLE EARTH

RAP Storage – NMDOT Case Example



SOURCE: GOOGLE EARTH



SOURCE: APTECH

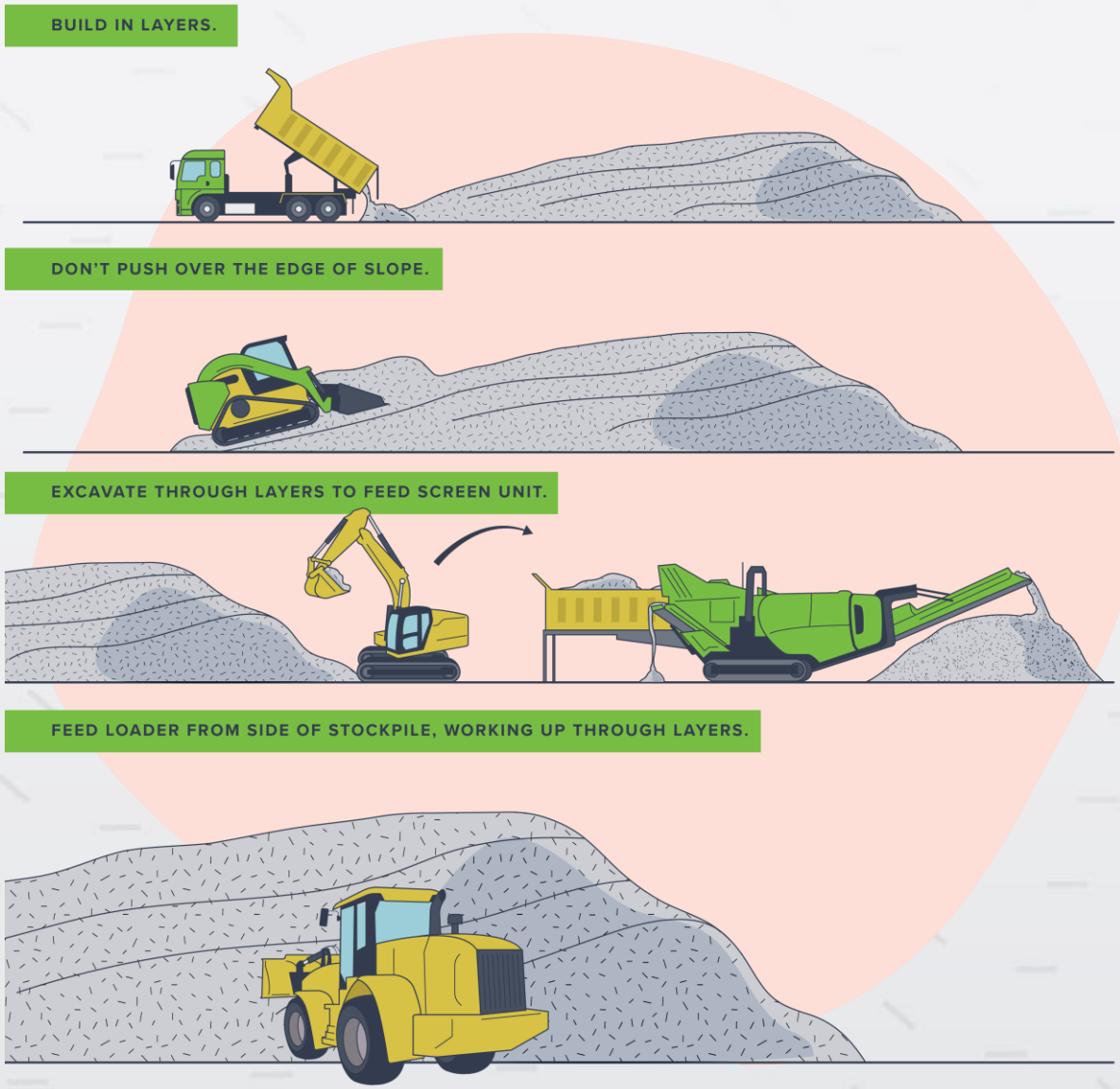
Fractionation

- Process of breaking down RAP into sized materials for subsequent use

Fractionation Unit Considerations

- Mobile vs stationary
- Production rates
- Assembly time
- Deck size and count
- Working and transport size
- Limitations

SOURCE: FHWA



SOURCE: APTECH (AFTER NAPA)

RAP Storage and Fractionation

- To get a consistent product
  - Create a uniform stockpile, i.e., gradation, asphalt content, moisture
  - Screen RAP in advance of crushing loop to minimize production of fines
  - Crush oversize particles to meet size requirements
  - Use RAP within 2 weeks to prevent conglomerating
  - Rescreening may be required

Testing

Materials	Test Type	AASHTO / ISSA	RAP Considerations
Aggregates	Sampling	T2	▪ Avoid sampling from stockpiles that have been undisturbed for long. ▪ Sample from different points of the stockpiles for a representative samples.
	Gradation	T27	▪ Run tests on unextracted-RAP. ▪ Extracted aggregates to meet gradation specifications.
	Bulk Density and Specific Gravity	T19, T84, T85	▪ For chip seal, run as asphalt coated aggregate. ▪ For slurry system, run test in water on asphalt coated aggregate.
Emulsions	All	T59, T53, T49, T50, T51, M140, M208, M316, T301, T40, T59	▪ No difference between RAP and non-RAP mixes. ▪ Emulsion suppliers may alter chemistry slightly, but the test parameters and limits are unchanged.
Mixture	Excess Asphalt	ISSA TB 109	▪ Determine remaining life of RAP asphalt to assess its impact on test results. Contribution from RAP to mixture.
	Compatibility by Breuer and Ruck Procedure	ISSA TB 144	▪ Prescribed 8.125% should count fresh asphalt only (not RAP asphalt).
	Measurement of Stability	ISSA TB 147	▪ Low cohesion could be an indication of an over-asphalted mix.
	Sweep Test of Emulsified Asphalt Surface	ASTM D7000	▪ Run test on unextracted-RAP.

Testing Chip Seal Design AASHTO R102

$$A = \frac{5.61 \times e \times \frac{1.33 \times Q}{W} \times \left[1 - \frac{W}{62.4 \times G}\right] \times T + V}{R}$$

Where the terms are as follows:

A = Emulsified asphalt application rate, gallons per square yard

e = Percent embedment depth of aggregate, expressed as a decimal, typically 0.50 – 0.70

Q = quantity of chips from board test, lb/yd^2

W = dry loose unit weight of chips, pcf

G = dry bulk specific gravity of chips

T = traffic correction factor

V = pavement surface correction factor

R = emulsified asphalt residue, expressed as a decimal, as reported by the manufacturer

Performance-Based Specifications

SLURRY

- Abrasion Loss (TB 100)
- Excess Asphalt (TB 109)
- Wet stripping test (TB 114)
- Cohesion test (TB 139)

MICROSURFACING

- All of Slurry tests plus:
  - Loaded-wheel testing (TB 147)
  - Compatibility (SBR) test (TB 144)

CHIP SEALS

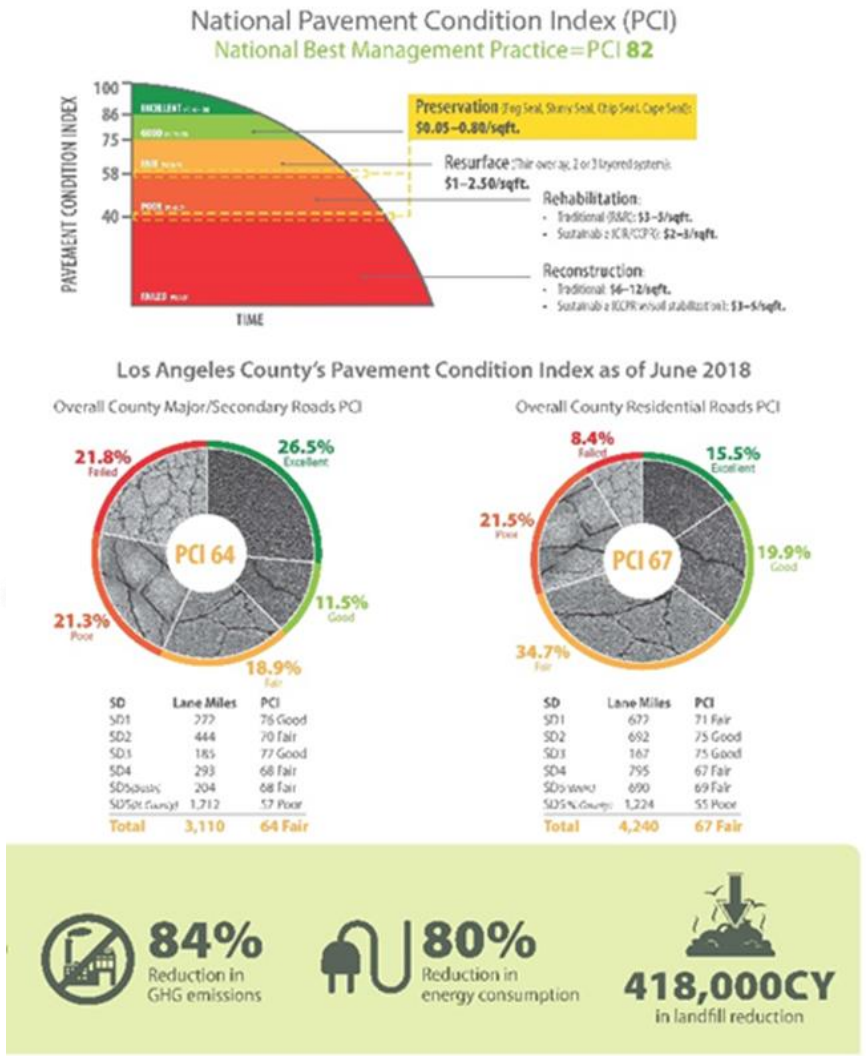
- Sweep test (D7000)

SOURCE: FHWA

Performance-Based Specifications: Thin AC Overlays

- AASHTO M 323
  - Addresses RAP mixtures in design equations
  - Requires softer base asphalt for high-RAP mixtures
  - Provides recommendation on aggregate specific gravity
  - Blending charts
- Quality control plan governs tests and frequency

CASE STUDY – LOS ANGELES CO. (LAC)

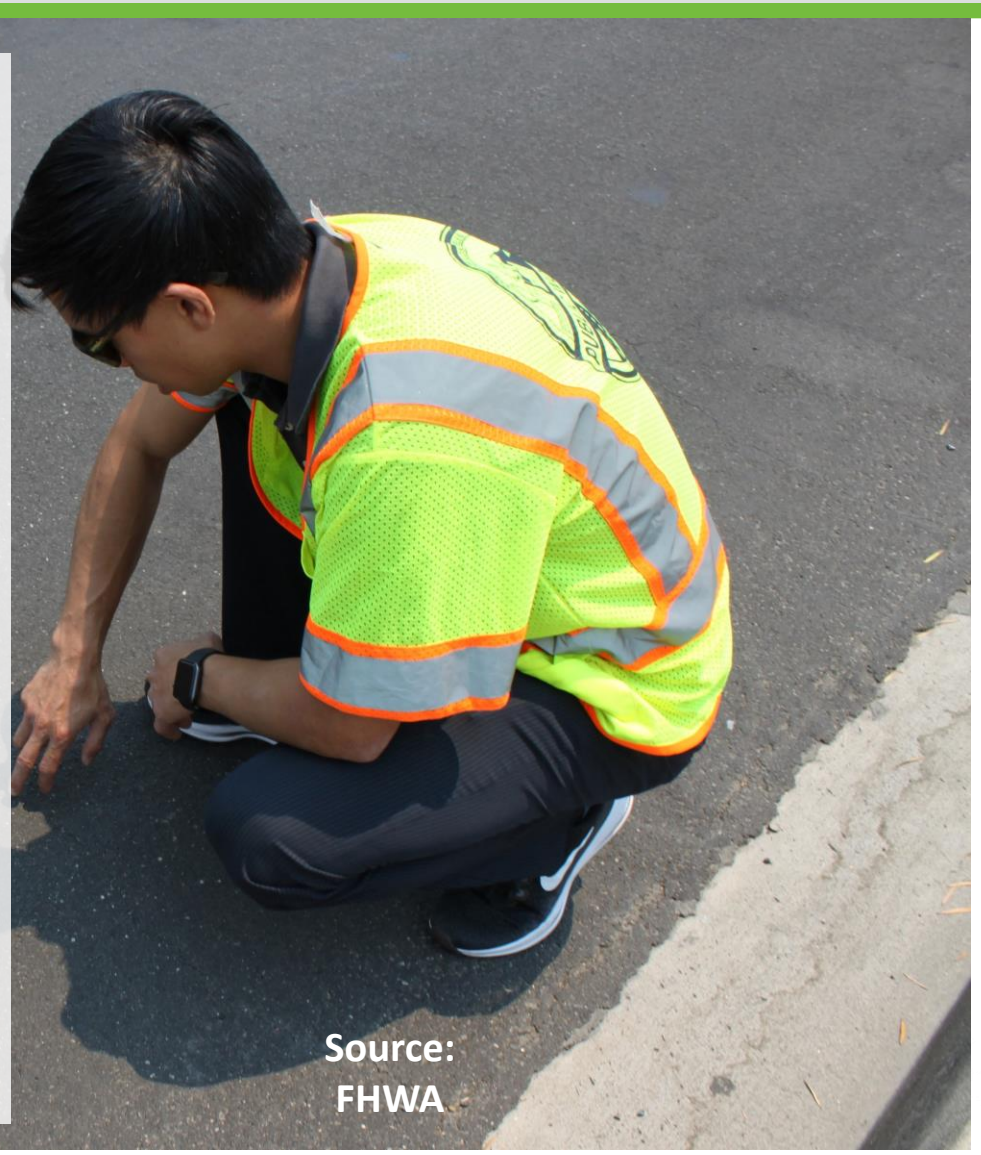


- Case study findings
- Public relations campaign – emphasis on sustainability
- Specify RAP treatments
- Use scrub, chip, and slurry seals and micro surface treatments
- Found similar performance after three years

CASE STUDY – LAC

Specification used

- Job-order contract based on Greenbook
- Allow RAP in microsurfacing
- Specify RAP slurry
- Require quality acceptance testing
- Adjust payment for non-compliance



Source: FHWA

LAC SPECIFICATIONS FOR SLURRY SEALS

Component	Characteristic	Test Method	RAP Slurry Seal Requirements	Virgin Type II Slurry Seal Requirements
Asphalt	Slurry seal emulsion, percent by weight of dry RAGG	—	9.0–14.0	14.0–18.0
	Minimum residual asphalt, percent	ASTM D6307 (ASTM 2019b) or CTM 382 (Caltrans 2014b)	11.0	7.5
Aggregate	Percentage wear, 500 revolutions, maximum percent	ASTM C131 (ASTM 2020)	35.0	40.0
	Sand equivalent, minimum	ASTM D2419 (ASTM 2014)	60.0	55.0
	Soundness (five cycles), maximum percent	ASTM C88 (ASTM 2018)	15.0	15.0
	Durability, minimum	CTM 229 (Caltrans 2011)	55.0	N/A
Mixture	WTAT, maximum weight loss (g/sq ft)	ASTM D3910 (ASTM 2015b)	50.0	60.0
	Consistency test (mm)	ASTM D3910 (ASTM 2015b)	30.0 (maximum)	20.0–40.0
	Extraction test (calculated emulsion content, percent)	ASTM D6307 (ASTM 2019b) or CTM 382 (Caltrans 2014b)	±1 percent of mix design	±1 percent of mix design
	Water content (percent of dry RAGG weight)	—	<25.0	<25.0

FHWA Study Findings

- **RAP Availability** → Salvage value governed by State plan
- **RAP Storage** → Reduce long-term storage of processed RAP
- **Fractionation** → Configure equipment to maximize RAP output and limit issues
- **Testing and Specification** → RAP functions as coated-aggregate; some tests require modifications
  - Unknown contribution of RAP asphalt to mixture properties for emulsified treatments

Sustainability, Environmental Product Declarations, and the Future

- **Material Transportation Impacts:** shorter haul distances
- **Material Use:** reduced use of virgin aggregates, potentially less demand for binder
- **EPDs:** since 2023 ARRA working on EPDs for CIR, CCPR, FDR, and HIR; nothing yet on RAP in PP

FHWA Project Deliverables ~ Spring 2025

- Final Report
- Tech Brief from FHWA
- Webinar
- Possible in-person Peer Exchange

Questions?

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