

# County of San Diego Department of Public Works

## Using RAP in Pavement Seals Pilot Project

### Pilot Study Report Outline

#### Executive Summary

Preventive pavement maintenance methods such as slurry seals and chip seals are cost-effective treatments that increase the longevity of pavements with minimum public disruption. Utilizing reclaimed asphalt pavement (RAP) as a replacement for virgin aggregate helps to reduce costs and impacts to the environment. Additionally, RAP use in pavement seals reduces the strain on the depleting virgin aggregate resources and can produce a darker surface color than virgin aggregate seals with the potential for superior traffic delineation properties.

#### Introduction

Chip seals and slurry seals are the primary preventive maintenance methods used in the County. A chip seal is an asphalt binder (commonly an emulsion) sprayed directly to a pavement surface, followed by spreading aggregate. This is immediately followed by rolling to properly embed the aggregate.

A Slurry seal is a combination of aggregates, asphalt emulsion, water, and additives which are portioned and mixed either onsite or at a central facility. The combined mixture is then spread over a prepared road surface.

State and local agencies are interested in expanding the use of RAP in resurfacing projects to achieve sustainability and cost benefits associated with using reclaimed materials. Using RAP in pavement-preservation treatments is not as well-known because of limited research (Duncan et al. 2020). The County of San Diego has been successfully using 25% RAP in Hot Mix Asphalt (HMA) mixtures since 2019. Using RAP in pavement seals will enable the County to further expand its use and save precious virgin aggregate.

The objective of this pilot study is to monitor, evaluate and document the cost and performance of 100% RAP chip and slurry seals relative to conventional seals using virgin aggregate within San Diego County. Throughout the study monitoring period and at the conclusion of the study, summary reports will detail the findings and ultimately provide recommendations for continued use.

For this study the County of San Diego, Department of Public Works (DPW) has selected the following road segments:

<b>Location 1: (Community Collector/Residential Collector with 1500 to 4500 average daily trips located in the Sweetwater River Valley):</b>					
<b>Section</b>	<b>Road</b>	<b>From</b>	<b>To</b>	<b>Length (MI)</b>	<b>Treatment</b>
1	Country TI	Wild Oats Ln	Blacksmith Rd	0.56	Slurry Seal (Control)
2	Country TI	Blacksmith Rd	Chula Vista Cl	0.50	Slurry Seal (RAP)
<b>Location 2: (Community Collector/ Residential Cul-De-Sac with 400 daily trips or less located in the Sweetwater River Valley)</b>					

Section	Road	From	To	Length (MI)	Treatment
1	Winnetka Dr	Pluto Ct	Cul De Sac	0.1	Slurry Seal (RAP)
<b>Location 3: (Community Collectors/Industrial-Commercial Collector with continuous two-way left turn lanes with more than 4500 daily trips located in the Borrego Desert area)</b>					
Section	Road	From	To	Length (MI)	Treatment
1	Palm Canyon Dr	Christmas Circle Dr	Ocotillo Cr/Country Club Rd	0.47	Double Chip Seal (Virgin+Virgin) (Control)
2	Palm Canyon Dr	Ocotillo Cr/Country Club Rd	Five Diamonds Rd	0.48	Double Chip Seal (RAP+RAP)
3	Palm Canyon Dr	Five Diamonds Rd	Hoberg Rd/Montezuma Valley Rd	0.42	Double Chip Seal (RAP+Virgin)
<b>Location 4: (Community Collector/Residential Cul-De-Sac with less than 400 daily trips in the Borrego Desert area)</b>					
Section	Road	From	To	Length (MI)	Treatment
1	Sun and Shadow Dr	Sun and Shadow Ln	Cul De Sac	0.07	Chip Seal (RAP)
2	Sun and Shadow Ln	Palm Canyon Dr	Sun and Shadow Dr	0.07	Chip Seal (Control)

**\*Refer to APPENDIX 3 for Location Exhibits.**

### **Problem Statement**

Pavement preservation is a more cost-effective option compared to other pavement treatment methods such as rehabilitation or reconstruction and are intended to extend the service life of the existing asphalt surface. Compared to asphalt placement, pavement preservation treatments are quicker and easier to apply and result in less impact to traffic operations. Public agencies are eager to include more pavement preservation projects in their resurfacing program to extend the life of more expensive surface treatments, such as overlays.

Aggregate is an essential raw building material for everything from concrete to pavement preservation seals. Estimates developed by the California Department of Conservation (CDC) indicate that aggregate reserves in San Diego County may run out as soon as 2030. 30% of the aggregate used in San Diego County is being imported, per CDC, which has caused aggregate prices to increase significantly over the past couple of decades. If this trend continues, higher aggregate prices will lead to higher construction costs for numerous industries, including pavement preservation (Ford, 2021).

RAP is readily available from stockpiles or obtained and processed at a project site. Hauling asphalt millings, virgin aggregate, and asphalt binder are costly compared to recycling materials available onsite. Using RAP eliminates the need for virgin aggregate without sacrificing pavement performance—in some instances improving performance—which justifies and encourages increased RAP use (Duncan et al. 2020).

Based on the above discussion, the County has decided to conduct a pilot study to evaluate the performance of RAP pavement seals compared to conventional pavement seals.

### **Objective**

This pilot study aims to evaluate the performance of conventional (control) and RAP pavement seals using both visual observations and laboratory testing. The goal is to assess if and how RAP will affect the performance of pavement seals, specifically slurry seals, chip seals, and double chip seals under different conditions. These conditions are traffic volume, rutting, surface distresses, residential uses, varying structural sections and subgrade conditions, and the desert environment with high-temperature fluctuations.

### **Timeline**

Upon completion, the control and RAP pavement seal sections will be monitored and evaluated at 3-month intervals for the six months. Then, monitoring will be conducted annually for a total of 3 years. Photo documentation and Field Notes will be collected by pavement engineers during each review.

After each monitoring session, the design team will summarize its findings in a pilot report. At the end of the pilot program the design team will deliver a final report. The field reports are provided in APPENDIX 1.

### **Materials**

Material requirements for RAP seals are included in APPENDIX 2, County of San Diego specifications for pavement seals.

### **Construction**

Please see construction requirements including aggregate and emulsion application rates in APPENDIX 2, County of San Diego specifications for pavement seals.

### **Test Types & Results**

#### **Production Testing & Observations**

During production of the various mixes, testing as specified in the contract documents occurred for quality control purposes. RAP Chip Seal testing includes Sand Equivalent (CT 217) and Gradation (CT 202). RAP Slurry Seal testing includes Wet Track Abrasion test (ASTM D3910), Consistency test (ASTM D3910), Extraction test (ASTM D6307) and Water Content of RAP. Please see APPENDIX 2, County of San Diego Specifications for further details.

#### **Visual Inspections**

This study will measure cracking and rutting before and after seal placement and over the timeframe specified in this report to evaluate long-term results. The study focuses on identifying raveling, premature cracking, weathering, bleeding, stripping, and aging.

This information will be used to develop a comparison between the RAP and conventional treatments and how they performed over time.

### **Data Analysis Summary & Recommendations**

This section will provide a summary of data comparisons between the various sections and recommendations based on the data.

There were visual inspections performed pre, during, and post construction. Those results are summarized below.

### **Conclusions**

This section will provide a conclusion and final recommendation about using RAP in pavement seal projects.

### **REFERENCES**

Duncan, G., L. Sibaja, S. Seeds, and D. Peshkin. 2020. Using Reclaimed Asphalt Pavement in Pavement-Preservation Treatments. FHWA Notice HRT-21-007. Washington, DC: Federal Highway Administration.

Ford, D. 2021. RAP Use in Pavement Preservation Treatments, County of San Diego Building Better Roads White Paper.

Peshkin, D., K. L. Smith, A. Wolters, J. Krstulovich, J. Moulthrop, and C. Alvarado. 2011 Guidelines for the Preservation of High-Traffic-Volume Roadways. REPORT S2-R26-RR-2. Washington, DC. Transportation Research Board.

## **APPENDIX 1: Summary Progress Reports**

### **Location 1 Country TI Road:**

<b>Location 1: (Community Collector/Residential Collector with 1500 to 4500 average daily trips located in the Sweetwater River Valley):</b>					
<b>Section</b>	<b>Road</b>	<b>From</b>	<b>To</b>	<b>Length (MI)</b>	<b>Treatment</b>
1	Country TI	Wild Oats Ln	Blacksmith Rd	0.56	Slurry Seal (Control)
2	Country TI	Blacksmith Rd	Chula Vista Cl	0.50	Slurry Seal (RAP)

**Pre Construction Summary:** We selected Country TI as a model for a Neighborhood Collector with steep slopes. Most of the distress at this location is age-related or associated with utility patches. We selected a slurry seal to address the minor distresses in this location. The road preparation for these sections included RSD and crack treatment. The control section was in a worse pre-paving condition and received 2 times more RSDs.

**Construction Summary:** No major concerns were identified during construction. The construction was performed on September 7, 2022. Both the control and RAP sections were placed according to specifications and passed all testing requirements. The water content of the RAP aggregates was out of specification per QA test results.

**3 Month Review Summary (1/18/2023):** There was a minor amount of raveling and stripping. We observed multiple transverse cracks near the edges and close to utility covers. After reviewing the road review and preconstruction photos, we concluded that most of the cracks are reflective cracking. There was an extensive longitudinal crack parallel to the curb and gutter. We took several photos of these conditions so we could monitor and determine if it has any impact on the performance. We compared this section with the control section of Country Trail, which we resurfaced with a conventional slurry seal. The conventional slurry section is in significantly better condition. The conventional slurry section had minor raveling and few transverse cracks. The PCI for this road was 71 pre-resurfacing. The contractor stated that increasing the emulsion rate for low-traffic roads may improve the crack resistance of RAP slurry sections. The contractor also believes the RAP slurry will perform better if placed in warm weather because the emulsion will combine better with the residual binder in the RAP.

### **6 Month Summary (4/14/2023):**

After duration of 6 months, it can be observed that the color of the RAP seal section has approached the color of the control road section. The control road section has experienced signs of some reflective cracking. Despite this the RAP slurry section still exhibits a greater number of cracks. Most of the cracks are in the vicinity of utility covers and trench cuts. It is important to note that these cracks have not grown extensively.

### **12 Month Summary:**

After 12 months, the color of the RAP seal section remains consistent with that of the control section. RAP slurry section still exhibits a greater number of cracks. Nevertheless, upon comparative analysis over the past 6 months, the size and quantity of these cracks have not shown any noticeable increase. Moreover, there have been no observable indications of bleeding in either section.

**24 Month Summary:**

**Location 1-1 (Control)**

Photo 1-1-1: 3 months



Photo 1-1-2: 3 months



Photo 1-1-3: 6 months



Photo 1-1-4: 6 months



Location 1-2 (RAP Slurry)

Photo 1-2-1: 3 months



Photo 1-2-2: 3 months



Photo 1-2-3: 6 months



Photo 1-2-4: 6 months



**Location 2 Winnetka Dr:**

Location 2: (Community Collector/ Residential Cul-De-Sac with less than 400 daily trips located in the Sweetwater River Valley)					
Section	Road	From	To	Length (MI)	Treatment
1	Winnetka Dr	Pluto Ct	Cul De Sac	0.1	Slurry Seal (RAP)

**Pre Construction Summary:** We selected Winnetka Dr as a model for a Neighborhood Collector and residential Cul-De-Sac. Most of the distress at this location is age-related or associated with utility patches. We selected a slurry seal to address the distresses in this location. The road preparation for this section included RSD and crack treatment.

**Construction Summary:** No major concerns were identified during construction. The QA testing was not performed for this location. Construction was performed in fall, 2023.

**3 Month Review Summary (1/18/2023):** There was a minor amount of raveling and stripping, and we observed multiple transverse cracks near the edges and utility covers. The conventional slurry is in better condition on other roads in the area. We took several photos of the existing distresses. The contractor stated that increasing the emulsion rate for low-traffic roads may improve the crack resistance of RAP slurry sections. The contractor also believes the RAP slurry will perform better if placed in warm weather because the emulsion will combine better with the residual binder in the RAP.

**6 Month Summary (4/14/2023):**

The reflective cracks and cracks around utility covers have increased in both size and number. Additionally, new cracks have emerged throughout the entire road. As a result, the overall condition of road is deemed unacceptable.



**12 Month Summary:**

After 12 months, there's noticeable evidence of reflective cracking and the presence of cracks around utility covers. Nevertheless, the overall size and extent of these cracks have exhibited minimal change compared to their condition 6 months ago. No indications of bleeding have been detected.

**24 Month Summary:**

Location 2: RAP Slurry

Photo 2-1: 3 months



Photo 2-2: 3 months

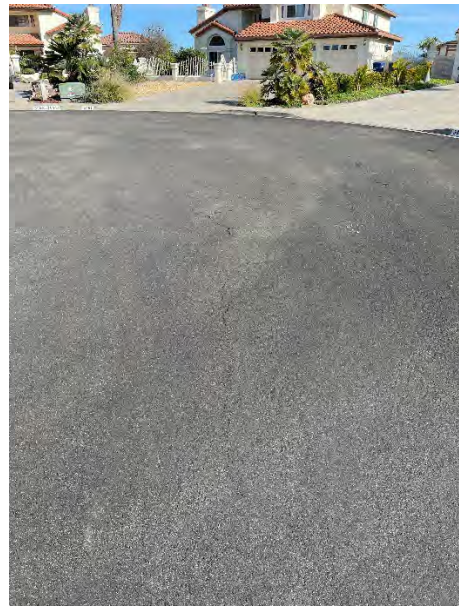


Photo 2-3: 6 months



Photo 2-4: 6 months



### **Location 3 Palm Canyon Dr:**

<b>Location 3: (Community Collectors/Industrial-Commercial Collector with continuous two-way left turn lanes with more than 4500 daily trips located in the Borrego Desert area)</b>					
<b>Section</b>	<b>Road</b>	<b>From</b>	<b>To</b>	<b>Length (MI)</b>	<b>Treatment</b>
1	Palm Canyon Dr	Christmas Circle Dr	Ocotillo Cr/Country Club Rd	0.47	Double Chip Seal (Virgin+Virgin)(Control)
2	Palm Canyon Dr	Ocotillo Cr/Country Club Rd	Five Diamonds Rd	0.48	Double Chip Seal (RAP+RAP)
3	Palm Canyon Dr	Five Diamonds Rd	Hoberg Rd/Montezuma Valley Rd	0.42	Double Chip Seal (Virgin+RAP)

**Pre Construction Summary:** We selected Palm Canyon Dr as a model for a Community Collector with two-way left turn lanes in a desert climate. We divided this road into three sections to compare different RAP chip seal treatments as shown in the table above. The road treatment included RSD and crack treatment.

**Construction Summary:** No major concerns were identified during construction. All the control, Double Chip Seal (RAP+RAP), and Double Chip Seal (Virgin+RAP) sections were placed according to specifications and passed all testing requirements.

**3 Month Review Summary (2/2/2023):** There was a minor amount of raveling and stripping, and we observed a few reflective cracks. Overall, the conventional double chip had more chip loss and more reflective cracks.

#### **6 Month Summary (4/19/2023):**

An evaluation of the sections reveals that all segments are performing in accordance with the desired expectations. Notably, the RAP chip seal exhibits a lower occurrence of cracks. Furthermore, the darker color of the RAP sections contributes to the reduced visibility of these cracks and better striping delineation.

#### **12 Month Summary:**

Upon evaluation, all segments demonstrate performance within anticipated parameters. Notably, the RAP SEAL sections excel in concealing and mitigating Reflective cracking. While occasional instances of bleeding were noted along the wheel path within the RAP seal section, they did not impact road functionality. Additionally, minor bleeding was also observed within the control section.

#### **24 Month Summary:**

Location 3-1 (V+V)

Photo 3-1-1: 3 months



Photo 3-1-2: 3 months



Photo 3-1-3: 6 months



Photo 3-1-4: months



Location 3-2 (RAP+RAP)

Photo 3-2-1: 3 months



Photo 3-2-2: 3 months

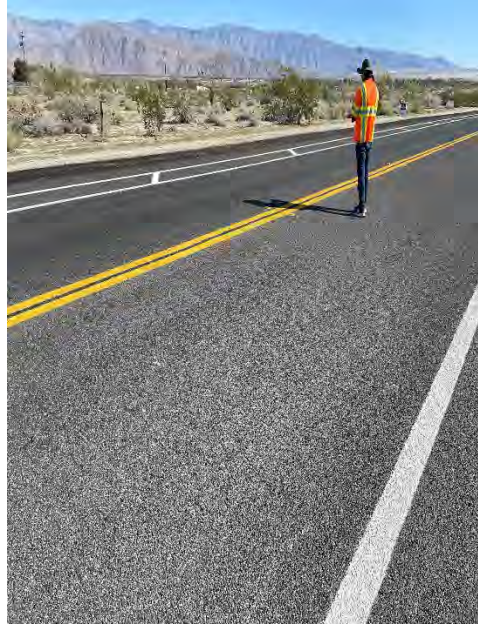


Photo 3-2-3: 6 months



Photo 3-2-4: 6 months



Location 3-3 (V+RAP)

Photo 3-3-1: 3 months



Photo 3-3-2: 3 months



Photo 3-3-3: 6 months



Photo 3-3-4: 6 months



**Location 4:**

**Location 4: (Community Collector/ Residential Cul-De-Sac with less than 400 daily trips in the Borrego Desert area)**

Section	Road	From	To	Length (MI)	Treatment
1	Sun and Shadow Dr	Sun and Shadow Ln	Cul De Sac	0.07	Chip Seal (RAP)
2	Sun and Shadow Ln	Palm Canyon Dr	Sun and Shadow Dr	0.07	Chip Seal (Control)

**Pre Construction Summary:** We selected location 4 as a model for a Neighborhood Collector and residential Cul-De-Sac. Most of the distress at this location is age-related or associated with utility patches. We selected a chip seal to address the distresses in this location. The road preparation for these sections included RSD and crack treatment.

**Construction Summary:** No major concerns were identified during construction. All the control and Chip Seal (RAP) sections were placed according to specifications and passed all testing requirements.

**3 Month Review Summary (2/2/2023):** There was a minor amount of raveling and stripping, and we observed a few reflective cracks. Both control and Rap chip sections were in a similar condition.

**6 Month Summary (4/19/2023):**

Upon inspection, it is evident that the RAP chip section displays noticeable chip loss, particularly at turns and low-speed sections. However, it is important to note that both RAP and control sections are generally in good condition. Notably, the virgin section has exhibited better chip retention compared to the RAP section.

**12 Month Summary:**

Both RAP and control section are in a good condition. No signs of bleeding in either section was observed. Both sections have good chip retention.

**24 Month Summary:**

Location 4-1: Sun and Shadow Dr (RAP chip Seal)

Photo 4-1-1: 3 months



Photo 4-1-2: 3 months



Photo 4-1-3: 6 months



Photo 4-1-4: 6 months



Location 4-2: Sun and Shadow Ln (Control Section)

Photo 4-2-1: 3 months



Photo 4-2-2: 3 months



Photo 4-2-1: 6 months



Photo 4-2-2: 6 months







**APPENDIX 2 – COUNTY OF SAN DIEGO SPECIFICATIONS**

**37 BITUMINOUS SEALS**

Replace *Department’s Independent Assurance Program* in the 1<sup>st</sup> paragraph of section 37-1.01D(1) of the RSS with:

CALTRANS Independent Assurance Program

**Replace 2<sup>nd</sup> paragraph of section 37-1.01D(1) with:**

For emulsion testing, quality control laboratories must be AASHTO accredited laboratories and participated in the AASHTO re:source proficiency sample program.

**Add to the list in the 1<sup>st</sup> paragraph of section 37-2.01A(3):**

- 6. RAP test results for the following (if used):
  - 6.1. Gradation
  - 6.2. Sand Equivalent

**Add to the table of section 37-2.01A(3):**

Sand Equivalent (min, only for RAP)	24 hours
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**Add to the end of section 37-2.01A(4)(b)(ii):**

If RAP is used, RAP screening shall be produced by crushing asphalt concrete pavement, free of detrimental quantities of deleterious materials. RAP quality requirements shown in the following table:

**RAP Quality Control**

Quality characteristic	Test method	Minimum sampling and testing frequency	Location of sampling
Sand equivalent (min)	California Test 217	1 per working stockpile per day	See California Test 125
Gradation (% passing by weight)	California Test 202	2 per working stockpile per day	See California Test 125

**Add to the end of section 37-2.01A(4)(c):**

If RAP is used, for RAP, acceptance is based on the County’s sampling and testing for compliance with the requirements shown in the following table:

**Chip Seal RAP Aggregate Acceptance Criteria**

Quality characteristic	Test method	Requirements
Sand equivalent (min)	California Test 217	80

Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.
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**Add to the end of section 37-2.01B(3)(a):**

If RAP is used, RAP must comply with the requirements shown in the following table:

<b>Chip Seal RAP Requirements</b>		
Quality characteristic	Test method	Requirements
Sand equivalent (min)	California Test 217	80
Gradation (% passing by weight)	California Test 202	Aggregate Gradation table shown under Materials for the chip seal type specified.

**Add the following to the list in section 37-2.01C(2):**

- 4.6. Be 5-ton.

**Add to the beginning of section 37-2.03A(3):**

Provide a Chip Seal Operations Manager with sufficient knowledge and experience (3 similar sized projects within the last 2 years) in chip seal operations. The Chip Seal Operations Manager shall be onsite for all chip seal work and shall provide input on the emulsion formulation and application rates as described elsewhere in this specification. Submit proof of experience within 10 working days of receipt of the Notice to Proceed.

Provide an independent authorized laboratory. The independent authorized laboratory must be accredited under Caltrans' Independent Assurance Program and participate in the AASHTO Proficiency Sample Program. Submit the independent authorized laboratory qualifications to the Engineer for approval within 10 days of the Notice to Proceed.

At least 10 days prior to seal work commencing, provide the following certifications and testing results from the independent authorized laboratory:

1. Certification from the emulsion manufacturer stating that the polymer modified asphaltic emulsion meets the specifications along with testing results from an independent authorized laboratory.
2. Certification from the screenings supplier stating that the screenings meet the specifications along with testing results from an independent authorized laboratory.

At least 10 days prior to starting the seal work, submit the following samples to the Engineer. Sample sizes must conform to the type and size indicated below and must include corresponding SDS/MSDS sheets. Each sample must be clearly labeled as to its contents, project name, job number and supplier name.

1. 1/2 gallon of polymer modified asphaltic emulsion in a clean airtight container.
2. 10 pounds of screenings.

10 days prior to beginning chip seal work, submit proof of distributor truck calibration conforming to CT 109.

During the work, provide Certificates of Compliance for each shipment of polymer modified asphaltic emulsion. Polymer modified asphaltic emulsion shipped without a Certificate of Compliance will not be allowed to be used on the work unless otherwise approved by the Engineer. County is not responsible for any delays associated with obtaining the approval of the Engineer.

Submit quality control testing reports as described herein.

**Replace the 1st sentence in the 2nd paragraph of section 37-2.03B(2) with:**

A polymer modified asphaltic emulsion must be Grade PMCRS2h.

**Add to the beginning of section 37-2.03B(3):**

The size of screenings used shall be medium fine (M-F) or medium (Med) as shown in the contract documents.

**Replace section 37-2.03C with:**

**37-2.03C Construction**

**37-2.03C(4)(a) General**

Reserved.

**37-2.03C(4)(b) Applying Polymer Modified Asphaltic Emulsion**

Polymer modified asphaltic emulsions must be applied within the application rate ranges shown in the following table:

**Polymer Modified Asphaltic Emulsion Application Rates**

Aggregate Size, Aggregate gradation	Application Rate Range (gal/sq yd)	Initial Application Rate (gal/sq yd)
Medium, 3/8"	0.30–0.45	0.38
Medium-Fine, 5/16" (RAP or Virgin)	0.25–0.35	0.32

For double polymer modified asphaltic emulsion chip seals, polymer modified asphaltic emulsions must be applied within the application rates shown in the following tables:

**Polymer Modified Asphaltic Emulsion Application Rates (Virgin Aggregates+ Virgin Aggregates)**

Double Application, Aggregate Size	Application Rate Range (gal/sq yd)	Initial Application Rate (gal/sq yd)
1st application, medium (Virgin)	0.30–0.45	0.32
2nd application, medium-fine (Virgin)	0.20–0.30	0.25

**Polymer Modified Asphaltic Emulsion Application Rates (Virgin Aggregates+ RAP)**

Double Application, Aggregate Size	Application Rate Range (gal/sq yd)	Initial Application Rate (gal/sq yd)
1st application, medium (Virgin)	0.30–0.40	0.32
2nd application, medium-fine (RAP)	0.18–0.25	0.20

**Polymer Modified Asphaltic Emulsion Application Rates (RAP+ RAP)**

Double Application, Aggregate Size	Application Rate Range (gal/sq yd)	Initial Application Rate (gal/sq yd)
1st application, medium (RAP)	0.30–0.40	0.32
2nd application, medium-fine (RAP)	0.18–0.25	0.20

Use the initial application rate for each road. Provide in writing for adjustments to the initial application rate. Application rate may be adjusted if authorized.

Apply polymer modified asphaltic emulsions when the ambient air temperature is from 60 to 105 degrees F and the pavement surface temperature is at least 80 degrees F.

Do not apply polymer modified asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

Do not apply emulsion at a greater distance than can be immediately covered by aggregates/screenings, and, in no case, shall the distributor truck advance more than 200 feet ahead of the screening spreader.

Do not apply polymer modified asphaltic emulsions when weather forecasts predict the ambient air temperature will fall below 39 degrees F within 24 hours after application.

**37-2.03C(4)(c) Spreading Screenings**

Spreading Screenings must conform to Section 37-2.01C(4)(c).

Screening for both virgin aggregate and RAP must be spread within the spread rate ranges shown in the following table:

**Screening Spread Rates**

Screening Size, Screening gradation	Application Rate Range (lb/sq yd)	Initial Application Rate (lb/sq yd)
Medium, 3/8"	20–30	27
Medium-Fine, 5/16"	16–25	24

For double chip seals, virgin aggregates or RAP must be spread within spread rate ranges shown in the following table:

**Screening Spread Rates**

Double Application, Screening Size	Application Rate Range (lb/sq yd)	Initial Application Rate (lb/sq yd)
1st application, medium	23–30	27
2nd application, medium-fine	12–20	18

Use the initial application rate for each road. Provide in writing for adjustments to the initial spread rate. Spread rate may be adjusted if authorized.

Remove excess aggregate on the 1st application before the 2nd application of asphaltic emulsion.

You may stockpile aggregate for the polymer modified asphaltic emulsion chip seals if you prevent contamination. Aggregate must have damp surfaces at spreading. If water visibly separates from the aggregate, do not spread. You may redampen aggregate in the delivery vehicle.

Spread aggregate before the polymer modified asphaltic emulsion sets or breaks.

Do not spread aggregate more than 2,500 feet ahead of the completed initial rolling.

#### **37-2.03C(4)(d) Flush Coat**

Flush Coat must conform to Section 37-4.03.

Apply a flush coat on roads that are scheduled for chip seal (single and double chip seal).

Asphaltic emulsion for the flush coat must be grade CQS1h per Section 94-1.02E.

Asphaltic emulsion must be applied per Section 37-4.03C. Determine the exact application rate.

#### **37-2.03C(4)(e) Finishing**

##### **37-2.03C(4)(e)(i) General**

Finishing must comply with section 37-2.01C(4)(d).

Perform the following work prior to placement of the second application of chip seal on roads scheduled for double chip seal:

1. Initial rolling
2. Final rolling
3. Removal of excess screenings

##### **37-2.03C(4)(e)(ii) Sweeping**

Sweeping must be performed after the chip seal has set and there is no damage or dislodging of screening from the chip seal surface. As a minimum, sweeping is required at the following times:

1. On 2-lane 2-way roadways, from 2 to 4 hours after traffic, controlled with pilot cars, has been routed on the chip seal
2. On multilane roadways, from 2 to 4 hours after aggregate have been placed
3. In addition to previous sweeping, perform final sweeping immediately before opening any lane to public traffic, not controlled with pilot cars

Comply with the following sweeping schedule:

1. Day 1:  
Pre-Application Sweeping:  
Sweep the road on the same day and immediately prior to commencing chip seal operations on a specific road.  
  
Post-Application Sweeping:  
Sweep the road on the same day as chip seal was performed and prior to applying flush coat (if called for) and opening a road to public traffic. Back-pack style blowers must be used to ensure screenings are removed from driveways, gutters, sidewalks, and all other areas where loose screenings are present.
2. Day 2 - 4:  
Perform post application sweeping as described for Day 1.

No sweeping is required on weekends.

The Engineer will order additional sweeping as required. The County does not pay for this additional work.

Assume full liability and pay all costs associated with any claims made for cracked/broken windshields, damage to paint, etc. on roads scheduled for chip seal at no cost to the County.

Go to the “Maintaining Traffic” section of Part 4 of these contract documents for noticing requirements for roads scheduled for chip seal. Include the sweeping schedule on all notices.

The County may assess liquidated damages in the amount of \$2,500.00 per day for each day the sweeping schedule described herein is not adhered to; the work must be performed by your own forces or an outside contractor. The Engineer will determine the cost of said work and deduct from remaining monies owed to you.

**Replace section 37-2.03D with:**

**37-2.03D Payment**

Chip seal is paid for as Polymer Modified Asphalt Emulsion. Payments for screenings and flush coats are not included in payment for Polymer Modified Asphalt Emulsion.

Medium chip seal screening is paid for as Screenings (Med).

Medium-Fine chip seal screening is paid for as Screenings (M-F).

Flush coat asphaltic emulsion is paid for as Asphaltic Emulsion (Flush Coat).

Flush coat sand cover is paid for as Sand Cover.

**Replace the 1st paragraph of section 37-3.01C(4) with:**

Immediately before applying slurry seals or micro-surfacings, remove all channelizers, pavement markers and tubular markers, and clean the surface to receive slurry seals or micro-surfacings by removing any extraneous material affecting adhesion of the slurry seal or micro-surfacing with the existing surface. Use self-propelled power brooms or other methods such as flushing to clean the existing pavement.

**Add to the end of section 37-3.01C(5)(d):**

After spreading polymer modified slurry seal and before opening to traffic, perform rolling consisting of 3 coverages with a pneumatic-tired roller.

**Replace the table titled “Slurry Seal Spread Rates” of section 37-3.02C(4) with:**

<b>Slurry Seal Spread Rates</b>		
<b>Slurry Seal Type</b>	<b>Application Range (lb of dry aggregate/sq yd)</b>	<b>Mean Rate (lb of dry aggregate/sq yd)</b>
Type I	8–12	10
Type II	12–18	15
Type III	20–25	22.5

**Add between the 2nd and 3rd paragraphs of section 37-3.02C(4):**

The initial application rate must be the mean rate. Use the initial application rate for each road. Adjust application rate as needed on a per road basis. Provide in writing for adjustments to the initial application rate.

Do not apply polymer modified slurry seal when there is a danger that the finished product will freeze within 24 hours of placement.

Do not apply polymer modified slurry seal when rain is imminent or weather conditions are unsuitable.

Only place polymer modified slurry seal to insure the roadway will be opened to public traffic by the end of work time listed in Part 4 of these contract documents.

**Replace section 37-4.02A(1) with:**

**37-4.02A(1) Summary**

Section 37-4.02 includes specifications for applying fog seals and fog seals (dike).

**Replace the 1<sup>st</sup> paragraph of section 37-4.02B with:**

**37-4.02B Materials**

Select grade QS1h or CQS1h asphaltic emulsion to be used.

**Add to section 37-6.01A:**

Use only hot-applied crack treatment. Cold-applied crack treatment is not allowed.

The type of crack treatment material to be used at each location is shown in the Part 6 schedules.

**Replace the 1<sup>st</sup> paragraph of section 37-6.03 with:**

Apply crack treatment to all singular cracks up to 1-1/2 inch wide within the traveled way including shoulder areas. Cracks up to 1/2 inch in width must be routed with equipment capable of cutting a 3/4 inch wide by 3/4 inch deep channel along the original crack alignment prior to placing the crack treatment. Do not treat areas experiencing fatigue or "alligator" cracking.

For cracks wider than 1-1/2 inch, apply a tack coat using SS-1H asphalt binder, then apply a fine mix of asphalt material and compact. Prior to commencing this work, obtain written approval from the Engineer for this work and the materials being used.

**Add to section 37:**

**37-7 POLYMER MODIFIED EMULSIFIED ASPHALT-RECLAIMED ASPHALT PAVEMENT (PME-RAP) SLURRY SEAL SURFACING**

**37-7.01 General**

PME-RAP slurry seal must comply with Standard Specifications for Public Works Construction (SSPWC) (Greenbook), 2018 Edition and these special provisions.

**37-7.01A Field Sampling and Testing**

During the performance of the Work, test the quality of work by taking at least 2 field samples of the mixed slurry per slurry mixer per Day. The Wet Track Abrasion Test sample shall not be transported until the slurry has set as defined by ASTM D391. RAP needs to be sampled every day.



### 37-7.01B Department Acceptance

For a PME-RAP, acceptance is based on the Department's sampling and testing for compliance with the requirements for the quality characteristics specified.

RAP acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Quality characteristic	Test method	Requirements
Gradation of Un-Extracted RAP	ASTM C136	Aggregate Gradation table shown in this section.
Sand Equivalent	ASTM D2419	60 Minimum

Slurry acceptance is based on the Department's sampling and testing for compliance with the requirements shown in the following table:

Quality characteristic	Test method	Requirements
Wet Track Abrasion Test, Weight Loss, gm/ft <sup>2</sup> (gm/m <sup>2</sup> ) Type Fine Aggregate	ASTM D3910 <sup>a</sup>	0-50(540)
Consistency Test (mm)	ASTM D3910 <sup>a</sup>	30
Extraction Test (Calculated Emulsion Content, %)	D6307 <sup>b</sup> , CT 382 <sup>b</sup>	± 1 % of mix design
Water Content (% of Dry RAP Aggregate Weight)	See Note <sup>c</sup>	< 25

<sup>a</sup> Modified ASTM D3910 to include No. 4 (4.75 mm) aggregate or greater and to be performed using field samples. Subsection 6.4.4.7, ASTM D 3910 may be modified to use a microwave oven for drying the specimen after the abrasion cycle is complete and the debris washed off.

<sup>b</sup> Modified ASTM D6307 and California Test Method 382 to allow a minimum of 500 ± 50 grams sample.

<sup>c</sup> Weigh a minimum of 500 grams of homogenized mixed slurry into a previously tared quart can with a friction lid. The lid shall be placed on the can to prevent loss of material during transportation. Place the can with the lid off in an oven and dry to constant mass at 220°F ± 10°F (110°C ± 5°C).

ASTM D3910, modified per 203-5.2, shall be used on field samples during performance of the Work. The Contractor shall perform "referee" sampling on its behalf. Each referee sample shall be taken immediately before, during or after the sampling by the Agency. No changes in machine calibration will be allowed between sampling. The Agency will observe the referee sampling to insure compliance with specified procedures. The Agency shall be given the opportunity to observe the remaining portions of the WTAT to assure the accuracy of the referee test. The Contractor shall notify the Engineer at least 24

hours in advance of actual test performance. The referee WTAT shall be performed by an independent, certified laboratory. The results of each referee test will be compared to the respective test performed by the Agency. At the discretion of the Engineer, the referee test may be used as a basis to modify the result of the respective test performed by the Agency. All costs for referee testing shall be considered as included in the Contract Unit Price for emulsion-aggregate slurry.

If the test results fail to meet the Specifications, the Contractor shall cease spreading slurry seal produced by the nonconforming mixer until the Contractor demonstrates the mixer is producing slurry seal which conforms to the Specifications.

### 37-7.02 Materials

#### 37-7.02A General

Not used.

#### 37-7.02B Polymer Modified Emulsified Asphalt (PME)

PME shall be grade PMCQS-1h conforming to 203-3.4.5 of the SSPWC. The percentage of emulsified asphalt and residual asphalt content shall conform to the requirements shown in the following table:

Tests	Test method	Requirements
Emulsified Asphalt, % by weight of dry RAP Aggregate	-	9.0-14.0
Residual Asphalt Content, % by weight of dry RAP Aggregate	ASTM D6307 <sup>a</sup> Or CTM 382 <sup>a</sup>	11.0 Min

<sup>a</sup>Sample size shall be 500g minimum.

#### 37-7.02C Reclaimed Asphalt Pavement (RAP) Slurry Seal Aggregate

##### 37-7.02C(1) General

RAP used to produce RAP slurry seal aggregate shall conform to 203-6.2.5, except for sand equivalent, and the requirements in the following table:

Tests	Test method	Requirements
Percentage Wear, 500 Revolutions <sup>a</sup>	ASTM C131	35% Maximum
Sand Equivalent	ASTM D2419	60 Minimum
Soundness (5 Cycles) <sup>a</sup>	ASTM C88	15% Maximum
Durability	CTM 229	55 Minimum

<sup>a</sup>On RAP retained on No. 4 sieve.

##### 37-7.02C(2) Grading

The grading of the combined RAP aggregates shall conform to the requirements shown in the following table:

<b>Gradation</b>		
Requirements	Un-Extracted RAP-% OF Combined Aggregate Passing Sieves (ASTM C136)	Extracted RAP-% OF Combined Aggregate Passing Sieves (ASTM C136)
3/8" (9.5 mm)	100	100
No. 4 (4.74 mm)	90 - 100	90 - 100
No. 8 (2.36 mm)	60 - 90	65 - 90
No. 16 (1.18 mm)	35 - 60	45 - 70
No. 30 (600 µm)	23 - 45	30 - 50
No. 50 (300 µm)	12 - 30	18 - 36
No. 100 (150 µm)	5 - 20	10 - 24
No. 200 (75 µm)	0.5 - 10	5 - 15

### **37-7.02D Water**

Water shall be potable and compatible with the other ingredients of the slurry.

### **37-7.02E Set Control Agents**

Set control agents shall conform to 203-5.4.2.5 of the SSPWC.

### **37-7.02F Mix Designs**

Mix designs shall conform to 203-5.2 of the SSPWC.

### **37-7.02G Continuous-Flow Mixers**

PME-RAP slurry seal shall be mixed in continuous-flow mixers conforming to 302-4.3 of the SSPWC and the following:

Prior to the beginning of slurry operations, the Contractor shall furnish current licensed weighmaster's certificates indicating the net weight capacity of the aggregate bin of each mixer. Except for partial loads to complete a Day's schedule, or for patching, each mixer shall be filled to its rated capacity and the Engineer and the Contractor shall each keep a daily count of the number of loads and/or partial loads applied to the surface of the existing pavement by each mixer. Each aggregate bin shall have permanent calibration marks in maximum increments of 2 tons.

### **37-7.03 Construction**

#### **37-7.03A General**

Treat cracks under section 37-6. Do not place the slurry seals until the Engineer determines that the crack treatments are cured. All Cracks less than 1/4 inch shall be blown out with compressed air immediately prior to placing slurry seals.

PMERAPAS shall be applied at a rate of 10 to 15 pounds of dry RAP aggregate per square yard over existing or micro-milled pavement and at a rate of a minimum of 19 pounds of dry RAP aggregate per square yard over chip seals. The exact rate shall be as directed or approved by the Engineer.

When the Engineer determines that the application rate does not conform to the requirements, the Contractor shall take immediate corrective action. When the rate is less than the minimum amount

required, the Contractor shall reapply additional PME-RAP slurry seal material to the nonconforming area to meet the requirements.

The sites for stockpiling and batching materials shall be free and clean from objectionable material. Arrangements for these sites shall be the responsibility of the Contractor.

The Contractor shall have 2 fully operational mixers for use at the Work site at all times. These mixers shall be available for inspection by the Engineer at least 48 hours prior to commencing the Work.

### **37-7.03B Spreading and Application**

Spreading and application shall conform to 302-4.8 of the SSPWC and the following:

The Contractor will be required to work around all existing utility facilities and to seal up to the edges of said facilities. During sealing operations, the Contractor shall cooperate with the owners of any utility covers and shall cover and completely protect said covers with heavy plastic or other suitable material. Raised pavement markers shall be removed or covered and completely protected as directed by the Engineer. The Contractor shall exercise care to prevent slurry from being deposited on concrete surfaces and shall remove slurry from surfaces not designated to be sealed. Covering of slurry on concrete surfaces with sand, cement, or paint will not be acceptable.

PMERAPAS, after spreading and application, shall be rolled with 3 passes of a pneumatic roller conforming to 302-2.3.5 of the SSPWC.

### **37-7.04 Payment**

#### **37-7.04A General**

Payment for PMERAPAS will be made at the Contract Unit Price per ton for "PME-RAP SLURRY SEAL SURFACING." No separate payment will be made for portable scales.

The basis of measurement shall be the weight of materials, in tons, used in the Work, as determined by licensed weighmaster certificates. Upon completion of the Work, the Contractor shall submit to the Engineer licensed weighmaster certificates for materials delivered to the Work site and for excess materials not incorporated into the Work.

PME-RAP slurry seal will be measured by the total of the tonnage of polymer modified emulsified asphalt (PMCQS-1h) and RAP slurry seal aggregate used in the Work.

The Contractor shall submit to the Engineer, no later than noon of the first Working Day following the day of delivery, licensed weighmaster certificates showing the weight of emulsified asphalt and RAP slurry seal aggregate delivered to the Project stockpile/storage site. Only PME and RAP aggregate intended for use on the Work shall be delivered to the Project stockpile/storage site. Deliveries shall not be made on Saturday, Sunday, or holidays unless otherwise approved by the Engineer. Prior to acceptance of the Work, the Contractor shall also submit to the Engineer licensed weighmaster's certificates showing the weight of PME and RAP aggregate remaining at the Project site. Payment will be determined by deducting the weight of unused PME and unused RAP aggregate from the total weight of each material delivered to the Project stockpile/storage site. The Engineer will compare these quantities to the quantities calculated by multiplying the number of loads spread by each continuous-flow mixer times the net weight capacity of each mixer. The Engineer will adjust the calculated weights for partial loads and deduct the quantities of each material used to prevent tracking, if any. If there is an unaccountable difference between the respective weights, final measurement will be determined by the Engineer using the method showing the lesser weight.

The Contractor shall furnish, operate, maintain, and remove portable scales at the stockpile site. Scales shall be calibrated, certified, and sealed after installation and prior to initial use by a State of California Department of Food and Agriculture, Division of Measurement Standards, Registered Service Agency. A listing of registered service agencies is available at the following:

**37-7.04B Payment Reduction**

If the average of all Wet Track Abrasion Tests made per slurry mixer per day by the Engineer fail to conform to the requirements specified in this section, the Contractor agrees that payments for the work represented by the failed tests shall be reduced as shown in the following table:

WTAT Loss gm/ft <sup>2</sup> (gm/m <sup>2</sup> )	Payment Reduction (Percent)
0 – 50 (0 – 540)	0
50.1 – 60 (540.1 – 650)	5
60.1 – 70 (650.1 – 750)	15
70.1 – 80 (750.1 – 860)	30
80.1 – 99 (860.1 – 1070)	70
99.1 or greater (1070.1 or greater <sup>a</sup> )	100

<sup>a</sup> Slurry seal surfacing with WTAT loss greater than 99.1 gm/m<sup>2</sup> (1070.1 gm/ft<sup>2</sup>) shall be removed to the satisfaction of the Engineer.

## **APPENDIX 3**

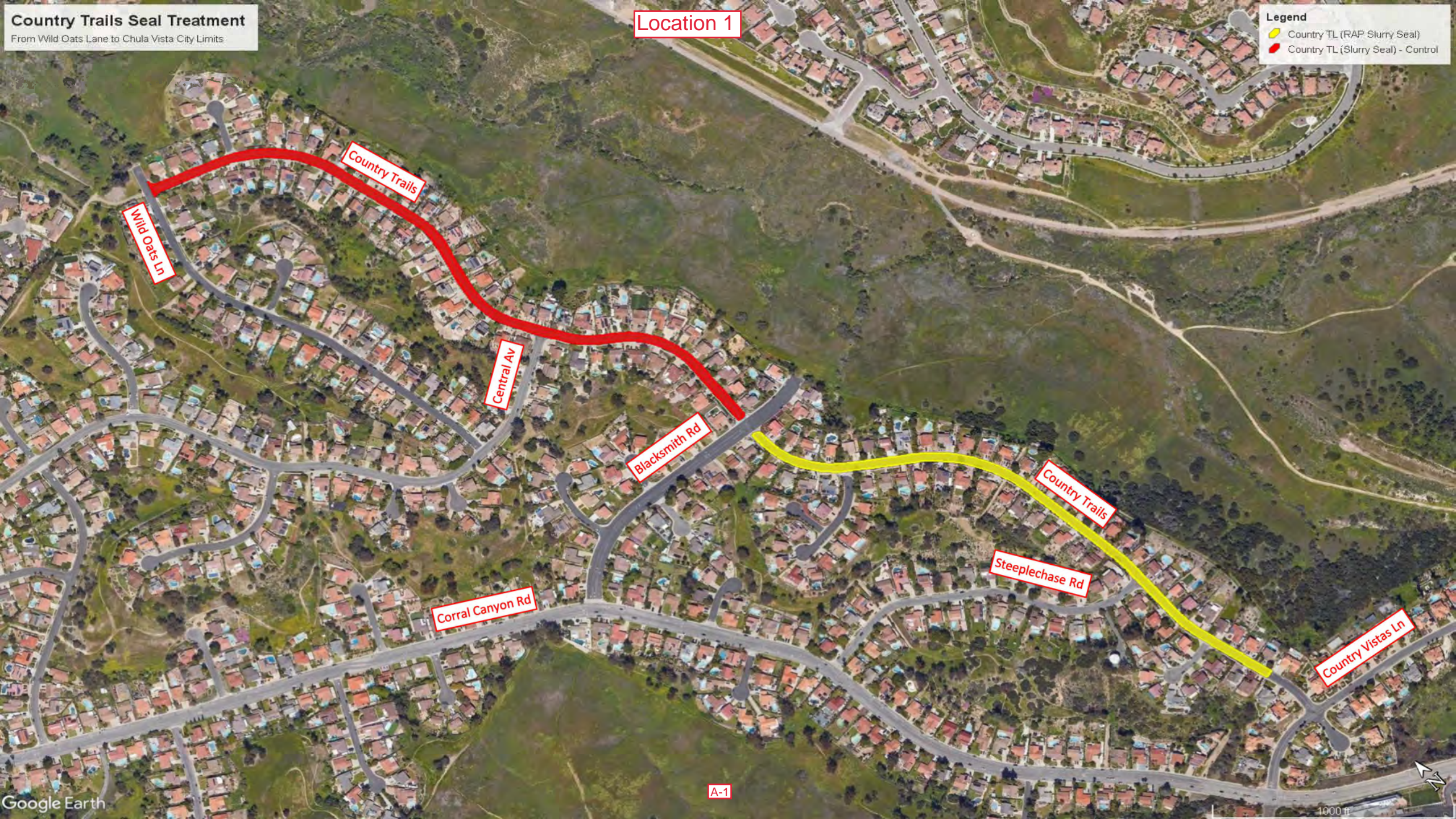
# **LOCATION EXHIBITS**

# Country Trails Seal Treatment

From Wild Oats Lane to Chula Vista City Limits

Location 1

- Legend**
- Country TL (RAP Slurry Seal)
  - Country TL (Slurry Seal) - Control



Winnetka Dr Seal Treatment  
from Pluto Ct to Cul de Sac

Location 2

Winnetka Dr (PA) Seal

Pluto Ct

Winnetka Dr

Wheeling Ln

A-2

200 ft








# Palm Canyon Dr Seal Treatment

From Christmas Circle Dr to Hoberg Rd/Montezuma Vly Rd

Location 3

- Legend**
-  Palm Canyon Dr (Double Chip Seal, RAP+RAP)
  -  Palm Canyon Dr (Double Chip Seal, V+RAP)
  -  Palm Canyon Dr (Double Chip Seal, V+V)



Hoberg Rd

Montezuma Valley Rd

Five Diamonds Rd

Palm Canyon Dr

Ocotillo Cir

Country Club Rd

Christmas Circle Dr

Borrego Springs Rd

A-3



# Sun and Shadows Dr and Ln Seal Treatments

From Palm Canyon Dr to Cul de Sac

Location 4

- Legend**
- Sun and Shadow Dr (RAP Chip Seal)
  - Sun and Shadow Ln (Chip Seal) - Control



Palm Canyon Dr

Ocotillo Cir

Country Club Rd

Sun and Shadows Ln

Sun and Shadows Dr

A-4

