STATE OF CALIFORNIA
AIR RESOURCES BOARD

# MEETING OF THE RESEARCH SCREENING COMMITTEE

**March 19, 2024**
**10:00 a.m.**

Air Resources Board
Research Division
Cal/EPA Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753

**California Air Resources Board**

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753
March 19, 2024
10:00 A.M

**Agenda**

I. Approval of Minutes of Previous Meeting

January 18, 2024 *i-v*

II. Discussion of Draft Final Reports

1. "Evaluating the Potential for Housing Development in Transportation-Efficient and Healthy, High-Opportunity Areas in California" University of California, Irvine, $599,974, Contract No. 20STC009 1

2. "Health Impacts of California Wildfire PM2.5 Across the Lifespan: Wildfire Exposure to Rhesus Monkeys," University of California, Davis, $452,811, Contract No. 19RD005 6

3. "Remote Sensing Measurements of Light-Duty Vehicle Emissions at Multiple California Locations," Eastern Research Group, $449,958, Contract No. 20RD001 10

III. Other Business

1. Update on Research Planning

**California Air Resources Board**

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Sacramento, CA 95814
(916) 445-0753

January 18, 2024
10:00 A.M

**Minutes**

**Research Screening Committee Members in Attendance via Teleconference**
Aly
Francesca
Roya
Sam
Bryan

I. Approval of Minutes of Previous Meeting

November 17, 2023

II. Discussion of a Research Proposal

1. "Ozone Exposure and Respiratory Effects- School Absenteeism, Asthma-Related Symptoms, and Asthma-Related ED visits and Hospitalizations", University of California, Los Angeles, $500,000

   Research Screening Committee (RSC or Committee) members provided the following key comments:

   - The socioeconomic characteristics of urban core areas and suburban areas can be quite different. Researchers should be able to look at these different urban and suburban areas with different diurnal profiles of ozone and assess how the concentration-response (C-R) functions differ.

   - The current ozone NAAQS uses the daily 8-hour max as the metric, rather than a daily or weekly average. Using the weekly average of the daily 8-hour maximum might be more appropriate to capture exposure during key high ozone periods.

   - Consideration should include interaction between air pollution and key variables such as taking medications to control asthma, health insurance coverage, and household income.

Staff responded as follows:
Thank you for the comments. The researchers will analyze the C-R functions by stratifying the urban and suburban areas with different diurnal profiles of ozone. For the analyses, the researchers will use the weekly average of the daily 8-hour max and annual average of the daily 8-hour max ozone exposure. The researchers will also examine the intersection between asthma management strategies (e.g., daily medication use), insurance coverage, income level, and air pollution exposures.

Motion: Move to recommend that California Air Resources Board (CARB) accept the proposal, subject to the inclusion of revisions based on Committee comments.

The Committee approved the motion.

III. Discussion of a Proposed Contract Augmentation

1. "Examining the Health Impacts of Short-Term Repeated Exposure to Wildfire Smoke," University of California, Irvine, $25,000, Contract No. 21RD003

   The Committee expressed support for the proposed augmentation of the community outreach efforts in this project, specifically conducting a survey in disadvantaged communities, evaluating the results of the survey, translating information into Spanish, and providing stipends for participants. Committee members stressed the need to convey the epidemiology findings of this project through community engagement. Also, members addressed federal Environmental Protection Agency's concerns on focusing the health analysis on wildfire-specific exposure. The Committee suggested taking total fine particulate matter (PM2.5) exposure into account and examining the modification effects of wildfire smoke in the epidemiological analysis. While this analysis will not be possible in the current project, it should be considered in future analysis and research.

   Motion: Move to recommend that CARB accept the proposal, subject to the inclusion of revisions based on Committee comments.

   The Committee approved the motion.

IV. Discussion of Draft Final Reports

1. "Measurements of Volatile Organic Compounds in the South Coast Air Basin: Chemical Characterization and Impacts on Potential Ozone and PM Formation," National Oceanic and Atmospheric Administration, $294,284, Contract No. 20RD002

Committee members praised the comprehensiveness of the report, particularly the ambient air quality data collected during the 2021 ReEvaluation of California Air Pollution (RECAP-CA) research campaign. One member verified that the data was publicly accessible in the National Oceanic and Atmospheric Administration database. The importance of decadal air pollution trend comparisons in the Draft Final Report (DFR) was emphasized. Committee members recommended minor editorial changes, limited to missing information in a figure/report.

Motion: Move to recommend that CARB accept the proposal, subject to the inclusion of revisions based on Committee comments.
The Committee approved the motion.

2. "Measuring, Analyzing and Identifying Small-Area Vehicle Miles Traveled Reduction," University of California, Davis, $199,500, Contract No. 20RD006

   The Committee opened this item by noting that this contract was discussed and reviewed at the last RSC meeting on November 17, 2023. The Committee stated that several comments were made, and it was recommended the Contractor address the comments and submit a revised DFR for the RSC to review and discuss at the January 18, 2024, meeting. Initially, the Committee expressed concerns that the changes they requested were not fully addressed in the revised version. The Committee specified that they had requested the inclusion of additional data on a scale fine enough to account for changes in bike and pedestrian travel behavior changes and that those changes should be included in the accounting of changes in vehicle miles traveled (VMT). However, staff commented that they had reviewed the revised DFR and considered the revisions acceptable in accordance with the comments raised by the RSC in November and the scope of this contract. Further, staff went on to summarize the revisions made by the Contractor, which included language to say the results are inconclusive, an explanation in the methodology section about the weighting for the datasets used in the project, figures edited to include margin of error, and additional formatting issues.

   Motion: Move to recommend that CARB accept the proposal, subject to the inclusion of revisions based on Committee comments.

   The Committee approved the motion.

3. "Low-Carbon Transportation Incentive Strategies Using Performance Evaluation Tools for Heavy-Duty Trucks and Off-Road Equipment," University of California, Irvine, $1,000,000, Contract No. 19RD026

The Committee provided a summary of the project objectives and provided the following recommendations on the DFR. Members also provided the following comments:

Abstract: Currently the abstract includes names of the research team members. The Committee recommended removing those names and instead including a summary of the methods used and of the findings of the project.

Executive Summary: Committee members recommended that the research team expand the executive summary to include a summary of all the methods used in the project and the main outcomes from each method. A discussion of potential impacts, limitations and the importance of the findings is needed.

Individual Tasks: For each task chapter, it was recommended that the research team provide a brief introduction at the beginning as well as a summary of findings at the end.

General writing and clarity issues:
The Committee noticed the use of very long sentences that should be broken up and clarified. There were also many instances where it was not clear if the research team was citing its own work or that of the literature.

Performance Evaluation Tool Model Chapter:
On page 127 the research team included a map with 163 zones, county lines, air basins, air quality management districts, utilities, etc. Committee members requested the research team clarify if this was a standard map and how they developed it if it was done in-house.

Interview Chapter:
The Committee recommended that the research team clarify upfront how many interviews were actually carried out. The number was 12 and that information was hard to find. It was challenging to find which questions were asked and the information should be more readily available, which would benefit this DFR.

Motion: Move to recommend that CARB accept the proposal, subject to the inclusion of revisions based on Committee comments.

The Committee approved the motion.

V. Other Business

1. Update on Research Planning

Research Division staff provided the RSC with an update on the funding year 2024-2025 annual research plan presented at the prior RSC meeting. The proposed projects have been prioritized into two (2) funding tiers and this list of projects is currently under review by the Executive Office. Once approved, the projects will go out for solicitation of pre-proposals or proposals in cases where a principal investigator has been identified.

Research Division staff also provided a brief update on the 5-Year Strategic Research Plan. The planning process for developing this document has commenced and the RSC will be updated in future meetings on proposed research initiatives that will be included in the Plan.

**Item No.:** II.1
**Date:** March 19, 2024
**Contract No.:** 20STC009

**Staff Evaluation of a Draft Research Final Report**

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|---|---|
| Title: | Evaluating the Potential for Housing Development in Transportation-Efficient and Healthy, High-Opportunity Areas in California |
| Contractor: | University of California, Irvine |
| Principal Investigator: | Nicholas J. Marantz, JD, PhD |
| Contract Type: | Interagency Agreement |
| Budget: | $599,974 |
| Contract Term: | 36 Months |

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For further information, please contact Dr. Aaron Kurz at (279) 216-0422 or *Aaron.Kurz@arb.ca.gov*.

## I. Summary

This study identifies transportation-efficient (TE), healthy, high-opportunity (HHO) areas for housing development within California. Adding housing in these areas could promote housing affordability and reduce greenhouse gas emissions, while contributing to enhanced socioeconomic mobility and more equitable development patterns. Based on data provided by regional planning organizations and local jurisdictions, the development potential in the identified census tracts substantially exceeds the number of existing units. However, the layering of regulatory restrictions may impede development at the assumed planned densities. This study identifies policy levers to promote development in the identified areas, including regulatory changes to expedite the approval of infill housing, to increase the financial feasibility of infill housing, and to more effectively target regulatory requirements related to the provision of below-market-rate housing units.

## II. Technical Summary

### Objective

The main objectives of this project are to identify where HHO and TE areas are located within California, to evaluate the potential for new development therein, to identify policy levers to promote development, and to assess implications for social and racial equity. The results of this study will inform policies related to Senate Bill (SB) 375 along with other policies and programs at other State agencies (e.g., California Department of Transportation, Department of Housing and Community Development, Governor's Office of Planning and Research, and Strategic Growth Council).

### Background

California faces a variety of housing-related challenges that have serious implications for environmental sustainability, climate protection, and social and racial equity. Many of these challenges stem from a statewide lack of housing, particularly affordable housing. At the same time, and in part due to the housing shortfall, California is also struggling to meet critical climate and air quality goals, especially VMT reductions required by SB 375. This study was conceived to identify areas that are particularly well-suited for housing development because they are (or could become) transportation-efficient (e.g., low VMT per capita with transit and active transportation infrastructure and services) and offer (or with improvement, could offer) current and future residents healthy, high opportunity places to live. Although a variety of tools have been proposed to categorize TE, HHO areas, each tool has potential methodological shortcomings for the purposes of identifying high-priority areas for development. In addition, realistically assessing development potential requires the application of clear and plausible assumptions to detailed spatial data concerning local zoning and the regulatory approvals process. In short, policymakers require analytical tools specifically tailored to identifying high-priority areas for new development statewide, as well as plausible information concerning the potential for development in high-priority areas.

**Project Summary**

First, the Contractor developed definitions and classified California's census tracts into "TE-HHO", "TE-adjacent, HHO," "TE", or "non-TE, non-HHO." The HHO areas were identified through a metric based on measures of neighborhood income, income mobility, and pollution burdens. TE areas were identified using factor-cluster analysis based on a range of built environment characteristics, including population density, job accessibility, public transit utilization, housing types and ages, and road density. The TE-adjacent, HHO areas were defined as HHO areas that may be particularly susceptible to becoming TE due to their proximity to TE areas.

Next, the Contractor evaluated the development potential in priority areas (i.e., TE-HHO areas and TE-adjacent, HHO areas) based primarily on the maximum allowable density provided in local general plans. They did this by using harmonized land use data provided by regional planning agencies, supplemented by local data collected from individual jurisdictions.

Finally, the Contractor compared the estimated development potential, based on general plan data, to housing needs identified via two different methods: the regional housing needs assessments conducted under California's Housing Element Law and the land use plans created pursuant to the Sustainable Communities and Climate Protection Act (SB 375). They assessed implications for social and racial equity by examining the degree of ethno-racial segregation, screening for gentrification, and analyzing residential mobility patterns to and from priority areas.

The results show that the estimated development potential in priority areas is much higher than the number of existing units, providing adequate capacity to accommodate existing and future housing needs. The notable difference between the estimated buildout and existing units is largely due to the high densities indicated in many land use plans. These plans should serve as blueprints for future development, but achieving the high planned number of housing units may be unattainable due to regulatory constraints.

Expanding housing opportunities in the identified priority areas can contribute to enhanced socioeconomic mobility. Relative to the rest of the state, these priority areas are more likely to be racially concentrated areas of affluence (as defined by the California Department of Housing & Community Development) and less likely to be affected by gentrification. The findings also reveal that these priority areas do not provide substantial housing opportunities for new entrants, which could perpetuate a lack of diversity in household composition.

Results reveal that, compared with the rest of the United States, multifamily housing permitting in California has been significantly lagging since 2015. Findings identify several policy levers for opening TE-HHO and TE-adjacent, HHO areas to more housing, including: 1) Changing substantive and procedural requirements for the development of housing types such as townhomes, duplexes, triples, and quadplexes in single-family zoning districts statewide; 2) Requiring each local government to identify presumptive densities for sites included in the Housing Element of its general plan; 3) Providing authoritative maps of sites that should be exempt from California Environmental Quality Act review for housing development or that should qualify for expedited review of their exempt status; 4) Facilitating the targeting of incentives and mandates for below-market-rate housing based on quantitative models; and 5) Improving data collection to enable accurate statewide mapping and policy modeling.

## III. Staff Comments

The research team delivered the first draft final report to CARB in February 2024, which was subsequently distributed for review to various staff within CARB, the California Department of Transportation, the Department of Housing and Community Development, the Governor's Office of Planning and Research, and the Strategic Growth Council. Within CARB, the draft report was distributed for review by representatives from: 1) Office of Community Air Protection; 2) Office of Environmental Justice, Tribal Affairs, & Border Relations; 3) Research Division; and 4) Sustainable Transportation and Communities Division.

Initial staff comments received have been positive and include the following suggestions to improve the final report: 1) Discuss the role and impact of the advisory committee in this study; 2) Expand upon the biases and limitations with the approaches taken to define TE and HHO areas; 3) Include a glossary of key terms upfront; and 4) Minor formatting changes for ADA compliance. Further staff comments are expected by March 12, 2024. The contract manager will update the committee with staff feedback during the RSC meeting on March 19, 2024.

One reviewer provided a comment that falls beyond the scope of the project, requesting a market feasibility assessment of the studied areas.

## IV. Staff Recommendation

Staff recommends the Research Screening Committee recommend that CARB accept this DFR, subject to inclusion of appropriate additions and revisions specified by the Committee.

**Item No.:** II.2
**Date:** March 19, 2024
**Contract No.:** 19RD005

**Staff Evaluation of a Draft Research Final Report**

| | |
|---|---|
| Title: | Health Impacts of California Wildfire PM2.5 Across the Lifespan: Wildfire Exposure to Rhesus Monkeys |
| Contractor: | University of California, Davis |
| Principal Investigator: | Lisa A. Miller, Ph.D. |
| Contract Type: | Interagency Agreement |
| Budget: | $452,811 |
| Contract Term: | 36 Months |

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For further information, please contact Dr. Hye-Youn Park at (279) 208-7525 or *Hye-Youn.Park@arb.ca.gov*.

## I. Summary

Although wildfires in California are predicted to increase in frequency and intensity in the coming years, lifelong health effects from acute wildfire smoke exposure in sensitive groups such as children are currently unknown. This study aims to investigate the effects of wildfire smoke exposure on the long-term health of rhesus macaque monkeys. The findings of this study on primates indicate that exposure to ambient wildfire smoke PM2.5 during early life is associated with immune dysfunction, sleep disorders, and structure changes in the lungs that may persist into adulthood. This suggests that similar adverse health effects may occur in humans from early life exposure to wildfire smoke. Therefore, the results of this study will assist CARB in understanding wildfire smoke impacts on children's health and informing efforts to protect public health from the harmful effects of air pollution.

## II. Technical summary

### Objective

The primary objective of this study was to investigate the long-term impact of wildfire smoke PM2.5 exposure on the health of rhesus macaque monkeys. The study examined a cohort of adult female rhesus monkeys (13 years old) who were exposed during their infancy (around 3 months old). They were housed outdoors at the California National Primate Research Center (CNPRC) in Davis, CA, when the Trinity and Humboldt County wildfires occurred in June-July 2008. Specifically, the study aims to investigate whether:

1) Wildfire smoke PM2.5 exposure can result in persistent dysregulation of immune function in peripheral blood;
2) Wildfire smoke PM2.5 exposure can persistently compromise lung function, such as lung volume and structural changes; and
3) Physical activity levels, such as body movement and sleep patterns, can be impacted.

### Background

Wildfires contribute significantly to air pollution, and their occurrence is anticipated to rise due to climate change. The impact of acute wildfire smoke PM2.5 exposure on the development of chronic lung diseases is not yet fully understood, particularly in vulnerable populations such as young children.

CARB previously funded two studies involving a cohort of male and female primates (rhesus monkeys) housed in CNPRC outdoor colonies and had experienced natural exposure to outdoor smoke PM2.5 from the 2008 Trinity and Humboldt County wildfires during infancy. These studies utilized a primate model that is highly relevant to the study of pediatric populations. The study of 3-year-old adolescents found persistent changes in lung function and immune dysregulation when compared with age-matched animals not exposed to

wildfire smoke. A second cohort study found that 8-year-old adult females, along with their offspring, showed weakened immune systems and reduced lung functions. The current contract continued to investigate the same cohort of female monkeys, now age 13, focusing on non-invasive methods to evaluate chronic lung diseases, such as pulmonary fibrosis.

**Project Summary**

In this study, the investigators continued to assess the change in immune and lung function in 13-year-old adult female monkeys. They were born in the spring of 2008 and exposed to wildfire smoke PM2.5 as infants (around 3 months old). For controls, the researchers also examined 13-year-old female monkeys born in the spring of 2009 who were not exposed to wildfire smoke PM2.5 as infants.

Evaluating the long-term health impacts of exposure to wildfire smoke PM2.5 involves: 1) evaluating the peripheral blood response to microbial ligands to measure immune function; 2) assessing lung function using high-resolution computerized tomography (HRCT), including lung volume and structural changes; and 3) collecting activity monitoring data to measure whole-body movement and sleep patterns. Peripheral blood cells exhibited enhanced cytokine production compared to the control group, suggesting alterations in immunity, which protects the body against infections and diseases. Adult monkeys showed increased activity levels and reduced sleep duration, a shift in the timing of daily activity compared to the controls, suggesting alterations in their circadian rhythm. Regarding lung function, an analysis of thoracic HRCT scans conducted on adult monkeys exposed to wildfire smoke PM2.5 showed alterations in lung structure. However, no significant differences in lung volume were observed compared to the control group. This study provides critical insights into the long-term impact of early-life exposure to ambient wildfire smoke PM2.5 on rhesus macaque monkeys. The study shows that this type of exposure can result in sleep disorders, dysregulation of immune responses that may persist throughout their lifetime, and irreversible changes in lung structure.

## III. Staff comments

Dr. Miller submitted the DFR titled "Health Impacts of California Wildfire PM2.5 Across the Lifespan: Wildfire Exposure to Rhesus Monkeys". The initial DFR submission did not include the results of Task 4: Analysis of Lung Structure and Function (high-resolution computerized tomography (HRCT) data) because of delays in acquiring results from the sub-contractor. CARB staff in the Research Division and staff from the Office of Environmental Health Hazard Assessment (OEHHA) reviewed the DFR. Dr. Miller revised the DFR, incorporating Task 4 results and addressing reviewers' comments. Subsequently, the DFR was submitted to the RSC for review.

Overall, reviewers considered the DFR well-written and concluded that the study contributes to the scientific understanding of the long-term health effects of early-life wildfire exposure. The reviewers had no major concerns about the DFR. Most of the comments were for clarification, such as defining acronyms, providing citations missing figure captions including p-values.

The researchers have incorporated the findings of Task 4 (Lung Function data) and updated the discussion. To provide more clarity, the researcher included a list of abbreviations, citations of references, and the p-value on the figure. The revised report has improved compared to the initial version. The project has successfully met its stated objectives. The DFR provides an accurate account of the completed work.

## IV. Staff Recommendation

Staff recommends the Research Screening Committee recommend that CARB accept this DFR, subject to inclusion of appropriate additions and revisions specified by the Committee.

**Item No.:** II.3
**Date:** March 19, 2024
**Contract No.:** 20RD001

**Staff Evaluation of a Draft Research Final Report**

| | |
|---|---|
| Title: | Remote Sensing Measurements of Light-Duty Vehicle Emissions at Multiple California Locations |
| Contractor: | Eastern Research Group (ERG) |
| Principal Investigators: | Alan Standard and Sandeep Kishan |
| Contract Type: | Request for Proposal |
| Budget: | $650,000 |
| Contract Term: | 42 Months |

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For further information, please contact Dr. Seungju Yoon at (279) 842-9159 or *Seungju.Yoon@arb.ca.gov*.

## I. Summary

Light-duty vehicles (LDV) continue to contribute to air pollution at both community and regional levels in California. This project uses roadside-deployed remote sensing devices (RSD) to measure exhaust carbon monoxide (CO), hydrocarbon (HC), and nitrogen oxides ($NO_X$) emission rates from LDV and heavy-duty vehicles (HDV) with downdraft exhaust tailpipes at 8 California locations, and use the data, along with RSD data measured at an additional location under a companion project, to analyze emission characteristics for geographically diverse fleets. The analysis shows: long-term LDV fleet emission rates measured at a West Los Angeles site for two decades continued to trend downward for nitric oxide (NO), remained unchanged for CO, and increased slightly for HC in the two most recent campaigns (2018 and 2021); vehicles registered in socioeconomically disadvantaged communities (DAC) emit at significantly higher rates than their non-DAC-registered counterparts even after adjusted for model year differences; electric vehicle (EV) prevalence was noticeably higher in non-DAC as compared to DAC; HDV NO emission rates generally decreased with model year; the Mexico-registered vehicles had significantly higher average

emission rates for CO and NO than their California-registered counterparts; average emission rates for vehicles registered in change-of-ownership (COO) areas were generally higher than those registered in biennial Enhanced Smog Check inspection areas, especially for pre-2000 model year vehicles. The data and findings could inform CARB's mobile source emissions inventory, Community Air Protection Program, LDV and HDV in-use emission compliance programs, EV purchase incentive programs, and Smog Check program.

## II. Technical Summary

### Objective

This project used roadside-deployed RSD to measure exhaust CO, HC, and $NO_X$ emission rates from LDV and HDV with downdraft exhaust tailpipes at eight (8) California locations: Stockton, Bakersfield, West Los Angeles, Oakland, El Centro, Riverside, City of Industry, and San Ysidro. Data analyses were performed with the collected data, along with RSD data collected at a Fresno site under a companion project sponsored by the Coordinating Research Council (CRC), to achieve the following six (6) objectives:

1) Continue tracking long-term fleet emission characteristics trends;
2) Evaluate vehicle emission rate disparities between DAC and non-DAC across the State;
3) Gauge EV penetration in DAC and their impact on fleet emission at community level;
4) Evaluate HDV vehicle profiles and emission characteristics;
5) Evaluate United States-Mexico border-crossing vehicles' air pollution impact on border communities; and
6) Evaluate Smog Check program attributes.

### Background

LDVs continue to be a major source of $NO_X$ and reactive organic gases (ROG) emissions in California, contributing to air pollution at both community and regional levels. Between 1999

and 2018, CARB, the California Inspection and Maintenance Review Committee (IMRC), and the CRC have sponsored studies to measure LDV exhaust emissions using an RSD at a West Los Angeles roadside location (ramp from South La Brea Avenue southbound to Interstate-10 eastbound). The longitudinal data shows that the LDV fleet has gradually become cleaner over the years. The data also suggests significant emission rate disparities between vehicles registered in DAC and those registered in non-DAC in the Los Angeles area.

In order to effectively reduce air quality disparities across communities for enhanced environmental justice, CARB needs a substantial set of vehicle emissions data throughout California, especially those reflecting real-world driving conditions such as RSD measurements. The study allows continued monitoring of the fleet emission trends as vehicles certified to CARB's Low Emission Vehicle II (LEV II) emission standards ages, and as the total fleet emissions are increasingly attributable to older vehicles. The collected RSD data may inform CARB's mobile source emissions inventory as required by the California Health and Safety Code, the California Clean Air Act of 1988, and the Federal Clean Air Act of 1990. The collected EV profiles can help gauge EV ownership penetration and their impact on fleet emission reductions in DACs as a result of California's EV-purchasing incentive funds for lower-income households under CARB's Clean Vehicle Rebate Project and Enhanced Fleet Modernization Program. In addition, this study provides data to help evaluate the air pollution impact of Smog Check program attributes such as Smog Check program area types.

**Project Summary**

The project team consisted of the Contractor, ERG, and subcontractors, University of Denver (DU) and Opus Inspections. Between the summer of 2021 and the spring of 2023, the project team conducted RSD measurement campaigns at nine (9) locations in the following municipalities: Stockton, Bakersfield, West Los Angeles, Oakland, El Centro, Riverside, City of Industry, San Ysidro, and Fresno. The Fresno field campaign was conducted under a companion project sponsored by the CRC. The data collected included RSD measurements of fuel-based CO, HC, $NO_X$, and $NH_3$ (for DU measurements) exhaust emission rates, vehicle

speed and acceleration, and vehicle license plate images. Each campaign consisted of consecutive measurements of 7 to 10 days, resulting in slightly under 20,000 to over 56,000 RSD measurements with readable license plates per campaign. CARB staff assisted the project team to obtain vehicle information (such as registration addresses, make, model, and model year) for the collected license plates, CalEnviroScreen (CES) scores for communities the registration addresses belong to, whether the particular community is a priority community selected under CARB's Assembly Bill 617 program, and the type of Smog Check program area (change-of-ownership [COO] area or biennial inspection area) the registration addresses belong to. The project team performed analysis on the six (6) aforementioned topics using the data collected during the nine (9) campaigns.

The study shows that:

- At the historical West Los Angeles location, the fleet average emission rate of NO continued to trend downward, whereas the fleet average CO emission rate remained relatively unchanged, and HC emission rates slightly increased in the two most recent campaigns (2018 and 2021). The Contractor postulates that this may be partially attributable to the generally lower Vehicle-Specific Power (VSP) during the recent two campaigns (especially in the 2021 campaign) and the higher fuel-based HC and CO emission rates at the low end of VSP spectrum.

- DAC-registered vehicles emit at significantly higher rates than their non-DAC-registered counterparts, and between 30% and 48% of the difference can be explained by their model year difference; non-DAC-registered fleet have higher percentages of newer (thus cleaner) vehicles.

- EV prevalence was noticeably higher in non-DAC as compared to DAC. This difference is expected to have had minimal impact on fleet average emission rates between communities due to the small EV fraction at the time of the campaigns.

- The near-ground deployment nature of RSD was less conducive to HDV (especially class 6 and above) measurements, resulting in much lower valid measurement rates for HDVs as compared to LDVs. Despite the large measurement uncertainties associated with the small sample sizes, NO emission rates generally were lower for newer model years.

- At the two border locations (El Centro and San Ysidro), the Mexico-registered vehicles had significantly higher average emission rates for CO and NO than their California-registered counterparts, and the difference for HC is not statistically significant. The emission rate differences were larger for older model years.

- The average emission rates for vehicles registered in COO areas were generally higher than those registered in biennial Enhanced Smog Check inspection areas, especially for pre-2000 model year vehicles.

## III. Staff Comments

Staff from Research Division, Sustainable Transportation and Communities Division, Office of Community Air Protection, Office of Environmental Justice, Tribal Affairs & Border Relations, Bureau of Automotive Repair, and U.S. Environmental Protection Agency reviewed a draft final report and provided comments. The project team addressed all comments in the current version of draft final report.

The project has accomplished its measurement objective and six (6) analysis objectives. The most significant aspect of the project is that it constitutes the first known study to use RSD to measure and evaluate the exhaust emission characteristics for geographically diverse fleets. The results highlight the value of multi-location measurements as well as extending longitudinal emission characteristics trends at historical measurement locations.

## IV. Staff Recommendation

Staff recommends the Research Screening Committee recommend that CARB accept this DFR, subject to inclusion of appropriate additions and revisions specified by the Committee.