December 1, 2021

Re: "Scripps/UCSD Interim Report 2021: Preliminary Results from May 2021 Aerosol Measurements"

From: Scientific Advisory Group (SAG)

To: California Off-Highway Motor Vehicle Recreation (OHMVR) Commission

Cc: Gary Willey, San Luis Obispo County Air Pollution Control District (SLOAPCD)
Sarah Miggins, California Department of Parks and Recreation (CDPR)
Liz McGuirk, California Department of Parks and Recreation (CDPR)

Chair Ureña and OHMVR Commissioners:

The Scientific Advisory Group (SAG) was established in 2018 through a Stipulated Order of Abatement (SOA), by mutual agreement of SLOAPCD and the OHMVR Division, to address the issue of particulate matter emissions associated with the Oceano Dunes State Vehicular Recreation Area (ODSVRA). The SOA directed the SAG to "evaluate, assess, and provide recommendations on the mitigation of windblown PM10 emissions from ODSVRA," among its responsibilities. (PM10 refers to particulate matter with an aerodynamic diameter of <10 microns, which is subject to California and federal air quality regulations.) The collective expertise on the SAG is unique and highly experienced in terrestrial wind erosion and dust emissions processes and mitigation. As specified by the SOA, the SAG includes experts in the fields of dune geomorphology, wind erosion control, soil ecology, shoreline botany, biophysical sand crust formation, and air quality monitoring and modeling.

Dr. Lynn M. Russell of the Scripps Institution of Oceanography at the University of California, San Diego (UCSD), recently submitted a report to the OHMVR Division, "Scripps/UCSD Interim Report 2021: Preliminary Results from May 2021 Aerosol Measurements." The Scripps report describes analyses of air quality filter samples collected from an independent sampling system at the CDF monitoring site in April-May 2021and compared to PM10 concentrations measured by the co-located SLOAPCD BAM (beta attenuation monitoring) air quality sensor. The BAM sensor is recognized widely as a U.S. EPA-compliant device that is used for regulatory purposes. On the basis of their independent filter sampling, the Scripps report argues, "on average less than one-fifth of the BAM PM10 at CDF can be attributed to dust during the high-PM10 days sampled in April-May 2021."

The SAG is writing to express serious concerns about the accuracy and interpretation of the analyses presented in this recent Scripps report. These concerns are summarized below:

1. Health and legal imperatives. The SAG disagrees with assertions within the Scripps report that minimize the health and legal importance of PM2.5 and PM10 associated with mineral dust. (PM2.5 refers to particulate matter with diameter of <2.5 microns.) From a health perspective, PM2.5 and PM10 are known to cause deleterious health impacts regardless of their chemical

composition. Coarse particulate matter between 2.5 and 10 microns in size is identified by the U.S. EPA in assessments of health effects studies to contribute to increases in thoracic flow resistance and heart rate variability, among other impacts, regardless of elemental or chemical composition. (See Appendix A, "Select References on Dust and Human Health.") It is on the basis of such studies that the U.S. EPA maintains the PM10 ambient air quality standard to protect public health. Statements to the effect that windblown dust particles in the coarser PM10 particulate size range do not contribute to chronic respiratory effects are erroneous. From a legal perspective (and related to the known health impacts), federal and state PM concentration standards do not distinguish between the constituents of particulate matter, nor does the SOA. For these reasons, the SAG argues for the urgent need to continue to reduce ambient PM2.5 and PM10 concentrations at Oceano Dunes regardless of the specific breakdown of PM constituents.

2. Effects of OHV on PM10 emissions. The SAG disagrees with assertions within the Scripps report that minimize the effect of OHV on PM10 emissions at the ODSVRA and PM10 concentrations at receptor sites downwind. By citing a lack of significant difference between weekday and weekend airborne PM10 concentrations as evidence for a lack of OHV impacts on PM10, the report perpetuates the misconception that OHVs produce PM emissions primarily through mechanical action during their operation. Instead, direct measurements and research by the Desert Research Institute (DRI) indicate that the primary effect of OHVs is to degrade dune surfaces and to increase the long-term PM emissivity of the dunes. Eventually, removal of OHVs should reduce PM10 emissions and concentrations, but this adjustment would occur over a matter of many months, not days. The recent DRI report, "Examining Dust Emissions and OHV Activity at the ODSVRA," presents strong evidence, based on years of data collection, for this understanding of the effect of OHVs on PM10 emissions. This DRI report was presented to the OHMVR Commissioners at their meeting on August 26, 2021.

3. Contribution of Mineral Dust to Airborne PM10. The SAG is not convinced by analyses within the Scripps report that lead to their conclusion that only a small percentage of overall ambient PM is composed of mineral dust. The SAG has several specific concerns regarding the methodology for determining the relative mineral dust contribution. (See Appendix B, "Methodological Concerns.") In addition, a large body of evidence, including years of modeling that have guided ODSVRA dust mitigation measures, demonstrates that the ODSVRA is the primary source of airborne PM10 observed at the CDF and Mesa2 receptor sites during typical strong onshore wind days. The recent DRI report, "Increments of Progress Towards Air Quality Objectives – ODSVRA Dust Controls," also presented to the OHMVR Commissioners at their August 26, 2021 meeting, demonstrates a direct causal relationship between ODSVRA dust controls and reductions in airborne PM10. (See Appendix C, "The ODSVRA and PM10 Emissions.")

In summary, the SAG expresses strong concerns about the accuracy of some of the results and questionable interpretations put forth by the Scripps report, which confound understanding of the mechanisms and sources of PM10 dust emitted from ODSVRA and dispersed to local monitoring stations. As such, the Scripps report understates the contribution of mineral dust to measured PM10 air quality exceedance events and, in doing so, risks minimizing the implications for human health in areas downwind of the observed highly emissive sand surfaces within ODSVRA. Given significant recent efforts implemented by California State Parks to

mitigate dust emissions, with corresponding declines in observed PM10, this report also fails to provide constructive insights on how to further improve air quality in local communities downwind of ODSVRA, as required by the governing SOA.

Respectfully,
The Scientific Advisory Group

Dr. Raleigh Martin (Acting chair of SAG); Dr. William Nickling; Dr. Ian Walker; Ms. Carla Scheidlinger; Mr. Earl Withycombe; Mr. Mike Bush, Dr. John A. Gillies

Appendix A. Select References on Dust and Human Health

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Appendix B. Methodological Concerns

This section details specific concerns with the methodology presented in the Scripps report.

(p. 9, first paragraph) The mineral dust component of PM2.5 filters collected on high-PM10 days is reported to average 27% by VSCC inlet and 19% by SCC inlet. Typically, the geologic component is predominately higher in PM10 samples than in PM2.5 samples as the mean particle size of windblown dust is about 4 microns. These results suggesting that the geologic component is higher in the PM2.5 fraction than in the PM10 fraction at the CDF monitoring station are unusual and warrant an explanation.

(p. 13, Figure 3) The labeling of the difference between BAM and PM10 filter measurements as "Semivolatile" is speculative in the absence of further testing. The positive identification of only 18% of PM10 mass results in very limited information with respect to the composition of PM10 measured at the CDF monitoring station.

(p. 13, Conclusions, first paragraph, last sentence) The statement that results of this study were consistent with the chemical composition reported by the SLOAPCD in its Nipomo Mesa Particulate Study (Phase 1) is misleading in that the Phase 1 study analyzed only total mass, sulfate, nitrate, and chloride values in PM10 samples collected at the CDF monitoring site. As the Scripps study did not analyze sulfate, nitrate, and chloride contributions at CDF, there is almost no overlap in the constituents measured in the two studies with respect to samples collected at CDF.

(p. 14, second sentence, second paragraph) The statement that a substantial fraction of PM2.5 was not associated with fossil-fuel combustion emissions ignores the failure in the paper to identify the composition and sources of 63.6% of total mass on PM2.5 samples collected on high PM10 days.

Appendix C. The ODSVRA and PM10 Emissions

The SAG is highly critical of the Scripps report conclusion that the mineral dust component of the PM10 is a small fraction of the total amount observed at CDF on high wind and particulate matter (PM) days when the wind direction is from the west. The source apportionment presented in the Scripps report suggests that on high PM10 days mineral dust contributes approximately 14% to the total observed mass concentration (Scripps report Fig. 3). For the high PM10 days in April and May (Scripps report Fig. 1) the wind direction was highly constrained (302°-308°, based on APCD data from CDF) for the daily 7 hour sampling interval. Regarding PM10 sources for such high wind days, the SAG refers to the extensive body of dust emission and dispersion modeling, informed by direct PI-SWERL dust emissivity measurements across the Oceano Dunes State Vehicular Recreation Area (ODSVRA), which clearly demonstrate the direct causative relationship between PM10 emissions from within the ODSVRA and elevated PM10 concentrations at the downwind CDF site (see, for example, 2019 Particulate Matter Reduction Plan Table 4-1 and Fig. 4-1). Model evidence for dune-derived airborne PM10 at CDF is further verified by direct measurements of high airborne PM10 concentrations at CDF on modeled high PM10 days (see, for example, 2020 Annual Report and Work Plan Fig. 2-11). Though the SAG recognizes that efforts to specifically apportion the constituents of this airborne PM10 remain ongoing (see 2021 Annual Report and Work Plan Sec. 3.3.1), the existing observational and modeling evidence already provides very strong support for airborne PM10 primarily originating from within the ODSVRA on strong westerly wind days.

With winds blowing onshore over the ODSVRA dune surfaces for these high PM10 episodes, the Scripps report fails to provide a plausible alternative explanation for the sources of the predominant contributing semi-volatiles and "other" particles in their source apportionment (Scripps report Fig. 3). When the wind blows onshore for multiple hours in conjunction with a frontal system or due to the sea-breeze effect, for example, what are the upwind sources of semi-volatile organic aerosols or "other" that can make such large contributions?

If the PM10 was dominated by sources attributed as the Scripps report suggests, then nearby locations should also have concentrations near to those observed at CDF for the same sampling days, minus the contribution associated with mineral dust. For instance, consider the APCD monitoring station at Oso Flaco (Fig. C1) that measures PM10 with a BAM, is situated closer to the coastline than CDF, and has much lower upwind areal extent of open sand that could contribute mineral dust particulates during saltation. The PM10 measured at Oso Flaco on the same days identified as high-PM in the Scripps report (Fig. C2), is correlated with the PM10 at CDF, but is lower by a factor of approximately 0.32 (i.e., Oso Flaco PM10/CDF PM10) when PM10 at CDF is >100 $\mu g\ m^{-3}$. If mineral dust was not the primary contributing factor at CDF, why would such lower values (i.e., <<14%) be observed at Oso Flaco, which is less than three miles away (to the south-south-west)?

The Scripps report also suggests that particle-bound water contributes substantially to the observed PM10 mass measured by the APCD BAM. Mineral dust particles composed of quartz and feldspar (predominant minerals within the ODSVRA), however, have low adsorption potential for water molecules (i.e., low hygroscopicity) (Engelbrecht et al., 2016; Formenti et al., 2011; Ito & Wagai, 2017; Journet et al., 2014; Nickovic et al., 2012; Rodriguez-Navarro et al.,

2018; Shao et al., 2007). In general, fresh mineral dust particles are usually considered to be rather non-hygroscopic (Herich et al., 2009; Koehler et al., 2009; Ma et al., 2010; Sullivan et al., 2009; Tang et al., 2016). Given this conventional knowledge in mineral dust research, it seems implausible that freshly-emitted mineral dust particles from the ODSVRA would adsorb significant amounts of water even in the high humidity of this coastal setting to contribute to appreciable source attribution in the "other" category. If the particle bound water is predominantly on the hypothesized semi-volatile particles, then it is critically important to identify the off-shore source of those particles to explain the PM10 mass concentrations. The Scripps report analyses simply do not convincingly demonstrate that their source apportionment is correct without a plausible physical explanation for predominant sources other than mineral dust and sea salt.

A second line of evidence on the contribution of mineral dust from ODSVRA to the PM10 measured at CDF is provided in the publicly available report commissioned by California State Parks and prepared by the Desert Research Institute (DRI):

> Gillies, J.A., E. Furtak-Cole, V. Etyemezian (2020). Increments of Progress Towards Air Quality Objectives – ODSVRA Dust Controls. Report prepared for California State Parks, December 2020.

This report was made publicly available in August 2021, with results presented at the OHMVR Commission Meeting on August 26, 2021. This report demonstrates, using measurements of PM10 and wind speed at CDF, that with the increasing amount of area within the ODSVRA receiving dust control treatments, the concentration of PM10 (mean 24 hour) measured at the CDF site has decreased through time for similar wind conditions. If the PM10 was dominated by sources other than mineral dust, the demonstrated scaling relation between total area occupied by dust controls and decreasing PM10 levels should not be demonstrable as observed.

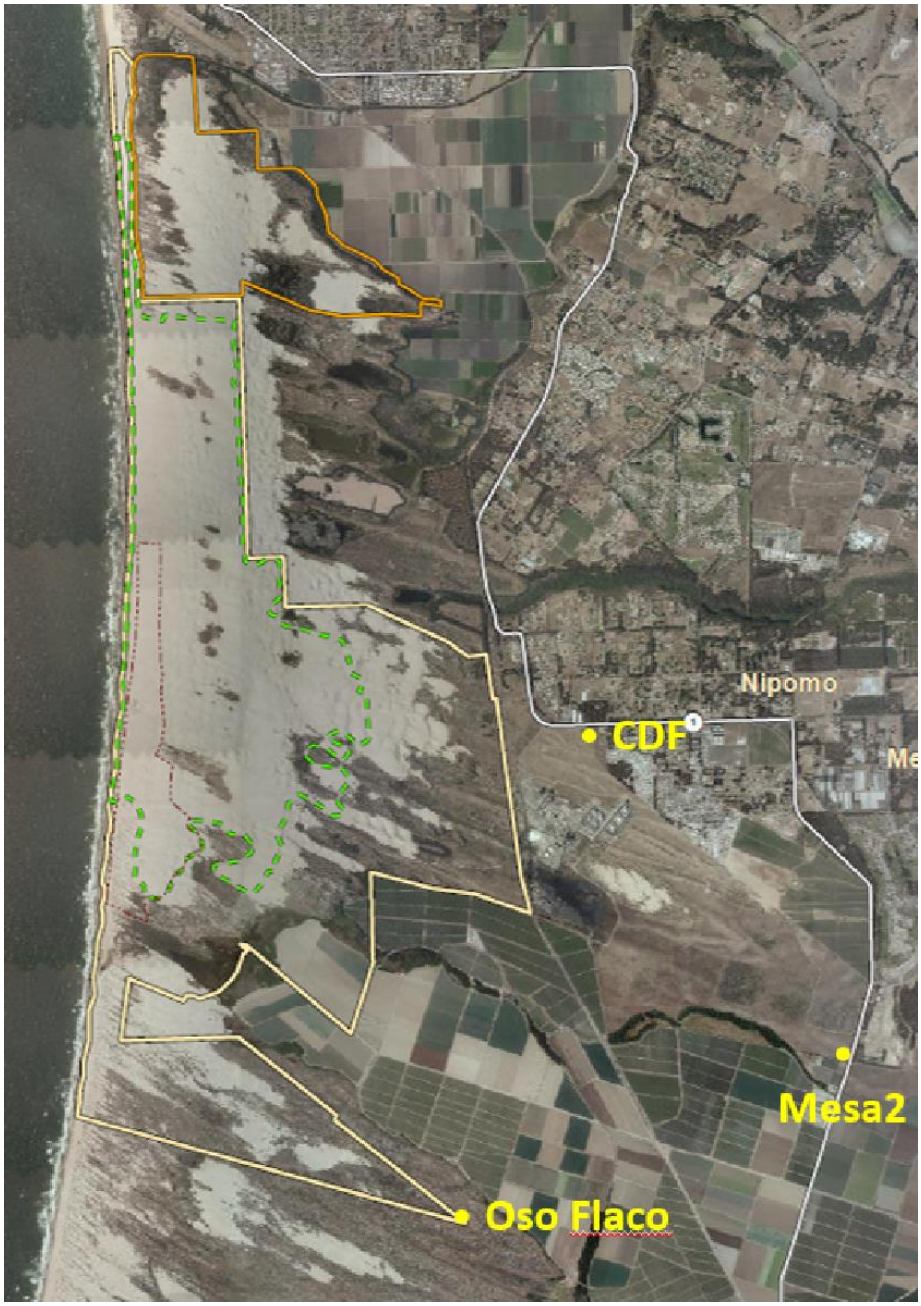

Figure C1. The locations of the APCD monitoring sites CDF, Oso Flaco, and Mesa2.

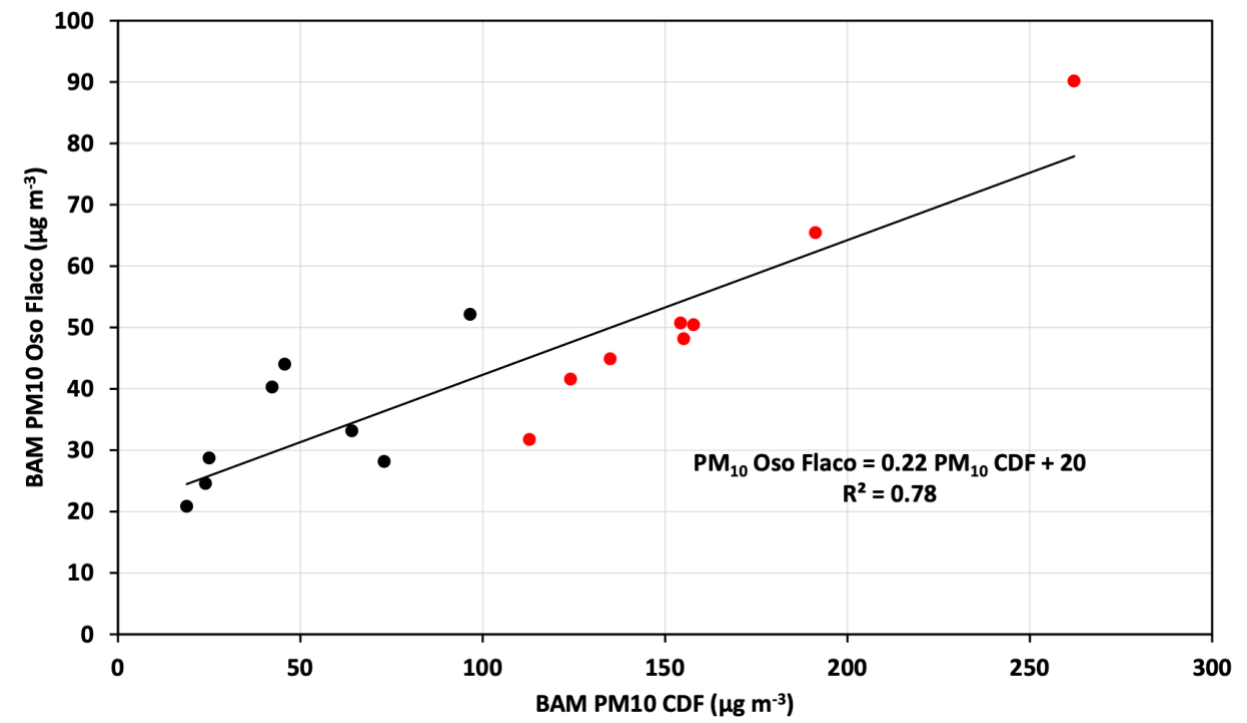

Figure C2. The relation between PM10 at Oso Flaco and CDF, for Scripps report sampling days April 27 to May 26, 2021. Red circles highlight high PM10 days when the seven hour mean value exceeded 100 µg m^{-3}.

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