

Report on Possible Compliance Metric for the Stipulated Order of Abatement in Case 17-01

San Luis Obispo County Air Pollution Control District

June 25, 2025

Executive Summary

At its last meeting (October 2024), the Hearing Board requested that District staff develop a metric for determining compliance with the SOA that is based on measured air quality data. Currently, compliance with the SOA emission reduction goal is based on the results of emissions modeling conducted by the Desert Research Institute (DRI) and reported by State Parks.

Several potential metrics were explored, and the District, State Parks, and the SAG agreed that a metric developed by the SAG strikes the best balance between simplicity and accuracy. The selected metric is the ratio of PM₁₀ to windspeed on days with onshore winds, considering only midday hours (9 a.m. to 6 p.m.) when PM₁₀ concentrations are greatest. It is calculated using hourly data and averaged by year. The metric can be calculated for CDF and/or Mesa2.

The value of the metric has generally declined at both CDF and Mesa2 as the SOA has been implemented and dust controls installed. The threshold value of the metric that delineates compliance from non-compliance can be selected taking into account the results of the DRI emissions modeling. If the results of the refined emissions modeling, expected with the 2025 ARWP, indicate that 2024 and/or other years were in compliance with the SOA emission reduction goal, then the value(s) of the metric observed in those years could be used to derive the threshold value indicating compliance.

The proposed metric is another useful tool for tracking how air quality changes in response to conditions at the ODSVRA. The SAG cautions against using it as a bright line for making decisions about adding or removing dust controls. The District agrees. While the proposed metric is a useful addition to the toolbox, we agree the emissions model should continue to be the primary tool for determining compliance with the SOA.

Introduction

The Stipulated Order of Abatement in Case 17-01 (SOA), as amended, requires the California Department of Parks and Recreation Off-Highway Motor Vehicles Division (State Parks) to “eliminate emissions in excess of naturally occurring emissions from the ODSVRA [Oceano Dunes State Vehicular Recreation Area] that contribute to downwind violations of the state and federal PM₁₀ air quality standards.”¹ As discussed in their approved Annual

¹ Hearing Board of the San Luis Obispo County Air Pollution Control District, “Order to Modify Stipulated Order Of Abatement,” Case 17-01, filed October 21, 2024. Available online at: https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Modified%20Stipulated%20Order%20of%20Abatement%2017-01_FILED%2010-21-2024.pdf

Reports and Work Plans (ARWPs), State Parks is in compliance with this requirement if PM₁₀ emissions from the ODSVRA are less than emissions from a “pre-disturbance” scenario representing conditions prior to the extensive use of off-road vehicles in the area.^{2,3}

As neither present-day nor past emissions can be measured directly, modeling is used estimate emissions. The model was developed and is run by the Desert Research Institute (DRI) under contract from State Parks. The assumptions underlying the modeling are recommended by the Scientific Advisory Group (SAG) and approved by the San Luis Obispo County Air Pollution Control District (District). Determining compliance is thus reliant on modeling outcomes, as specified in the SOA.

The District operates several PM₁₀ monitoring stations downwind of the ODSVRA and uses the data collected at these sites to assess the impacts of dust mitigations on air quality. Several air quality metrics are tracked, including the annual number of exceedances of the state PM₁₀ standard and local Rule 1001, annual averages, the number of hours over 300 µg/m³, and the District’s Difference-in-Differences metric. State Parks has developed their own measurement-based metric, the ratio of Total PM₁₀ to Total Wind Power Density (TPM₁₀:TWPDP ratio).

These metrics are reported in the District’s Annual Air Quality Reports⁴ and State Parks’ ARWPs, and they are regularly presented to the District Board and the Hearing Board. All show trends of marked improvement in air quality as dust controls were implemented under the SOA. For the most recent trends, see the 2024 Annual Air Quality Report, included with the materials for the present Hearing Board meeting.

While the trends are encouraging, these metrics have not been used to assess compliance with the SOA. This is because it is not known, for example, how many exceedances of the state standard or of Rule 1001 would be expected in the pre-disturbance scenario. Even without the long history of off-roading, sand dunes and strong onshore winds are natural features of the area, so there would be still some instances of elevated PM₁₀. The frequency of such instances would be expected to vary from year to year since dust events are

² California Department of Parks and Recreation, “Oceano Dunes State Vehicular Recreation Area Dust Control Program: Provisional Final 2024 Annual Report and Work Plan,” September 11, 2024. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2024ARWP_ProvFinal_20240911_reduced.pdf. Attachments available online at: https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2024ARWP_ProvisionalFinal_Attachments_reduced.pdf.

³ Documents relating specifically to Case 17-01 are compiled online here: <https://www.slocleanair.org/who/board/hearing-board/actions.php>. Other documents related to the Oceano Dunes dust issue are available online at: <https://www.slocleanair.org/air-quality/oceano-dunes-efforts.php>.

⁴ Annual Air Quality Reports are archived online at: <https://www.slocleanair.org/library/air-quality-reports.php>.

wind-driven, and some years are windier than others. Thus, to date, the determination of compliance with the SOA has remained dependent upon modeling, rather than being based on independently-measured air quality metrics.

At its October 15, 2024, meeting, the Hearing Board of the San Luis Obispo County Air Pollution Control District (Hearing Board) approved a motion directing District staff to:

... develop an air quality metric to be used in further compliance of the Stipulated Order of Abatement and present it to the Hearing Board at its next scheduled meeting.⁵

This document presents a possible metric designed to fulfill this direction. District staff and the Scientific Advisory Group (SAG) considered several air quality-based compliance metrics. Ultimately, a metric proposed by the SAG was selected as best balancing intuitiveness and simplicity versus robustness and accuracy. As described in detail below, the SAG metric is the ratio of measured PM₁₀ to measured wind speed for days with onshore winds and elevated PM₁₀ levels. Only daytime (9 a.m. to 6 p.m.) data are considered, as this corresponds to the timing of windblown dust events. The value of the ratio has decreased as dust controls have expanded.

To use the SAG metric to determine compliance with the SOA, a value needs to be selected that represents compliance. If the metric remains below this threshold value, compliance with the emission reduction goal of the SOA could be assumed; if the metric exceeds the threshold, non-compliance with the SOA would be indicated. It is proposed that the value of this threshold be determined by consulting the results of the emission modeling.

The modeling disclosed in the 2024 ARWP found that the ODSVRA was in compliance with the SOA emission reduction goal, i.e., its estimate of present-day emissions was less than its estimate of pre-disturbance emissions. The ARWP also noted some additional refinements to the model were needed to ensure accuracy. Therefore, while the District approved the ARWP, we deferred making a determination of compliance. We expect that State Parks will present the results from the refined model in their 2025 ARWP. If the refined model indicates that 2024 (and/or other year(s)) were in compliance, then the value of the SAG metric for that year(s) could be set as the compliance threshold. For example, if the model shows that 2024 was indeed in compliance, and the value of the SAG metric was 15 that year, then if the metric remains at or below 15 going forward, continued compliance could be assumed.

⁵ See the Minutes for the October 15, 2024, meeting of the Hearing Board, included with the materials for the present Hearing Board meeting.

The SAG Metric

The SAG Proposal

The SAG memo, "Toward a Data-Informed Metric for Assessing Progress Leading to PM₁₀ Reductions Downwind of the ODSVRA," describes the development of the metric. This memo is included with the materials for the present Hearing Board meeting. It is essentially the ratio of PM₁₀ at CDF to windspeed measured on the beach of ODSVRA (i.e., by the S1 tower), for the subset of days with high winds blowing across the dunes and toward CDF. The metric is reported as an annual average, rather than daily quantities or for each wind event.

As described in the memo, the metric is calculated by the following procedure:

1. For each day of the year, calculate the 9-hour PM₁₀ average at CDF for 9 a.m. to 6 p.m.
2. Calculate 9-hour average wind speeds and wind directions at the S1 tower for the same period.
3. Throw out any days when the 9-hour average wind direction is not between 225° and 345°
4. Throw out any days when the 9-hour average PM₁₀ at CDF is less than 100 µg/m³.
5. With the remaining days, calculate the average PM₁₀ concentration for each year and the average S1 wind speed for each year.
6. For each year, divide the PM₁₀ average by the wind speed average. This the SAG metric for each year.

Figures A1 and 23 of the SAG memo, reproduced below, plot this metric for 2016 through 2023. As expected, the value of the metric has declined as dust controls have been installed, reaching a minimum value of about 13 in 2023.

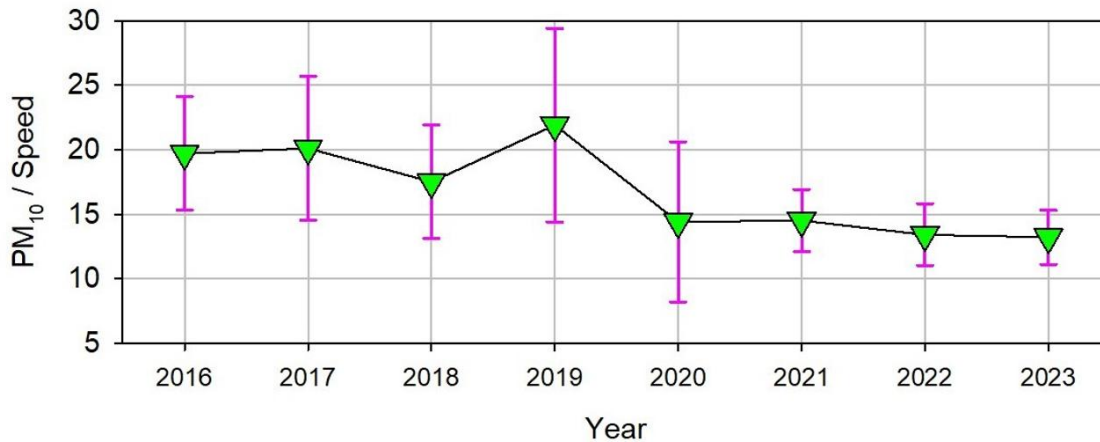


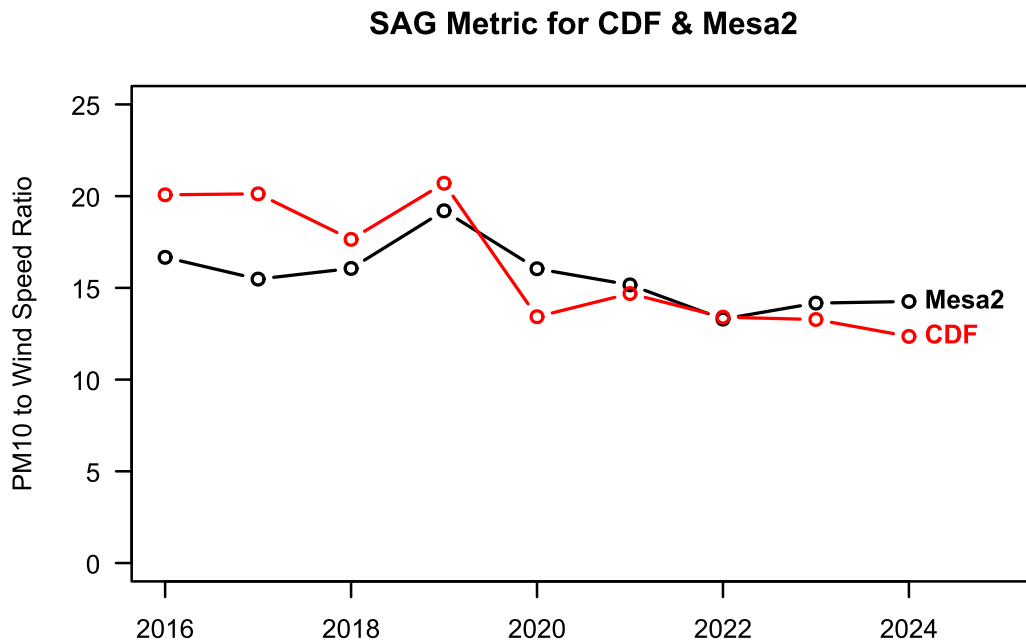
Figure 23: Trends in annual PM₁₀ concentrations at CDF for 9-6 mean events normalized by associated mean wind speed from the S1 tower. Error bars show the span of the standard deviation of the yearly event values (see Figure 20 for number of events per year).

Implementation of the Metric by the District

The District proposes to implement the SAG metric adding the following details, which are not specified in the SAG Memo:

- Wind speed and wind direction are vector averaged, rather than scalar averaged.
- For any hourly PM₁₀ value that is missing, remove the corresponding hourly wind speed and direction values, and vice versa.
- Remove any day which, in the judgement of the Air Pollution Control Officer, is clearly influenced by non-ODSVRA sources such as wildfires or San Joaquin Valley dust.

The District proposes to apply the metric to Mesa2 as well to ensure that emission reductions impacting that station and the surrounding neighborhood are maintained. The figure below shows the District's implementation applied to both CDF and Mesa2 and includes 2024. For CDF, the trend for 2016 to 2023 appears to be identical to the trend as depicted in the SAG memo.



Compliance Threshold

To use the SAG metric as an indicator of compliance with the SOA, a threshold value needs to be defined. If the metric is below this threshold, compliance is indicated; if above, non-compliance is assumed. The forthcoming modeling results can inform the selection of this threshold value.

For CDF, the value of metric as calculated by the District for 2024 is 12.4, and for Mesa2 it is 14.3. If the results of the refined modeling (expected in the forthcoming 2025 ARWP) indicate that the ODSVRA had met the emission reduction goal in 2024, then these values could be used as the compliance thresholds for CDF and Mesa2. If the model indicates that 2022 and 2023 were also in compliance, then a composite of the metric's values for the three years could be used—perhaps the mean or maximum observed value for each site.

This is the only data-based approach for determining the compliance threshold that the District and the SAG could identify. Nonetheless, the SAG memo expresses reservations about this approach:

...a ratio value of 13 (+/- 2.1, which is the standard deviation) [for 2023] might be taken as a guiding threshold value.

However, future-year values should not be interpreted in isolation but, rather, in the context of long-term trends (i.e., several years running) with the understanding that there is natural variability in the system that partially masks the desired outcomes of

management interventions in the ODSVRA. A specific value of the ratio in any given year should not be used to trigger immediate adaptive management action. For instance, a value greater than 15 (i.e., $13 + SD$) should not mandate that more land should be taken out of OHV riding designation and re-vegetated. Conversely, a value below 11 (i.e., $13 - SD$) should not suggest that land currently in non-riding status be returned to OHV access. Rather, the proposed data metric is simply one of many indicators that can be used to track whether long-term trends are consistent with a state of compliance and to evaluate the long-term impacts of dust-mitigation efforts in the ODSVRA. Decisions regarding compliance within the purview of the SOA should be evaluated according to periodically updated simulation modeling results that compare current emissions from the ODSVRA to pre-disturbance conditions.

The District shares many of these concerns. While we have reservations about incorporating the standard deviation into the threshold (i.e., setting the threshold for intervention at 15 rather than 13), we agree that the metric should not, by itself, drive decisions about whether more or less mitigation is needed at the ODSVRA.

Considerations in Developing a Compliance Metric

Daily vs Annual Metric

All the metrics considered by the District and the SAG assessed compliance on an annual basis, rather than trying to determine whether individual windblown dust events are in or out of compliance. In other words, instead of looking at, for example, each exceedance of the California PM_{10} standard and trying to assess whether the ODSVRA was in compliance on that day, all parties agreed that it was better to look at each year as a whole. One reason for this is because there is substantial day-to-day variability in the response of PM_{10} to wind conditions. Anecdotally, two days can have nearly identical wind conditions, but yield very different PM_{10} levels downwind. The response may also have a seasonal component, further suggesting determining compliance annually rather than daily. Finally, the dust mitigations change slowly, on a timescale of months or years rather than daily, which also suggests evaluating compliance on an annual basis.

Simplicity

The District recognizes that a simple metric—one that people can easily grasp and readily calculate from publicly available data—is preferred. For example, the annual number of exceedances of the California PM_{10} standard at the CDF (or Mesa2) monitoring station is both familiar and can be independently verified by the public since the raw data are streamed to the internet in real-time and archived on the website of the California Air Resources Board. The problem with this metric was alluded to above: some years are

windier than others, and all else being equal, more exceedances are expected in windier years. For example, from 2011 to 2017 there were minimal dust controls at the ODSVRA, yet the number of annual exceedances at CDF varied from 60 to 97 with this variability mostly due to differences in windiness. Another complication is that PM₁₀ sources other than the ODSVRA, like wildfires and dust from the San Joaquin Valley, can also contribute to exceedances.⁶

The District's difference-in-differences metric and State Parks' TPM₁₀:TWPD ratio metric were developed to account for these intricacies, but admittedly they are neither intuitive nor straightforward to calculate. On the other hand, the SAG metric also accounts for annual variations in windiness while being simpler than either of these metrics. Thus, it is potentially nuanced enough to be useful while remaining understandable.

Other metrics explored

The District explored a metric based on the Difference-in-Difference analysis. That analysis essentially tracks the ratio of PM₁₀ at CDF and Oso Flaco on wind-event days, so the idea of using that ratio as the compliance metric was considered. A plot of this ratio from 2016 to 2023 (not shown) looks very similar to the plot of the SAG metric over this same time period (above). A plot of State Parks' TPM₁₀:TWPD ratio over time also shows the same general trend as the SAG ratio. As all three metrics essentially told the same story, the SAG metric was selected as it was the simplest.

Annual exceedances of Rule 1001 were not considered as it applies only to CDF. It is also subject to annual variations in windiness—a very calm year followed by a very windy year could potentially result in a large increase in Rule exceedances, but this would not necessarily indicate that the dust mitigations had become less effective. Further, it is not immediately evident what a threshold number of exceedances (i.e., the expected number for any given year due to natural conditions) should be to assess compliance with the SOA.

Finally, the District explored variations of the SAG metric, for example, using different criteria for whether to include or exclude days from the averaging. None of the potential refinements yielded trends substantially different from the original SAG metric.

⁶ Nonetheless, the District still tracks this metric and others, as they are readily digestible by the public and do indicate significant long-term trends. The point is that metrics such as these are not nuanced enough to discriminate final compliance. These metrics are akin to a magnifying glass, when the task at hand requires a microscope.

Conclusion

Several potential measurement-based metrics for tracking compliance with the SOA were explored. Ultimately, the metric proposed by the SAG was selected. It appears to be nuanced enough to account for annual variations in the frequency of wind events, while being the simplest of the metrics considered. The SAG metric is the ratio of PM_{10} to windspeed on days with high onshore winds, considering only data from midday (9 a.m. to 6 p.m.). It is calculated on an annual basis. It can be calculated for CDF and/or Mesa2.

If the forthcoming emissions modeling results indicate that the ODSVRA was in compliance with the SOA emission reduction goal in 2024, then the value of the SAG metric for 2024 could be used as a threshold delineating compliance from non-compliance. In the future, as long as the metric remains at or below that threshold, it can be assumed that the ODSVRA has remained in compliance with the SOA. If the model indicates that other years were also in compliance, then the compliance threshold could be based on a combination of the SAG metric values for those years.

The SAG memo cautions against using the metric as a bright line for making decisions about adding or removing dust controls. The District agrees. While the proposed metric is a useful addition to the toolbox, we agree the emissions model should continue to be the primary tool for determining compliance with the SOA.