Oceano Dunes State Vehicular Recreation Area
Dust Control Program

DRAFT
2021 Annual Report and Work Plan

August 2, 2021

State of California

Department of Parks and Recreation

Off-Highway Motor Vehicle Recreation Division

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Oceano Dunes SVRA Dust Control Program
2021 Annual Report and Work Plan

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2021 Annual Report and Work Plan Attachments (Separate Documents)

Acronym / Symbol	Full Phrase or Description
$\mu g/m^3$	Micrograms Per Cubic Meter
ARWP	Annual Report and Work Plan
ASU	Arizona State University
BAM	Beta Attenuation Monitor
BSNE	Big Springs Number Eight
CAAQS	California Ambient Air Quality Standards
CALMET	Computer-Aided Learning in Meteorology
CARB	California Air Resources Board
CCA	California Coastal Act
CCC	California Coastal Commission
CDF	California Department of Forestry and Fire Protection
CDPR	California Department of Parks and Recreation
CGS	California Geological Survey
DEM	Digital Elevation Model
DRI	Desert Research Institute
GCD	Geomorphic Change Detection
GIS	Geographic Information System
GPS	Global Positioning System
MP	Megapixel
NAAQS	National Ambient Air Quality Standards
ND	Normalized Distance
NDRE	Normalized Difference Red-Edge Index
NDVI	Normalized Difference Vegetation Index
NSF	Normalized Sand Flux
Oceano Dunes SVRA	Oceano Dunes State Vehicular Recreation Area
OHMVR Division	Off-Highway Motor Vehicle Recreation Division
OHV	Off-Highway Vehicle
PI-SWERL	Portable In-Situ Wind Erosion Laboratory
PM_{10}	Particulate Matter 10
PMRP	Particulate Matter Reduction Plan
PPK	Post-Processing Kinematic GPS Positioning
RCD	Coastal San Luis Resource Conservation District
RGB	Red, Green, and Blue
SAG	Scientific Advisory Group
SB	Straw Bale
Scripps	Scripps Institution of Oceanography
SfM	Structure-From-Motion photogrammetry
SLOAPCD	San Luis Obispo County Air Pollution Control District

Acronym / Symbol	Full Phrase or Description
SM	Straw Measures
SOA	Stipulated Order of Abatement
SODAR	Sonic Detection and Ranging Instrument
TLS	Terrestrial Lidar Scanning
TV	Temporary Vehicle Exclusion
UAS	Uncrewed Aerial System
UCSB	University of California, Santa Barbara
USEPA	United States Environmental Protection Agency
VG	Vegetation
WF	Wind Fencing
WPD	Wind Power Density

1 INTRODUCTION

The California Department of Parks and Recreation (CDPR or State Parks), Off-Highway Motor Vehicle Recreation Division (OHMVR Division), has prepared this 2021 Annual Report and Work Plan (ARWP) for the Oceano Dunes State Vehicular Recreation Area (Oceano Dunes SVRA) Dust Control Program to comply with Condition 4 of the Stipulated Order of Abatement (SOA) approved by the San Luis Obispo County Air Pollution Control District (SLOAPCD) Hearing Board in April 2018 (Case No. 17-01) and amended in November 2019.

The Stipulated Order of Abatement Condition 4 requires the OHMVR Division to prepare and submit to the SLOAPCD, and the SOA Scientific Advisory Group (SAG), an ARWP by August 1 each year from 2019 to 2022. In general, SOA Condition 4 requires the ARWP to:

- Review dust control activities implemented over the previous 12-month period and, using tracking metrics specified in the Particulate Matter Reduction Plan (PMRP), document progress towards SOA goals. For this 2021 ARWP, the previous 12-month period started on August 1, 2020, and ended on July 31, 2021.
- Identify dust control activities proposed to be undertaken or completed in the next 12-month period. Using tracking metrics specified in the PMRP, document expected outcomes and potential emission reductions for these activities. For this 2021 ARWP, the next 12-month period starts on August 1, 2021, and ends on July 31, 2022.
- Using air quality modeling, estimate the downwind benefits and anticipated reductions in respirable particulate matter (PM_{10}) concentrations associated with proposed dust control activities.
- Describe the budgetary considerations for the development and implementation of proposed dust control activities.
- Provide a detailed implementation schedule with deadlines associated with the physical deployment of proposed dust control actions.

Section 2 of this ARWP **reports** on dust control activities implemented in the previous 12 months (08/01/20 to 07/31/22), including progress made towards SOA goals to date.

Section 3 of this ARWP **proposes** dust control program activities undertaken or completed in the coming 12 months (08/01/21 to 07/31/22), including model-predicted PM_{10} mass and concentration reductions and continued progress towards meeting SOA goals.

Section 4 and Section 5 of this ARWP **describe** budget considerations and implementation schedules for the proposed Dust Control Program activities to be initiated, undertaken, and/or completed in the coming 12 months.

This 2021 ARWP has been prepared under the supervision of Jon O'Brien, Environmental Program Manager, OHVMR Division, whom CDPR has designated as the Project Manager for the Dust Control Program under Condition 13 of the Amended SOA. State Parks' development of the 2021 ARWP was done in close consultation and coordination with the SAG ARWP subcommittee.

2 DUST CONTROL PROGRAM ANNUAL REPORT (08/01/20 to 07/31/21)

This chapter of the 2021 ARWP **reports** on Dust Control Program activities undertaken from August 1, 2020, to July 31, 2021, **estimates progress** towards achieving SOA goals and **presents additional information** on other activities related to the Dust Control Program undertaken by CDPR and/or the SAG.

From August 1, 2020, to July 31, 2021, CDPR installed approximately 92 acres of new dust control measures at Oceano Dunes SVRA, converted approximately 33 acres of existing, temporary dust control measures to native dune vegetation, performed as-needed maintenance and supplemental planting activities on dust control measures throughout Oceano Dunes SVRA, and continued robust data collection and modeling efforts intended to improve the effectiveness of CDPR's Dust Control Program. State Parks undertook the above activities in consultation and coordination with the SAG and SLOAPCD. **As of July 31, 2021, CDPR has successfully installed approximately 323 total acres of dust control measures at Oceano Dunes SVRA.** More than 80% of these measures are located within the SVRA's open riding and camping area. **The Desert Research Institute (DRI) air quality model, being used per Section 2(c) of the SOA, estimates CDPR's dust control efforts to date have resulted in an approximately 21% reduction in mass emissions from the SVRA's open riding and camping area.** This cumulative reduction represents continued progress towards the SOA's goal of a 50% reduction in mass emissions from the open riding and camping area.

State Parks notes that while the SOA requires CDPR to report on activities "implemented over the previous year" by August 1, 2021, this 2021 ARWP reports on activities that were started more than one year ago (i.e., before August 1, 2020) and completed in the past year (i.e., between August 1, 2020, and July 31, 2021). It also reports activities started in the past year, which CDPR or the SAG did not expect to complete in time for reporting in this ARWP cycle. This lag in reporting is due to the seasonal nature of data collection efforts and the time involved to process, analyze, interpret, and report the data collected for the Dust Control Program. 2020

ARWP actions/results that are not available to CDPR for reporting in this 2021 ARWP will be discussed in the next ARWP cycle (i.e., the 2022 ARWP).

2.1 REPORT ON DUST CONTROL MEASURES INSTALLED AT OCEANO DUNES SVRA

State Parks' Oceano Dunes SVRA Dust Control Program is a multi-year, adaptive management program involving an iterative series of dust control projects intended to improve air quality downwind of Oceano Dunes SVRA.

Dust control projects are measures that CDPR puts on or into the ground to cover the ground surface or reduce surface disturbance, break the flow of wind across the landscape, and reduce or halt saltation and dust generation. The Dust Control Program includes seasonal dust control measures, temporary dust control measures, and vegetation dust control measures, which are permanent. A seasonal dust control measure is a project that CDPR implements to control saltation and dust generation for a defined period, usually between March 1 and October 31 of each calendar year. In contrast, temporary dust control measures control saltation and dust generation indefinitely, but not permanently.

Seasonal and temporary dust control measures generally include wind fencing, straw bales, and straw mulch, porous roughness elements, and other materials that can sometimes, but not always, be recovered and reused in subsequent dust control projects. State Parks also excludes vehicles from areas (vehicle exclosures) and has explored, in a very limited manner, the use of soil stabilizers as a form of seasonal and/or temporary dust control at Oceano Dunes SVRA. In contrast to seasonal and temporary measures like wind fencing, vegetation planted by CDPR at Oceano Dunes SVRA is generally considered a permanent dust control measure. However, treatment areas are subject to fluctuation in growing conditions, sand migration, etc.

Finally, CDPR also implements a track-out control program to prevent track-out of sand onto Grand Avenue and Pier Avenue entrances to Oceano Dunes SVRA.

State Parks' report on Oceano Dunes SVRA dust control measures is provided below as of July 31, 2021.

2.1.1 Dust Control Measures Installed Between 08/01/20 and 07/31/21

From August 1, 2020, to July 31, 2021, CDPR installed approximately 92 acres of new dust control projects at Oceano Dunes SVRA.[1] CDPR:

- Initiated planting on approximately 26 acres of new vegetation using sterile grass seed in 3 different treatment areas.[2]
- Installed approximately 66 acres of new, temporary dust control measures in 9 different areas, including:
  - Approximately 33 acres of wind fencing in 2 different treatment areas.
  - Approximately 27 acres of straw in 5 different treatment areas.
  - Approximately 6 acres of vehicle exclosures in 2 different treatment areas.

From August 1, 2020, to July 31, 2021, CDPR also converted and/or maintained approximately 73 acres of existing dust control projects. CDPR:

- Converted approximately 33 acres of existing, temporary wind fencing and straw measures to native dune vegetation.
- Conducted supplemental plantings in existing vegetation plots; and
- Maintained 40-acres of existing wind fencing installed as part of the 2019 ARWP.

The dust control measures implemented by CDPR during this period total 125 acres as listed in Table 2-1, shown in Figure 2-1, and briefly summarized below.

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[1] As recommended by the SAG, the main body of this 2021 ARWP document generally reports dust control measure acreages to the nearest whole number. Due to rounding, reported subtotal and total acreage values may not equal. As shown in Figure 2-1, between 08/01/2020 and 07/31/21, CDPR installed 92.3 acres of new dust control projects and converted 32.3 acres of new dust control projects. For simplicity and consistency, this ARWP reports that CDPR installed 92 acres of new dust control projects and 33 acres of converted dust control projects, for a total effort of 125 acres of dust control projects.

[2] To ensure consistency in reporting, this ARWP identifies 26 acres of sterile grass seed projects; however, as shown in Figure 2-1, the actual number is 26.6 acres. For the purposes of reporting the acreage of new dust control projects installed between 08/01/20 and 07/31/21, this ARWP considers project 2021-SE-02 to be a four-acre project instead of its actual 4.2-acre size.

Refer to Attachment 01, 2011 to 2021 Dust Control Measures for additional maps showing historical dust control measure locations, the dust control measures installed between 08/01/20 and 07/31/21, and all dust control measures in place as of 07/31/21. Refer also to Attachment 11, Updated PMRP Evaluation Metrics, for information on dust control projects at Oceano Dunes SVRA, dust mitigation targets, and other indicators of dust control progress at Oceano Dunes SVRA.

Table 2-1 Dust Control Measures Installed from 08/01/2020 and 07/31/2021

Dust Control Program ID[(A)]	Dust Control Measure ID[(B)]	New or Converted Dust Control Measure?	Status of Dust Control Measure	Dust Control Measure Size in Acres[(C)]
34	21-VG-01	Converted to Vegetation	Permanent	15
35	21-VG-02	Converted to Vegetation	Permanent	4
36	21-VG-03	Converted to Vegetation	Permanent	8
37	21-VG-04	Converted to Vegetation	Permanent	6
38	21-SM-01	New Straw Mulch	Temporary	5
39	21-SM-02	New Straw Mulch	Temporary	6
40	21-TV-01	New Vehicle Exclosure	Temporary	3
41	21-TV-02	New Vehicle Exclosure	Temporary	2[(D)]
42	21-WF-01	New Wind Fence	Temporary	22
43	21-WF-02	New Wind Fence	Temporary	11
44	21-SM-03	New Straw Mulch	Temporary	6
45	21-SM-04	New Straw Mulch	Temporary	5
46	21-SM-05	New Straw Mulch	Temporary	6
47	21-SE-01	New Straw/Seed	Permanent	18
48	21-SE-02	New Straw/Seed	Permanent	4
49	21-SE-03	New Straw/Seed	Permanent	4
Total Dust Control Measure Acreage Installed, 08/01/20 to 07/31/21				125
Total New Dust Control Measure Acreage Installed, 08/01/20 to 07/31/21				92

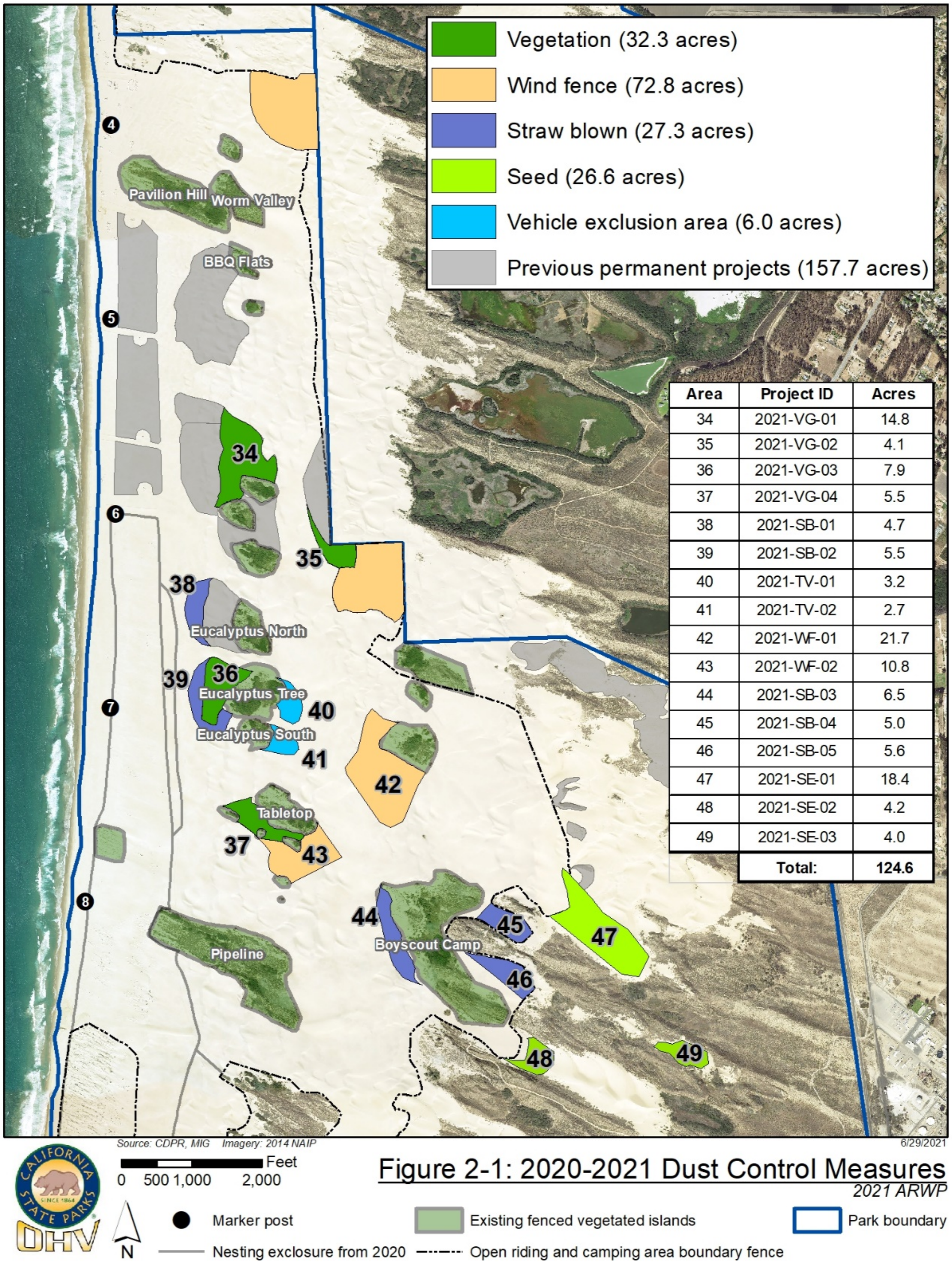
(A) CDPR has implemented a series of dust control projects at Oceano Dunes SVRA since 2011. The “Dust Control Program ID” represents the chronological order of these dust control projects, beginning with the first straw bale pilot project in 2011 (ID #01) and concluding with the final straw/seed project in 2021 (ID #49). For projects installed in the same dust control year (generally defined from August to July), projects are numbered from north to south.

(B) The “Dust Control Measure ID” identifies the dust control year, type of measure, and how many of the same type of measures were installed in the dust control year. For example, “21-SB-05" is the fifth straw bale project installed in the 2021 dust control year (identified from north to south). “SB” refers to strawbale, “SE” refers to sterile grass seed, “SM” refers to straw mulch or blown straw, “WF” refers to wind fencing, “TV” refers to temporary vehicle exclusion, and “VG” refers to vegetation.

(C) As recommended by the SAG, this 2021 ARWP document generally reports dust control measure acreages to the nearest whole number. See footnote 1 and footnote 2. Refer to Figure 2-1 and Attachment 1, 2011 to 2021 Dust Control Measures for precise dust control measure acreage amounts. Due to rounding for consistent reporting purposes, individual project acreages may differ from shown in Figure 2-1.

(D) Project 21-TV-02 is 2.7 acres but listed as 2 acres in this table for reporting purposes.

Figure 2-1: 2020 – 2021 Dust Control Measures



Area	Project ID	Acres
34	2021-VG-01	14.8
35	2021-VG-02	4.1
36	2021-VG-03	7.9
37	2021-VG-04	5.5
38	2021-SB-01	4.7
39	2021-SB-02	5.5
40	2021-TV-01	3.2
41	2021-TV-02	2.7
42	2021-WF-01	21.7
43	2021-WF-02	10.8
44	2021-SB-03	6.5
45	2021-SB-04	5.0
46	2021-SB-05	5.6
47	2021-SE-01	18.4
48	2021-SE-02	4.2
49	2021-SE-03	4.0
	Total:	**124.6**

2.1.1.1 New Permanent Vegetation Measures

In late spring 2021, CDPR initiated the planting of approximately 26 new acres of vegetation at Oceano Dunes SVRA in 3 different treatment areas selected in consultation with the SAG:

- Vegetation measures 21-SE-01 (approximately 18 acres), 21-SE-02 (approximately four acres), and 21-SE-03 (approximately four acres) are each located in the southeastern part of the SVRA, outside the SVRA's open riding and camping area. These new plantings are located adjacent to existing dune vegetation and generally fill in and/or expand and increase the size of existing vegetated dune areas.

State Parks first applied straw mulch to the selected planting areas. Then, CDPR broadcast the treatment areas with limited seeds and sterile cereal grains. Due to the timing of the seeding (late in the growing season), germination was limited in each treatment area. State Parks will stabilize and seed these areas using locally collected native seed during the 2021/22 planting season; container plants are not currently proposed in this area for 2021. CDPR's seeding methods are fully described in Chapter 6 of the June 2019 Draft PMRP.

2.1.1.2 New Temporary Dust Control Measures

In fall 2020 and spring 2021, CDPR installed approximately 66 acres of new, temporary dust control measures at Oceano Dunes SVRA in 9 different treatment areas selected in consultation with the SAG:

- Wind fencing measures 21-WF-01 (approximately 22 acres in south Boy Scout vegetation island) and 21-WF-02 (approximately 11 acres between the Tabletop and Willow Ridges vegetation islands) are located near the center of the SVRA's open riding and camping area. The fencing projects consisted of multiple rows of four-foot-tall porous fences (50% porosity) placed perpendicular to the prevailing sand transporting-wind direction.
- Straw mulch (SM) measures 21-SM-01 (approximately five acres west of the Eucalyptus North vegetation island) and 21-SM-02 (approximately six acres west of the Eucalyptus Tree vegetation island) are each located near the center of the SVRA's open riding and camping area. Straw measures 21-SM-03 (approximately six acres west of the Boyscout

Camp vegetation island), 21-SM-04 (approximately five acres east of the Boyscout Camp vegetation island), and 21-SM-05 (approximately six acres east of the Boyscout Camp vegetation island) are each located near the southeast corner of the SVRA's open riding and camping area. These new straw measures are located adjacent to existing vegetation islands and dust control vegetation projects and generally fill in and/or expand and increase the size of existing vegetated dune areas and/or treatment areas. CDPR applies straw to a depth of approximately six to eight inches; however, the amount of straw applied varies by treatment area due to topography.

- Vehicle exclosure measures 21-TV-01 (approximately 3 acres east of the Eucalyptus Tree vegetation island) and 21-TV-02 (approximately 3 acres east of the Eucalyptus South vegetation island) are located near the center of the SVRA's open riding and camping area.

2.1.1.3 Conversion of Existing Temporary Measures to Permanent Vegetation

In fall 2020 and winter 2021, CDPR converted approximately 33 acres of temporary wind fencing and straw bale dust control measures to permanent vegetation:

- Vegetation measure 21-VG-01 (approximately 15 acres north of the Heather and Acacia vegetation islands) is located near the center of the SVRA's open riding and camping area. This measure replaced approximately 15 acres of straw installed in March 2020, which had replaced wind fencing installed in 2018 pursuant to SOA Condition 1.b (see Attachment 01, Figures A01-09 and A01-11).
- Vegetation measure 21-VG-02 (approximately four acres) is located along the eastern boundary of the SVRA (perpendicular to marker Post 6) in the open riding and camping area. This measure replaced approximately four acres of straw installed in January 2020 pursuant to Condition 4 of the December 9, 2019 Order to Modify SOA #17-01 (20-SB-02, see Attachment 01, Figure A01-11).
- Vegetation measures 21-VG-03 (approximately eight acres west of the Eucalyptus Tree vegetation island), 21-VG-04 (approximately six acres south of the Tabletop vegetation island) are located near the center of the SVRA's open riding and camping area. These

measures replaced approximately 15 acres of wind fencing installed in 2018 pursuant to SOA Condition 1.b (18-WF-04 and 18-WF-05, see Attachment 01, Figure A01-09).

2.1.1.4 Supplemental Vegetation Plantings

From fall 2020 to spring 2021, CDPR planted approximately 24,800 plants and spread approximately 46 pounds of native dune seed (as well as 300 pounds of sterile seed) in areas previously treated with native vegetation. In total, this supplemental planting covered approximately eight acres of previously treated areas. Supplemental planting often focuses on the west-facing portions of vegetation installations where direct wind and sand activity bury or undermine treatments. Some supplemental planting areas require straw, while other areas are treated with just native plants and/or seeds. The areas that received supplemental plantings during the 2020/21 planting season include the Big Foot west (20-VG-04), BBQ Flats (19-VG-01), and Eucalyptus Tree North (19-VG-02) vegetated areas (see Attachment 01, Figures A01-10, and A01-11). Refer to Attachment 02, 2020/2021 APCD and Supplemental Restoration Projects for a detailed breakdown of the supplemental planting treatment areas, the type of species planted, and the amount of supplemental seed (pounds applied) and planting (number of seedlings planted) activity in each treatment area.

2.1.1.5 Maintenance of Existing Temporary Dust Control Measures

Consistent with SOA Condition 1.b., CDPR maintained approximately 40 acres of wind fencing in two (2) existing wind fencing projects installed at Oceano Dunes SVRA before August 1, 2020. These include projects 20-WF-01 (approximately 21 acres) in the northeast corner of the open riding and camping area and 20-WF-02 (approximately 20 acres) along the eastern boundary of the open riding and camping area (see Attachment 01, Figure A01-11). Maintenance activities included replacing fence posts, fencing materials, and installing new fence rows to maintain historical design control values for wind fencing arrays (greater than 80% to 90% control in the center of the array).

2.1.2 Cumulative Dust Control Measures Installed as of 07/31/21

As of July 31, 2021, 32 dust control projects are in the ground at Oceano Dunes SVRA. CDPR actively manages and maintains each of these projects. In total, the 32 dust control projects occupy approximately 323 acres of land at Oceano Dunes SVRA. The dust control measures in the ground at Oceano Dunes SVRA as of July 31, 2021, are listed in Table 2-2 and shown in Figure 2-2.

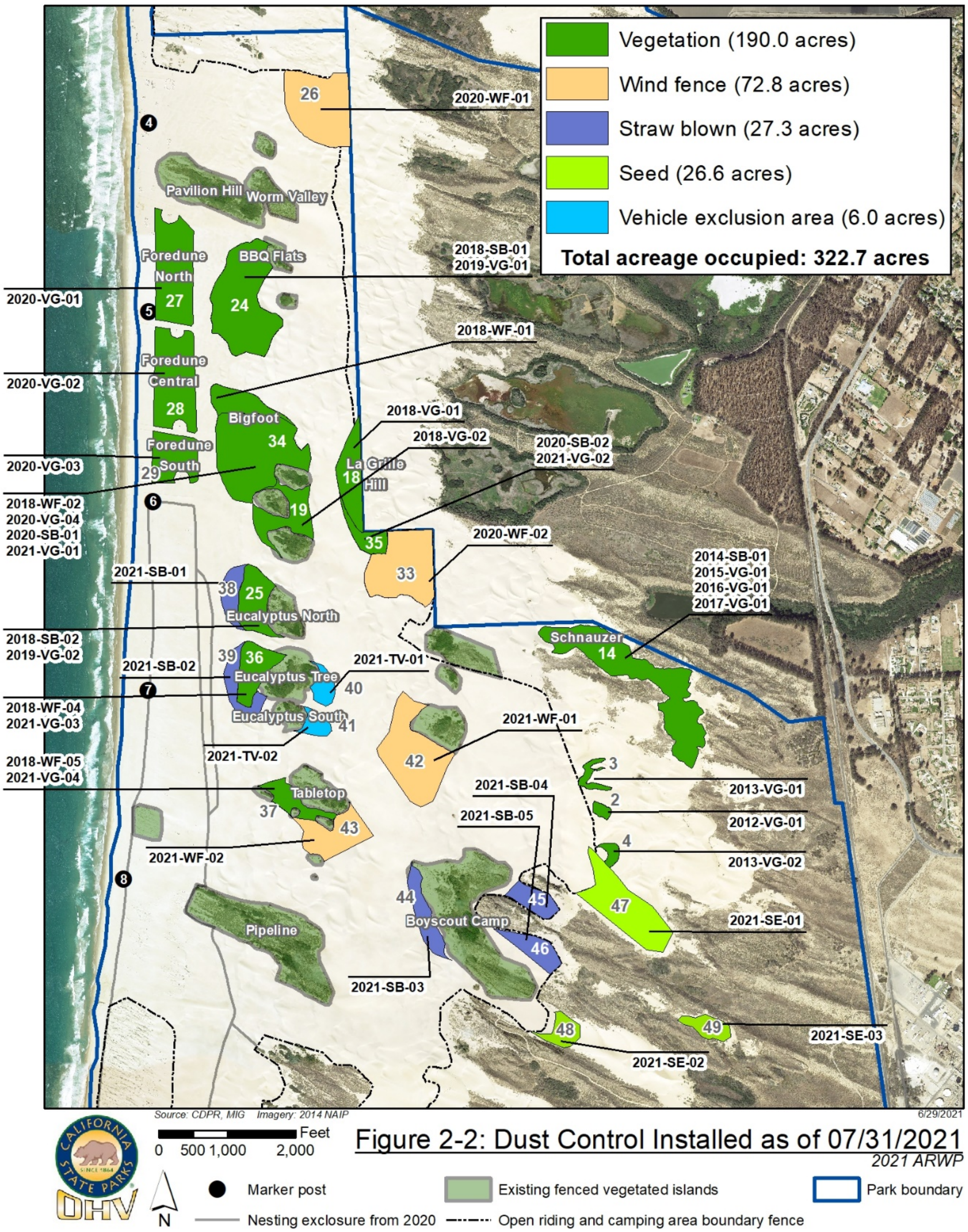
Refer to Attachment 01 for additional maps showing historical dust control measure locations and all dust control measures in place as of 07/31/21. Refer also to Attachment 11, Updated PMRP Evaluation Metrics, for information on dust control projects at Oceano Dunes SVRA, dust mitigation targets, and other indicators of dust control progress at Oceano Dunes SVRA.

Table 2-2 Cumulative Dust Control Measures Installed as of 07/31/21

Type of Dust Control Measure	Number of Projects(A)	Acres Controlled by Dust Control Measures		
		Inside Open Riding and Camping Area	Outside Open Riding and Camping Area	SVRA Total
Vegetation Dust Control Measures				
Foredune	3	48	0	48
Backdune	18	107	62	169
Subtotal	21	155	62	217
Seasonal and/or Temporary Dust Control Measures				
Straw	5	27	0	27
Wind Fencing	4	73	0	73
Vehicle Exclosure	2	6	0	6
Other(B)	0	0	0	0
Subtotal	11	106	0	106
Totals	**32**	**261**	**62**	**323**

(A) Value reflects the number of projects forecast to be in the ground as of July 31, 2021, and does not consider planned activities described in Chapter 3 of this ARWP.
(B) Other refers to porous roughness elements, soil stabilizers, or other types of dust control measures.

Figure 2-2: Dust Control Measures Installed as of 07/31/21



State Parks notes that the actual cumulative tally of dust control measures installed at Oceano Dunes SVRA cannot be represented by a single value for several reasons. First, CDPR has worked with the SLOAPCD, the California Air Resources Board (CARB), and SAG to conduct pilot projects, evaluate alternative arrays, etc. These efforts are not captured by Table 2-2. Second, a "snapshot" estimate of dust control acreage does not fully capture that CDPR plants vegetation in the same location where seasonal or temporary dust control measures were previously installed. For instance, 40 acres of wind fencing does not "count" towards the control number if it has subsequently been replaced with vegetation. Finally, estimates of dust control acreage do not fully consider or convey the annual maintenance and supplemental planting activities CDPR must undertake to maintain effective dust control measures.

2.2 REPORT ON PROGRESS TOWARDS SOA GOALS

As amended, SOA #17-01 establishes project, emission reduction, and air quality standard requirements.

- Condition 1.a requires CDPR to implement a 48-acre foredune project and 74-acres of wind fencing projects by September 15, 2018 (referred to as initial particulate matter reduction actions, or "Initial SOA" dust control measures). Pursuant to the SOA, CDPR is to prioritize the conversion of wind fencing projects to vegetation. As amended in November 2019, the SOA also requires CDPR to complete an additional 4.2 acres of vegetation in an area approved by the SAG.
- Condition 1.c requires CDPR to install APCD-approved sand track out control devices at the Grand and Pier Avenue entrances to Oceano Dunes SVRA.
- Condition 2.b. requires CDPR's PMRP to be designed to achieve the state and federal ambient air quality standards for PM_{10}. These standards are typically referred to as California Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Standards (NAAQS). The CAAQS and NAAQS for PM_{10} are shown in Table 2-3.

Table 2-3 California and National Ambient Air Quality Standards for PM10

Averaging Time	California Standard[(A)]	National Standard [(A)]
24-Hour Average	50 µg/m^3	150 µg/m^3
Annual Arithmetic Mean	20 µg/m^3	No standard adopted
Source: CARB, 2016 (https://ww2.arb.ca.gov/sites/default/files/2020-07/aaqs2.pdf) (A) µg/m^3 = micrograms per cubic meter		

- The CAAQS and NAAQS are mass concentration-based standards that require measurement and analysis of ambient air to determine compliance with the standard. Progress towards compliance with SOA Condition 2.b is measured by evaluating modeled and actual measured concentrations of PM_{10} concentrations at the SLOAPCD's CDF and Mesa 2 air monitoring stations.
- Condition 2.c requires the PMRP to reduce maximum 24-hour PM_{10} baseline emissions by 50%. This requirement is to be achieved through air quality modeling to define the baseline emissions conditions from May 1, 2013, through August 31, 2013, before any major dust controls being implemented. In contrast to the CAAQS and NAAQS, which are mass concentration-based standards, this SOA requirement is a mass-emissions-based standard. Progress towards compliance with SOA Condition 2.c is measured by modeling and identifying the maximum amount of PM_{10} mass (e.g., tons/day) emitted by (1) Oceano Dunes SVRA during the 2013 baseline period, (2) inputting dust control measures into the model, and (3) determining the reduction in PM_{10} mass achieved by the dust control measures based on the use of the air quality model.

State Parks' report on the progress made towards complying with the SOA requirements identified above is provided below.

2.2.1 Report on Progress Towards Specific SOA Projects

State Parks achieved the following progress towards the specific projects identified in the SOA, as amended:

- **Foredune Project:** State Parks installed perimeter fencing for the 48-acre foredune project in 2019 (20-VG-01, 20-VG-02, 20-VG-03; see Attachment 01, Figure A01-11).

During the 2019/20 growing season, CDPR implemented six different foredune treatment areas, including seed or seedling planting strategies, in consultation with the SAG. CDPR is monitoring foredune development in consultation with the SAG and UCSB.

- **Initial SOA Wind Fencing Projects:** State Parks installed approximately 49 acres of wind fencing in three different treatment areas in Summer 2018. As of July 31, 2021, CDPR has converted all 49 acres of Initial SOA wind fencing projects to vegetation.
  - *Heather, Acacia, and Cottonwood (aka "Paw Print" or "Bigfoot"):* CDPR installed two wind fencing arrays on approximately 35 acres of land adjacent to the Heather, Acacia, and Cottonwood vegetation islands in Summer 2018 (18-WF-01 and 18-WF-02, see Attachment 01, Figure A01-09). State Parks converted most of this wind fencing (20 acres) to dune scrub vegetation in December 2019 (20-VG-04, see Attachment 01, Figure A01-11). State Parks removed the remaining 15 acres of wind fencing treatments in September 2019, installed straw bales in the same area in March 2020 (20-SB-01), and converted this straw to vegetation as described in Section 2.1.1.3 in Winter 2021 (21-VG-01).
  - *Eucalyptus Tree and Eucalyptus South:* The OHMVR Division installed wind fencing arrays on approximately 8 acres of land adjacent to the Eucalyptus Tree, a vegetation island (18-WF-04). As described in Section 2.1.1.3, CDPR converted this wind fencing to vegetation in Winter 2021 (21-VG-03).
  - *Table Top:* The OHMVR Division installed wind fencing arrays on approximately 5 acres of land adjacent to the Table Top vegetation islands (18-WF-05). As described in Section 2.1.1.3, CDPR converted this wind fencing to vegetation in Winter 2021 (21-VG-04).
- **Initial SOA Straw Bale Projects:** State Parks installed approximately 36 acres of straw bales in two different treatment areas in Summer 2018. As of July 31, 2021, CDPR has converted all 36 acres of Initial SOA straw bale projects to vegetation.
  - *BBQ Flats:* The OHMVR Division installed approximately 3,630 strawbales on approximately 27 acres of land adjacent to the BBQ Flats vegetation islands in the northern part of the SVRA's open riding and camping area (18-SB-01, see

Attachment 01, Figure A01-09). In winter 2018, CDPR converted these straw bales to vegetation (19-VG-01, see Attachment 01, Figure A01-10).

  - *Eucalyptus North:* The OHMVR Division installed approximately 1,360 straw bales on approximately 9 acres of land adjacent to the Eucalyptus North vegetation island in the center of the SVRA's open riding and camping area (18-SB-02, see Attachment 01, Figure A01-09). In winter 2018, CDPR planted vegetation within this treatment area that replaced the straw bales installed in Summer 2018 (19-VG-02, see Attachment 01, Figure A01-10).

- **Modified SOA 4.2-Acres of Permanent Dust Control:** As described in Section 2.1.1.3, CDPR installed straw bales/mulch in this approximately 4-acre treatment area in January 2020 (20-SB-02, see Attachment 01, Figure A01-11), which was subsequently converted to vegetation in winter 2021 (21-VG-02).

2.2.2 Report on Progress Towards 50% Mass Emissions Reduction

The DRI model estimates the maximum amount of PM_{10} mass (e.g., tons/day) emitted by the dune surfaces in the Oceano Dunes SVRA open riding and camping area during the stipulated 2013 baseline period to 182.2 metric tons/day.[3] State Parks' progress in reducing baseline mass emissions is summarized in Table 2-4. Refer to Attachment 03, DRI Oceano Dunes: Status 2021 for DRI model estimates of baseline mass emission reductions by year.

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[3] The estimated baseline emissions are based on 2013 Portable In-Situ Wind Erosion Laboratory (PI-SWERL) emissivity data using the $1/r^2$, 5 nearest neighbor interpolation/extrapolation methodology) and reflect the average amount of PM_{10} mass emitted from the open riding and camping area on the 10 highest emitting days during the baseline time period. One metric ton is equal to 1.1 short tons (U.S. tons).

Table 2-4 Modeled Estimated Reductions of PM10 for the Oceano Dunes SVRA Riding Area

Scenario/Evaluation	Riding Area Controlled (Acres)	Mass Emissions (Metric Tons/Day) (A)	Emissions Reduced (%) (B)
2013 Baseline (no dust control measures)	0	182.2	0%
Cumulative Dust Control Measures through 07/31/20	195	155.3 (-27.5)	15%
Incremental New Dust Control Measures Installed 08/01/20 - 07/31/21	66	145.2 (-10.1)	6%
Cumulative Totals (All Dust Control Measures through 07/31/21)	**261**	**145.2 (-38.6)**	**21%**
SOA Condition 2.c Goal	**--**	**91.1**	**50%**

Source: DRI, 2021 (see Attachment 03), modified by CDPR.
(A) This column reports the total mass emissions of PM_{10} from the open riding and camping area. The net reduction in mass emissions from the baseline value of 182.2 metric tons per day is listed in parentheses.
(B) The emission reduction percentage is estimated by dividing the mass emissions under the listed scenario by the baseline mass emissions value of 182.2, e.g., 1- (155.3/182.2) = 15%.

As of July 31, 2020, the DRI model estimates CDPR's dust control measures reduced mass emissions by 27.5 metric tons per day, a 15% reduction in baseline mass emissions. The new dust control measures installed by CDPR between 08/01/20 and 07/31/21 reduced mass emissions by an additional 10.1 metric tons per day, or 6% of baseline mass emissions level. In total, the DRI model estimates the cumulative reduction in mass emissions achieved by the approximately 323 acres of dust control measures in the ground at Ocean Dunes SVRA as of July 31, 2021, is 38.6 metric tons per day, which equals a 21% reduction in baseline mass emissions. This 21% cumulative reduction in mass emissions from the Oceano Dunes SVRA open riding and camping area represents continued progress towards achieving the 50% reduction baseline mass emissions required by SOA Condition 2.c.

2.2.3 Report on Progress Towards Ambient Air Quality Standards

The DRI model is also used to evaluate potential changes in downwind PM_{10} concentrations at selected receptor sites such as the SLOAPCD's CDF and Mesa2 air quality monitoring stations. The model estimates the 24-hour average PM_{10} concentration during the stipulated 2013 baseline period to be 128.2 and 95.4 micrograms per cubic meter (μg/m^3). Refer to Attachment

11, Updated PMRP Evaluation Metrics, for information on dust control projects at Oceano Dunes SVRA, dust mitigation targets, and other indicators of dust control progress at Oceano Dunes SVRA.

2.2.3.1 CDF Air Quality Monitoring Station

State Parks' progress in reducing 2013 modeled baseline PM_{10} concentrations at the SLOAPCD's CDF air quality monitoring station is summarized in Table 2-5. Refer to Attachment 03 for additional information on DRI model estimates of 24-hour PM_{10} concentrations at the CDF station.

Table 2-5: Modeled Estimated Reductions of PM10 Downwind of Oceano Dunes SVRA (CDF)

Scenario/Evaluation	Cumulative Area Controlled (Acres)	CDF PM_{10} Concentration(A)	Concentration Reduced (%) (B)
2013 Modeled Baseline (no dust control measures)	0	124.7	0%
Cumulative Dust Control Measures through 07/31/20	231	72.4 (-52.3)	42.0%
Incremental New Dust Control Measures Installed 08/01/20 - 07/31/21	92	72.2 (-0.2)	0.1%
Cumulative Totals (All Dust Control Measures though 07/31/21)	**323**	**72.2 (52.5)**	**42.1%**
SOA Condition 2.c Goal	**--**	**50.0**	**60%**

Source: DRI, 2021 (see Attachment 03), modified by CDPR.

(A) This column reports the total modeled concentration of PM_{10} at CDF. The net reduction in concentration from the modeled baseline value of 124.7 metric tons per day is listed in parentheses.

(B) The concentration reduction percentage is estimated by dividing the concentration under the listed scenario by the baseline concentration value of 124.7, e.g., 1- (72.4/124.7) = 42%.

As of July 31, 2020, the DRI model estimates CDPR's dust control measures reduced downwind 24-hour PM_{10} concentrations at the CDF station by 52 $\mu g/m^3$, a 42% reduction in baseline PM_{10} concentrations for this site. The new dust control measures installed by CDPR between 08/01/20 and 07/31/21 reduced 24-hour PM_{10} concentrations at the CDF station by an additional 0.2 $\mu g/m^3$, or 0.1% of baseline PM_{10} concentrations. This limited reduction is because dust control projects installed between 08/01/20 and 07/31/21 focused on air quality improvements at Mesa2 station and not the CDF station. In total, the DRI model estimates the cumulative reduction in 24-hour PM_{10} concentrations at the CDF station from the approximately 323 acres of dust control measures in the ground at Ocean Dunes SVRA as of July 31, 2021, is 52.5 µg/m^3, which equals a 42.1% reduction in baseline modeled 24-hour PM_{10} concentrations. This 42.1% cumulative reduction in 24-hour PM_{10} concentrations at the CDF site represents continued progress towards achieving CAAQS (50 µg/m^3) required by SOA Condition 2.b.

2.2.3.2 Mesa2 Air Quality Monitoring Station

State Parks' progress in reducing 2013 modeled baseline PM_{10} concentrations at the SLOAPCD's Mesa2 air quality monitoring station is summarized in Table 2-6. Refer to Attachment 03 for additional information on DRI model estimates of 24-hour PM_{10} concentrations at the Mesa2 station.

Table 2-6: Modeled Estimated Reductions of PM10 Downwind of Oceano Dunes SVRA (Mesa2)

Scenario/Evaluation	Cumulative Area Controlled (Acres)	Mesa2 PM_{10} Concentration[(A)]	Concentration Reduced (%) [(B)]
2013 Modeled Baseline (no dust control measures)	0	97.5	0%
Cumulative Dust Control Measures through 07/31/20	231	91.2 (-6.3)	6.5%
Incremental New Dust Control Measures Installed 08/01/20 - 07/31/21	92	73.8 (-17.4)	17.8%
Cumulative Totals (All Dust Control Measures though 07/31/21)	**323**	**73.8 (-23.7)**	**24.3%**
SOA Condition 2.c Goal	**--**	**50.0**	**49%**

Source: DRI, 2021 (see Attachment 03), modified by CDPR.

(A) This column reports the total modeled concentration of PM_{10} at Mesa2. The net reduction in concentration from the modeled baseline value of 97.5 metric tons per day is listed in parentheses.

(B) The concentration reduction percentage is estimated by dividing the concentration under the listed scenario by the baseline concentration value of 97.5, e.g., 1- (6.3/97.5) = 6.5%.

Based on the dust controls in place as of July 31, 2020, the DRI model estimates that CDPR's dust control measures reduced downwind 24-hour PM_{10} concentrations at the Mesa2 station by 6.3 µg/m^3, a 6.5% reduction in baseline PM_{10} concentrations at this site. The new dust control measures installed by CDPR between 08/01/20 and 07/31/21 reduced 24-hour PM_{10} concentrations at the Mesa2 station by an additional 17.4 µg/m^3, or 17.8% of baseline PM_{10} concentrations. In total, the DRI model estimates the cumulative reduction in 24-hour PM_{10} concentrations at the Mesa2 station from the approximately 323 acres of dust control measures in the ground at Ocean Dunes SVRA as of July 31, 2021, is 23.7 µg/m^3, which equals a 24.3% reduction in modeled baseline 24-hour PM_{10} concentrations.

This 24.3% cumulative reduction in modeled baseline 24-hour PM_{10} concentrations at the Mesa2 station represents continued progress towards achieving the CAAQS (50 µg/m^3) as required by SOA Condition 2.b.

2.2.3.3 Increments of Progress Towards Air Quality Objectives, 2013 to 2020

Dust control measures have been used within Oceano Dunes SVRA to reduce mass emissions of PM_{10} originating from within the Park, primarily from within the Park's open riding and camping area. These controls are also expected to lower the regional PM_{10} burden and help meet SOA goals. As of July 31, 2020, approximately 223 acres of dust control measures were installed at Oceano Dunes SVRA. According to emission and dispersion modeling undertaken by DRI, as of July 31, 2020, dust control projects installed at Oceano Dunes SVRA have reduced baseline modeled PM_{10} at the CDF station by approximately 42% (see Table 2-5). Measurements of PM_{10} at CDF and wind speed at the S1 tower in Oceano Dunes SVRA demonstrate that the dust emission system in locations where controls have been placed produces less PM_{10} than prior to these controls. This reduction is consistent with the increase in acres of dust control. DRI's analysis of observational data also converges with model results that indicate PM_{10} reduction at the CDF receptor site is due to the dust controls.

Refer to Attachment 04, Increments of Progress Towards Air Quality Objectives (2013 – 2020), for DRI's analysis of the incremental progress made towards achieving SOA air quality objectives and related analysis prepared by the California Geological Survey (CGS). Refer to Attachment 12 for SAG comments on the CGS analysis.

2.2.4 Report on Progress Towards Track-out Control

State Parks has developed engineered drawings for permanent track out control at Grand and Pier Avenues. Those plans were finalized in 2020 and are included as Attachment 05, Sediment Track-Out Prevention Measures. The physical projects were not installed during the 2021 reporting period because control agencies had not approved funding. It is anticipated that these projects will be funded during the State of California's Fiscal Year from July 2021-June 2022, with construction possible in the first quarter of 2022. In the interim, CDPR installed temporary rubber track-out mats at the Pier Avenue exit to test the effectiveness and operational parameters of the track-out prevention measures. During the closure of Oceano Dunes SVRA during the 2020 COVID-19 pandemic (roughly March-October 2020), no track-out mats were in place because there was no public vehicle activity allowed on the beach. The temporary mats are in place and regularly cleaned during all periods when the beach was open to public vehicle activity.

Ongoing street sweeping activities on Pier and Grand Avenues occur three times per week using a combination of State Parks' sweepers and a private contractor on Pier Avenue.

2.3 REPORT ON FIELD MONITORING AND AIR QUALITY MODELING

Chapter 3 of CDPR's PMRP provides a basic overview of dispersion modeling and presents the methodology, key inputs, data sources, and assumptions experts from the DRI Division of Atmospheric Sciences, SAG, CARB, SLOAPCD, and CDPR have incorporated into the SOA's air quality modeling. As noted in Section 3.4 of the approved PMRP:

> The United States Environmental Protection Agency's (USEPA) Guideline on Air Quality Models states, "the formulation and application of air quality models are accompanied by several sources of uncertainty."

The Guideline describes two specific sources of uncertainty. 'Irreducible' uncertainty stems from unknown conditions, which may not be explicitly accounted for in the model, and which are likely to lead to deviations from the actual, observed concentrations for any individual event. Uncertainties cause “Reducible” uncertainties in the “known” input conditions (e.g., emission characteristics and meteorological data, errors in measured concentrations, and inadequate model physics and formulation.)

State Parks’ adaptative management approach to dust control at Oceano Dunes SVRA involves collecting data that supports the evaluation and improvement of model performance and dust control measure effectiveness. Incorporating new information and comparing model predictions to observations from actual air quality stations such as CDF facilitates model improvements and public understanding and confidence in the model’s results.

For example, State Parks’ monitoring network (see Section 2.3.1) provides data on meteorological and PM conditions across the spatial domain of Oceano Dunes SVRA and at locations external to the SVRA. These data are important for modeling of dispersion of PM for the time frame beginning with its establishment (effectively for 2017 to the present). For the baseline year, the stations set up in 2013, which were at different locations at that time, provided wind speed and wind direction data and PM measurements across the spatial domain as input into the model. These data are used within the DRI model to verify model-predicted PM at the monitoring locations, which are adjusted to reflect the measurement if the model values diverge from those local values. The monitoring network data are also used to investigate how the dust emission system has changed through time, allowing evaluation of how dust controls have modulated the PM levels on a regional scale.

State Parks’ report on field monitoring activities and progress towards improving the measurement, modeling, and evaluation of compliance with SOA goals is described below.

2.3.1 Meteorological and PM Monitoring

State Parks installed seasonal and temporary meteorological and PM monitoring sites at Oceano Dunes SVRA since the SLOAPCD first began evaluating PM emissions on the Nipomo Mesa in 2007. The purpose of these instruments is to help assess individual project effectiveness and update and refine meteorological inputs needed for the SOA’s air quality modeling.

State Parks' S1 meteorological tower (located near marker post 6) was installed in June 2010 and continues to operate and support Dust Control Program activities. In 2013, CDPR deployed a temporary network of meteorological and PM monitoring equipment throughout Oceano Dunes SVRA. This temporary network, which was mostly removed in 2013, has generally informed the basis and need for subsequent meteorological and PM data collection efforts and monitoring locations in subsequent years.

State Parks' meteorological and PM monitoring network varies slightly from year to year depending on specific goals, objectives, and dust control measures identified in the ARWP cycle. From August 1, 2020, to July 31, 2021, CDPR maintained the 2020 ARWP monitoring network shown in Figure 2-3, including:

- Six foredunes (see Section 2.3.2.2) meteorological and PM monitoring sites
- Fifteen other meteorological and PM monitoring sites located throughout and downwind of Oceano Dunes SVRA
- One sonic detection and ranging (SODAR) instrument station

Typically, the monitoring site consists of a suite of instruments affixed to a tripod, platform, or tower located three to ten meters above ground level (see Figure 2-4). Instruments collect wind speed and wind direction (using two-dimensional sonic anemometry), ambient temperature, relative humidity (RH), and barometric pressure. The SODAR instrument station (originally installed in May 2019) records three-dimensional velocity vector data from approximately 40 meters to 200 meters above ground level (see Figure 2-5).

The particulate matter at each station is measured using a MetOne 212-2 Particle Profiler that measures particle counts in eight size bins per sampled flow volume using an optically based measurement system. These particle count bins are used to derive a PM_{10} concentration on a minute and hourly basis. The PM_{10} concentration is derived from environmentally-controlled and field calibration relationships between particle count data collected by the Particle Profiler and mass-based PM_{10} concentration data collected by an EPA Federal Equivalent Method PM_{10} monitor. The DRI conducted initial, environmentally-controlled calibration procedures in 2020 and concluded the consistency of the calibration relationship among the Met One 212-2

Particle Profiler units was good for particles through size bin six both before and after field deployment. In addition, field calibrations indicate the MetOne Particle Profilers are not adversely affected by high wind conditions (above 5 meters per second). In April 2021, DRI repeated the environmentally-controlled calibration procedures with similar results. The 2021 calibration ensures that each MetOne 212-2 Particle Profiler instrument has a specific calibration relationship to provide the best estimate of PM_{10} during deployment at Oceano Dunes SVRA.

Refer to Attachment 06 for a detailed summary of DRI's MetOne 212-2 Particle Profiler PM_{10} calibration procedures.

A Sensit instrument is also deployed at/near the ground level to measure saltation activity in active sand transport areas.

Figure 2-3: 2020 – 2021 Monitoring Network

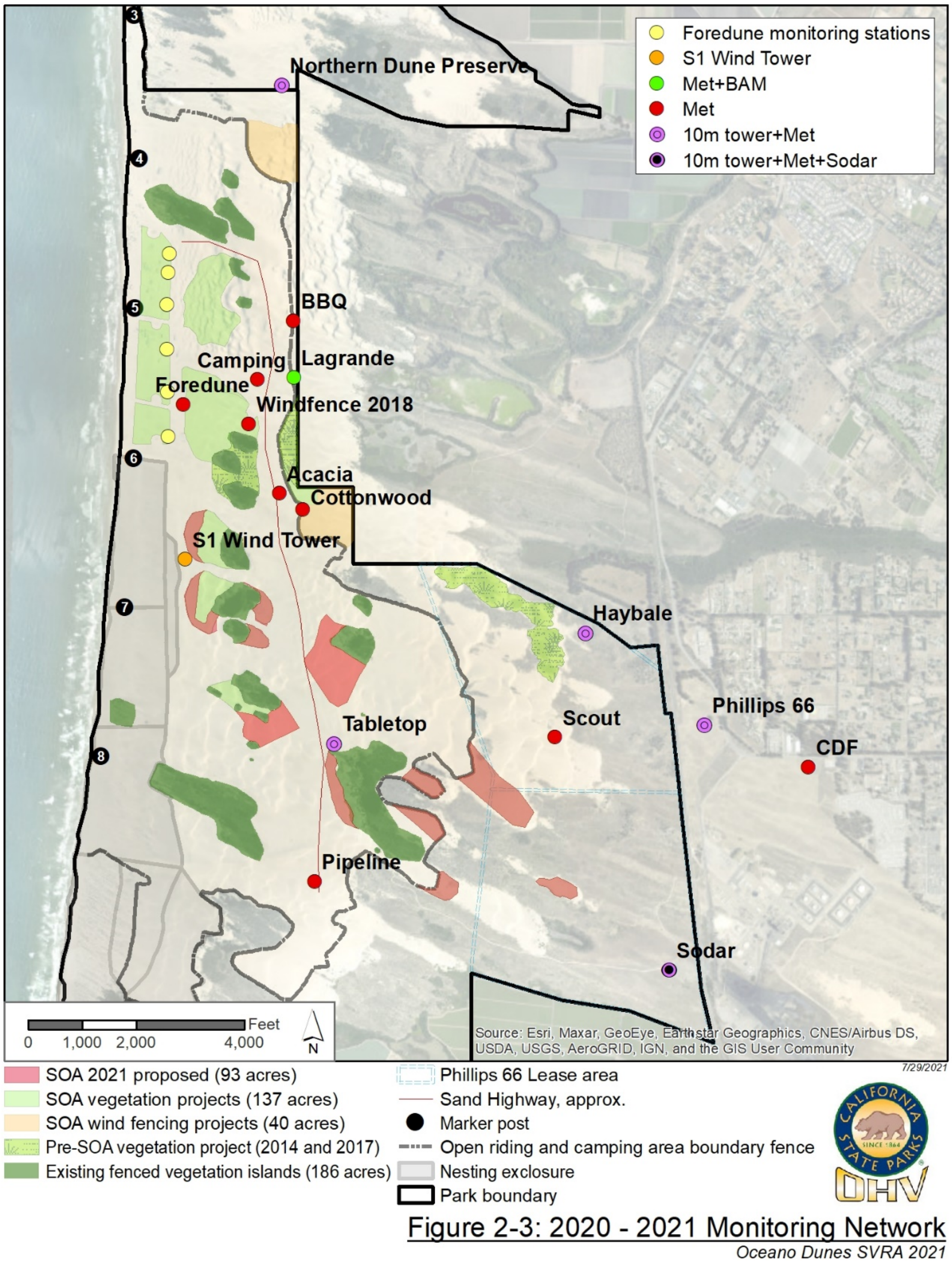


Figure 2-4: Typical Meteorological and PM Monitoring Station at Oceano Dunes SVRA

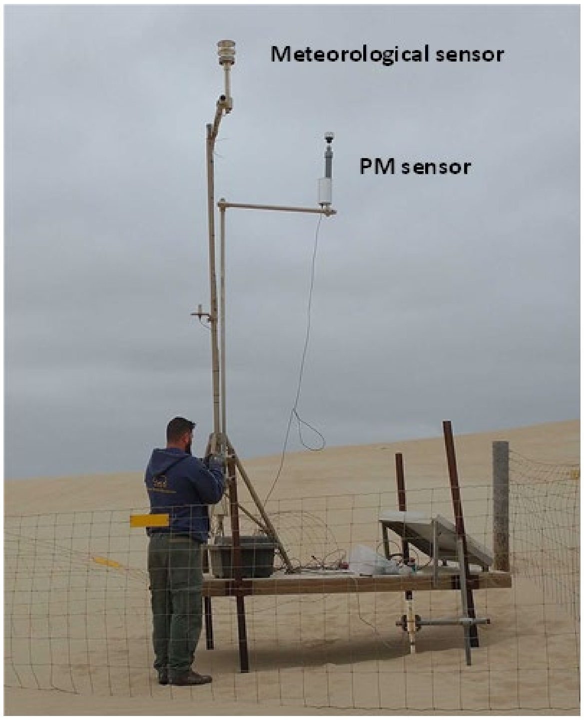


Figure 2-4. Typical meteorological (sonic anemometer) and PM (MetOne 212-2 Particle Profiler) monitoring site.

Figure 2-5: SODAR Monitoring Station

Figure 2-5. The SODAR upper-air measurement station is located near the southeast corner of Oceano Dunes SVRA. The co-located 10-meter meteorological tower and the Phillips 66 refinery are shown in the back left of the photo. UCSB and ASU operate the station.

2.3.2 SALTATION MONITORING

In addition to meteorological and airborne PM measurements, CDPR also operates instruments that physically collect or count the movement of sand particles when high wind events actuate the saltation process. These instruments include the Big Springs Number Eight (BSNE) dust collector and the Sensit saltation monitor. The saltation monitoring instruments help assess individual project effectiveness.

The BSNE sampling network quantifies sand flux in dust control measures. The sampling network is monitored and maintained by personnel from the Coastal San Luis Resource Conservation District (San Luis RCD) following procedures and training provided by DRI. The sampling strategy involves installing the BSNE dust collectors at the height of 15 centimeters (cm) above the ground surface before a sand transport event. After the sand transport event, sand is collected from the instrument, placed into a bag, and the date and location/instrument ID are recorded. The emptied BSNE dust collector is reset to 15 cm above the ground surface to collect sand during the next sand transport event. The collected sand samples were returned to the RCD office and weighed on an electronic balance to a precision of 0.01 grams (g).

2.3.2.1 Wind Fence Array Saltation Flux Measurements

From August 1, 2020, to July 31, 2021, CDPR, San Luis RCD, and DRI collected and analyzed saltation flux measurements from two temporary wind fencing projects installed in 2020 (20-WF-01 and 20-WF-02, See Attachment 01, Figure A01-11). Twelve traps were placed in each wind fence project. The traps were placed between consecutive wind fence rows at a distance of six fence heights from the upwind (i.e., western) fence. The control effectiveness of the wind fencing array is defined by the Normalized Sand Flux (NSF, defined as the sand flux internal to the array divided by the sand flux upwind of the array).

The overall control effectiveness is based on the change of NSF as a function of downwind distance through a dust control measure. Within dust control measure 20-WF-01, NSF decreased rapidly between the first four sets of traps (closest to the upwind fence position) then stabilized throughout the remainder of the array except for a fence row/trap situated in an elevated position where maximum winds are likely to occur. The DRI reports the mean NSF in the general center of 20-WF-01 to be 0.28 (±0.11), indicating a mean percent reduction in the sand flux of 72% near the array's center. Within dust control measure 20-WF-02, NSF similarly decreased rapidly between the first four sets of traps (closest to the upwind fence position), then stabilized to the end of the array. The DRI reports the mean NSF in the general center of 20-WF-02 to be 0.21 (±0.08).

The NSF values reported for 20-WF-01 (0.28 ±0.11) are lower than past mean NSF observations within wind fencing arrays. For example, a mean and 20-WF-02 (0.21 ±0.08) are generally lower than past NSF observations within wind fencing arrays. For example, the 2020 ARWP reported a mean NSF of 0.21 (±0.13) across 94% of larger, approximately 35-acre wind fencing (WF) arrays (18-WF-01 and 18-WF-02, See Attachment 01, Figures A01-09). This value is similar to the mean NSF reported for 20-WF-02; however, direct comparisons are limited due to differences in size, topography, and the area for which mean NSF was reported (e.g., the approximate center of the 2020 wind fencing projects vs. 94% of the 2018 wind fencing project).

Refer to Attachment 07 for DRI's detailed report on saltation flux measurements collected and analyzed from August 1, 2020, to July 31, 2021.

2.3.2.2 Foredune Restoration Area Saltation Flux Measurements

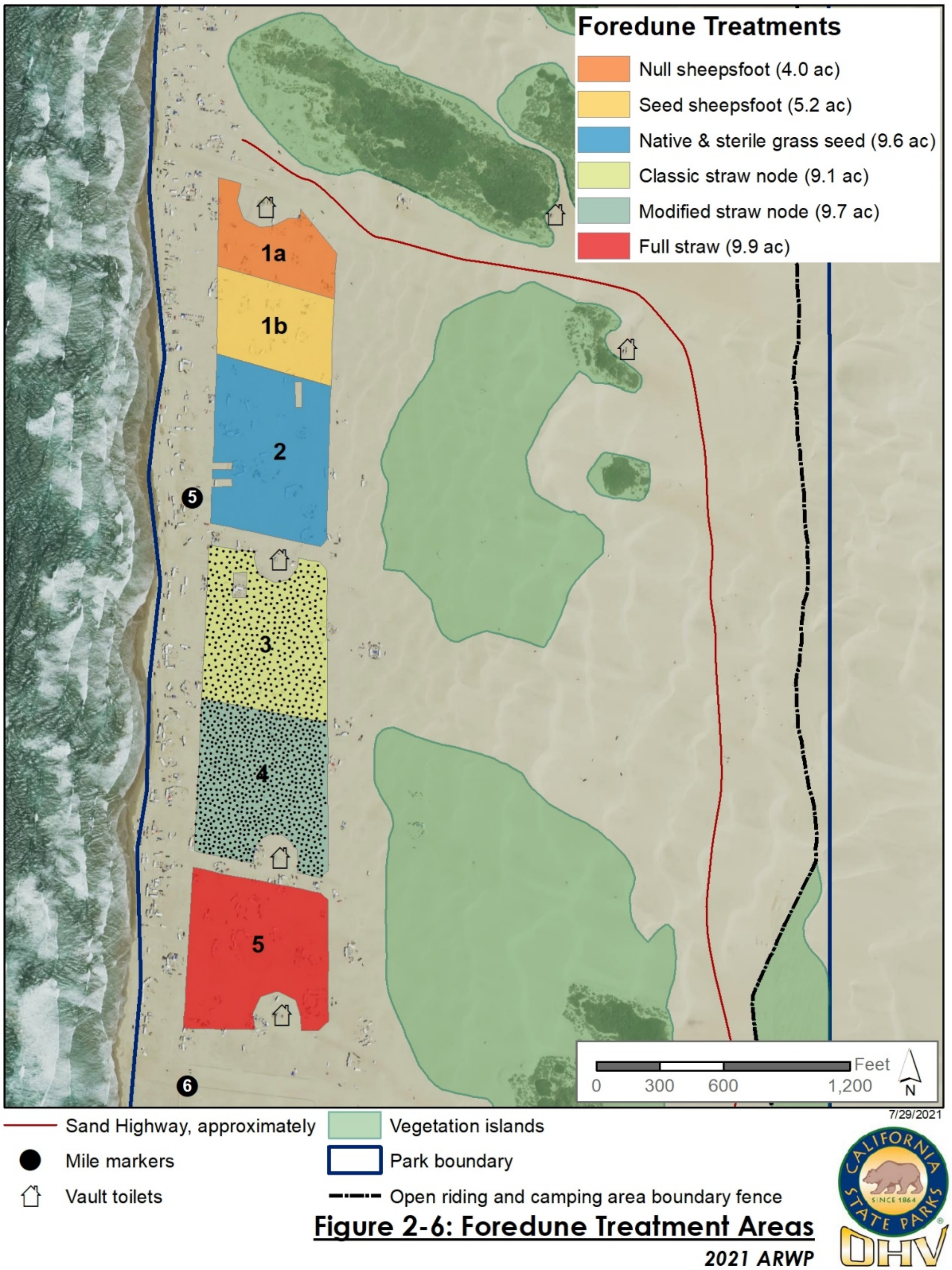
State Parks initiated the 48-acre foredune restoration treatment in 2019. The restoration treatment is based on a SAG design in which the 48-acre treatment area is sub-divided into six different treatment areas, as shown in Figure 2-6. The treatment areas include:

- Plot 1 – Foredune North, approximately 19 acres (20-VG-01):
    - Treatment 1 (approximately 4 acres): No treatment other than sheep's foot surface texturing to create divots for seeds and low-level aerodynamic roughness.
    - Treatment 2 (approximately 5 acres): Native seed mix with sheep's foot surface texturing.

- Treatment 3 (approximately 10 acres): Sheep's foot texturing with sterile ryegrass and native seed mix.

- Plot 2 – Foredune Central, approximately 19 acres (20-VG-02):
  - Treatment 4 (approximately 9 acres): Low-density random node planting (with a spacing derived from a natural analog site near Oso Flaco Lake) with approximately nine foredune-specific plants per node planted within a 12-foot radius zone of straw to protect seedlings.
  - Treatment 5 (approximately 10 acres): High-density random node planting with the same planting and straw protection strategy.
- Plot 3 – Foredune South, approximately 10 acres (20-VG-03):
  - Treatment 6 (approximately 10 acres): "Parks' Classic" restoration consisting of sheep's foot surface texturing, spread straw over the entire area, planting of foredune specific species, and seeding the area with native seed.

Figure 2-6: Foredune Treatment Areas



From August 1, 2020, to July 31, 2021, CDPR, San Luis RCD, DRI, and UCSB conducted meteorological and saltation flux measurements from each of the six foredune treatment areas. These measurements are intended to characterize wind changes, monitor saltation activity, and relate these data to changes in vegetation cover and dune morphology through time. The measurements were conducted with a suite of instruments on a three-meter tower on a platform deployed near the eastern edge of each treatment plot, approximately ten meters west of the eastern fence line and halfway along the north-south length of the treatment area. The typical foredune monitoring station is shown in Figure 2-7. The foredune monitoring stations have almost the same configuration as those deployed across and exterior to Oceano Dunes SVRA to measure temperature, RH, wind speed, wind direction, and pressure (see Section 2.3.1 and Figure 2-4). However, the foredune monitoring stations do not measure PM. Sensit saltation sensors are located at each station to provide data on threshold wind speed for sand transport and relative saltation activity. A remote camera system is also deployed at each station to provide additional information on the frequency and relative magnitude of sand transport events providing a wider field of view than the point-measurement of the Sensit. The camera systems also provide qualitative data on weather conditions, sea state, changes in plant cover, and changes in dune form and development. Three tipping bucket rain gauges are deployed across the restoration area (north, middle, south) to provide data on precipitation across the foredune restoration zone.

Similar to wind fence and other sand flux measurements at Oceano Dunes SVRA, sand flux in the foredune restoration treatment areas is measured using a series of BSNE dust collectors (see Attachment 07). For the foredune treatment areas, a linear transect of five BSNE dust collectors is located at the north-south midpoint of each defined test area and oriented to the major sand-transporting wind direction in the foredune treatment area (292° west-northwest). A pair of BSNE dust collectors are placed on the western side of a treatment area approximately two meters from the perimeter fence to receive the incoming sand flux. The next four BSNE dust collector pairs in the treatment area are positioned at four meters (12 feet), 13 meters (42 feet), 45 meters (148 feet), and 160 meters (525 feet) along the 292° transect line.

The control effectiveness of the foredune treatment areas is defined by the NSF as follows:

Foredune NSF = ($BSNE_n$ trap 1 + $BSNE_n$ trap 2)/2)/($BSNE_1$ trap 1 + $BSNE_1$ trap 2)/2)

Where:

n = BSNE dust collector position along the transect through the restoration area

$BSNE_1$ = BSNE dust collector position on the upwind leading edge of the treatment area

As the BSNE dust collectors are paired at each position 1 – 5, NSF is based on the mean value of the two traps at each position.

The DRI and UCSB completed data analysis from April to November 2020. They reported the NSF in foredune treatment areas 1, 2, and 3 remained relatively stable during this period, except for treatment area 2, which shows a considerable increase in NSF at the four interior measurement locations in November 2020. The NSF in foredune treatment areas 4, 5, and 6 also remained stable, except for area 6, which showed a considerable increase in NSF at the four interior measurement locations in November 2020. This is likely due to the straw surface becoming inundated with sand across the width of this test plot.

The relationship between mean NSF and normalized distance (ND) is defined as:

Foredune ND = Horizontal distance to measurement/Total distance across restoration area

For the April to November 2020 period, NSD as a function of ND was relatively steady across the measurement transects in foredune treatment areas 1, 2, and 3, indicating that control efficiency did not change appreciably during the study period. In contrast, the NSF was systematically reduced as a function of ND, most clearly in foredune treatment areas 5 and 6. The change in NSF as a function of ND through time in the foredune treatment areas suggests that saltation flux increased on the eastern side of foredune treatment areas 4, 5, and 6 as time progressed from the initial treatment efforts to November 2020. This change indicates that the ability and effectiveness of these treatment areas to control sand were diminishing through time, likely due to the increasing burial of straw over time and limited plant and nebkha (type of dune that forms around vegetation) development.

Refer to Attachment 07 for the detailed report on foredune saltation flux measurements collected and analyzed from August 1, 2020, to July 31, 2021.

2.3.3 UAS Surveys

CDPR, in coordination with a team from Arizona State University (ASU) and UCSB, has used a Wingtra One fixed-wing uncrewed aerial system (UAS, also known as a drone) to survey and monitor changes in dune morphodynamics, vegetation cover, and sediment budgets (volumetric change) at Oceano Dunes SVRA since October 2019. The Wingtra One UAS is a fully autonomous drone. Flight paths are pre-programmed into the drone and monitored by an FAA-certified pilot. The drone is typically flown at altitudes over 100 m above ground level. The system is equipped with post-processing kinematic (PPK) Global Positioning System (GPS) correction capabilities referenced during data collection to a survey-grade Trimble R10 base station that operates in static collection mode. These GPS data are then used to provide precise georeferencing for each photo collected by the onboard payload within mm-scale accuracy. Flights are coordinated with CDPR staff and wildlife monitors to ensure safety and minimal disturbance to birds and wildlife during the flight campaigns.

The UAS surveys conducted from August 1, 2020, to July 31, 2021, covering more than 20 square kilometers in total (approximately 4-6 km^2 per campaign) and involve the collection of high-resolution digital imagery using: 1) a Sony RX1RII 42-megapixel (MP) full-frame red, green, and blue (RGB) camera sensor at approximately 1.5 to 2 cm resolution, and 2) a Micasense Rededge-MX sensor that provides multispectral (RGB, rededge/RE, and near-infrared/NIR) imagery at a resolution of approximately 7 to 9 cm. The multispectral imagery provides the added benefit of allowing for vegetation to be easily extracted from the resulting imagery and, using various spectral indices, such as Normalized Difference Vegetation Index (NDVI) and

Normalized Difference Red-Edge Index (NDRE), seasonal changes in vegetation cover can also be identified.

The UAS imagery datasets are then used to create four main data products:

1. Georeferenced, orthorectified aerial photo mosaics of the study site in the visual (RGB) bands,
2. Georeferenced, orthorectified multispectral maps of vegetation cover using NDVI and other spectral methods
3. Three-dimensional digital elevation models (DEMs) derived from structure-from-motion (SfM) photogrammetry,
4. Geomorphic change detection (GCD) maps from consecutive time steps showing differences in elevation derived by comparison of DEMs over time using spatial statistics. The GCD maps are then used to calculate volumes of sediment change between surveys that can be used to identify and interpret dune development, evolution, erosion/deposition patterns, and sediment budgets.

As of July 31, 2021, four UAS survey campaigns have been flown at Oceano Dunes SVRA (see Table 2-7). The UAS surveys occur in February and October each year to avoid the western snowy plover nesting season between March and September. Initial UAS survey efforts in October 2019 and February 2020 focused on mapping the 48-acre foredune treatment areas (20-VG-01, 20-VG-02, and 20-VG-03, see Attachment 01, Figure A01-11). In early 2020, CDPR and the SAG decided to expand UAS surveys to include the full extent of Oceano Dunes SVRA’s open riding and camping area (approximately 1,500 acres). It included key reference sites of high OHV activity, protected non-riding areas, aeolian sand transport (saltation) pathways, vegetated restoration areas, natural foredune sites, and other highly emissive areas.

A pre-restoration baseline survey was flown in October 2019 before any restoration activity. The second survey was flown in February 2020 during the installation of restoration treatments and before the closure of Oceano Dunes SVRA in March 2020 due to Covid-19. Each of these initial surveys involved only the visual (RGB) camera payload. The third survey occurred in

October 2020 and captured the first growth phase of foredune seedlings using RGB and a multispectral sensor to detect better and assess vegetation growth. The fourth survey in February 2021, also using both RGB and multispectral sensors, captured the first year of changes in vegetation cover and dune morphodynamics.

Table 2-7: Summary of UAS Surveys at Oceano Dunes SVRA

UAS Survey Campaigns	Survey Dates	Sensor Payload (spectral bands)	Coverage Area (square kilometers)	Average Altitude (meters)
1: baseline pre-restoration survey	October 1-2, 2019	Sony RX1R II (42 Megapixel, RGB)	3.83	114
2: initial treatment installations	February 10-11, 2020	Sony RX1R II (42 Megapixel, RGB)	5.41	123
3: first post-treatment survey	October 13-15, 2020	Sony RX1R II (42 Megapixel, RGB)	5.98	121
	October 16, 2020	Micasense RedEdge-MX (RGB, RE, NIR)	4.63	113
4: first year of treatment response	February 17-18, 2021	Sony RX1R II (42 Megapixel, RGB)	5.95	120
	February 18-21, 2021	Micasense RedEdge-MX (RGB, RE, NIR)	5.79	118

To date, results from the UAS surveys of the foredune restorations treatments show essentially that all treatments are maintaining a net positive sediment budget (I.e., positive gains of sediment volume, or accretion vs. Negative losses, or erosion), which is one key indicator of success for restoration treatments.

UCSB has completed additional analysis and reporting related to UAS surveys at Oceano Dunes SVRA. This report is under review by State Parks and will be included as Attachment 08, UCSB-ASU 2020-2021 Oceano Dunes SVRA Foredune Restoration UAS Survey Report when State Parks' review is complete (currently anticipated to be complete in late Summer/Fall 2021.

2.3.4 Computational Fluid Dynamics

Computational fluid dynamics (CFD) is the science of producing simulations of fluid flow using large computational resources. The CFD modeling can be used to evaluate how the evolving foredune treatment areas will modulate the boundary-layer flow (wind speed, direction, and surface shear velocity) over the foredune area, in the lee of the foredune area, and with the re-vegetation areas located east of the foredune restoration area. Currently, the DRI model only accounts for localized reductions in dust emissivity directly within dust control treatment areas. Incorporating CDF into the DRI model could provide a more accurate assessment of the effectiveness of mitigation treatments by accounting for flow changes within and downwind of treatment areas.

CFD modeling requires inputs of monitoring data to constrain model boundary conditions. From August 1, 2020, to July 31, 2020, DRI and UCSB undertook a measurement campaign to characterize the flow over foredune treatment areas in the Oceano Dunes SVRA open riding and camping area and existing foredunes south of the open riding and camping area in the Oso Flaco area of Oceano Dunes SVRA. Monitoring consisted of three-meter towers instrumented with three-dimensional sonic anemometers to measure the three components of wind speed horizontal (*u*), spanwise (*v*), and vertical (*w*) at 10 hertz (Hz) at three positions on the tower: 0.25 m, 1.6 m, and 3.1 m.

The CFD data processing is ongoing. These data will be used to estimate flow quantities such as the surface Reynolds stress (a similar stress quantity as the shear velocity) and turbulence intensity. The sonic anemometry measurements combined with measurements of surface roughness parameters obtained from the UAS-derived DEMS, on-ground photogrammetry, and terrestrial lidar scanning (TLS) data collected in May 2021, will be used to understand how the evolving surface structures, such as plants and nebkha, in the foredune areas are influencing the flow and the sediment transport potential across each treatment type.

The CFD modeling is expected to result in the following benefits: 1) a means to provide more realistic estimates of the aerodynamic roughness lengths (z_0) for different areas of Oceano

Dunes SVRA, a parameter that plays a critical role in Computer-Aided Learning In Meteorology (CALMET) in the estimation of wind shear (which drives dust emissions), and at present, its representation in CALMET remains simplistic; 2) Better estimates of shear velocity based on the topographic position on the dunes and in their lee, which will also provide better estimates of emissions.

Refer to Attachment 09, DRI 2020/2021 CFD Report for DRI's detailed report on CFD activities completed from August 1, 2020, to July 31, 2021.

2.3.5 PI-SWERL/Emissivity Monitoring

In May 2020, DRI carried out PI-SWERL sampling in a subset of areas previously sampled for emissivity. The results of this sampling can be found in Attachment 13.

2.3.6 Vegetation Monitoring

From August 1, 2020, to July 31, 2021, CDPR developed and reported on, in consultation with SAG's vegetation working group, the vegetation sampling methods described below.

2.3.6.1 Line Intercept Transect Sampling Method

The line intercept method was used to estimate the species percent cover within each of the six foredune treatment areas and a reference site in the North Oso Flaco foredune. A total of three 30-meter transects were sampled in each treatment area. Sampling occurred in September when access to foredune areas was not limited by nesting bird activity.

The starting points for the transect lines were randomly selected within each project area using Geographic Information System (GIS). Transect directions were also randomly selected from the eight cardinal and intermediate directions (i.e., N, NE, E, SE, etc.). A measuring tape was run along the transect and secured with wooden stakes. As the vegetation canopy intersected the line, the species was noted on a data sheet along with the beginning and ending canopy measurements. When the canopies of two different species overlapped, each species was documented separately as two different canopies. A closed canopy for a given species was assumed until gaps in vegetation exceed the width of five cm. Dead vegetation was not included in the measurements unless it was clearly the result of the seasonal dieback of a perennial plant that was still viable. Once each 30-meter transect was surveyed, staff conducted a walk-around assessment within an area of ten meters from the transect line for the entire length of the transect (a "belt transect"), and all additional species observed were noted.

As expected in the first growing season, none of the foredune treatment areas met the vegetative cover (34.2%) of the Oso Flaco reference site; however, three of the six treatment areas did meet the species diversity of the Oso Flaco reference site with at least nine species represented in the treatment area for year one of monitoring. The treatment area that saw the highest percent cover was Area 3 with 4.02% cover, followed closely by Area 6 with 3.57% cover. Both Area 5 and Area 6 showed the highest level of species richness, with ten species represented in both areas. Based on the line intercept transect monitoring, it does not appear that three transects in each area were sufficient to determine the percent cover with certainty since Area 4 had greater cover than Area 5 (0.76% compared to 0.40%). At the same time, Area 4 was planted with 61% of the density of Area 5. The monitoring methods are expected to increase, and substantial vegetative growth has already been observed in the second growing season. It does appear that the survey methods were sufficient to determine the species richness. Additional survey work will be necessary to evaluate if survey methods are sufficient.

State Parks notes the rapid growth of vegetation within much of the foredune treatment areas was anecdotally observed during the winter and spring months following the September 2020 monitoring. State Parks anticipates that monitoring conducted from August 1, 2021, to July 31, 2022, will significantly increase vegetation cover within the foredune treatment areas.

Refer to Attachment 10, Foredune Restoration Monitoring Report, for detailed results of the foredune transect monitoring conducted from August 1, 2020, to July 31, 2021.

2.3.6.2 Photo Point Monitoring

State Parks conducted on-the-ground photo point monitoring of the 48-acre foredune treatment areas before project installation in February 2020 and following project installation in May 2020 and October 2020. Photo point monitoring is scheduled to continue in October in subsequent years. Photo points are located on all four corners of each treatment area. For each photo point, two photos are taken, each with one of the treatment area boundary lines on the outer edge of the photo with the interior of the treatment area centered in the photo. There is also one photo point overlooking the entire 48-acre foredune treatment area.

In addition to on-the-ground monitoring, drone aerial imagery photo point monitoring was conducted in May 2020 and again in December 2020. Two photo points were taken of each treatment area, including one from the east and one from the west for each area. Drone photo point monitoring is scheduled to continue on an annual basis.

2.3.7 Evaluation Metrics

Pursuant to the SLOAPCD SOA as amended, CDPR will continue to report PMRP evaluation metrics developed in consultation with the SAG to track progress and inform adaptive management actions. However, recent discussions among the SAG, CDPR, and SLOAPCD have highlighted that the existing set of evaluation metrics does not serve their intended tracking and management purpose. Therefore, a new set of evaluation metrics is adopted in this ARWP (see Attachment 11, 2021 Updated Evaluation Metrics).

This update intends to provide a more streamlined dashboard that makes it easier to track progress and inform adaptative management. “Dust Mitigation Targets” refer to evaluation metrics with specific, measurable endpoints. “Dust Mitigation Indicators” refer to values indicating progress but for which specific targets are not defined. Unlike previous reports of evaluation metrics, current and future ARWPs will report on all relevant metrics and include a record of metrics for past years to track progress more easily.

2.4 REPORT ON OTHER DUST CONTROL PROGRAM-RELATED ACTIVITIES

Chapter 7 of CDPR’s approved PMRP describes potential actions that CDPR, the SAG, and the SLOAPCD may undertake to further support and inform the overall adaptive management approach to dust control at Oceano Dunes SVRA.

CDPR's report on other dust control program-related activities undertaken between August 1, 2020, and July 31, 2021, is provided below.

2.4.1 SAG Responses to Studies

During the 2021 ARWP Reporting Period (August 1, 2020, to July 31, 2021), the SAG provided formal responses/reviews to the following studies and reports:

Report: Oceano Dunes SVRA Dust Control Program 2020 Annual Report and Work Plan – Draft 8-1-2020
Author: California Department of Parks and Recreation
Date: August 1, 2020
SAG Response Date: August 31, 2020

Report: An Analysis: May and June Wind Strength Year to Year and State PM_{10} Exceedances with and without OHV Recreation, Oceano Dunes SVRA
Author: W. Harris, California Geological Survey
Date: August 5, 2020
SAG Response Date: August 20, 2020

Report: September 2020 Scripps Supplementary Report on Particulate Matter (PM) Sources at Oceano Dunes State Vehicular Recreation Area (Oceano Dunes SVRA)
Author: L.M. Russell, Scripps Institution of Oceanography
Date: September 21, 2020
SAG Response Date: November 2, 2020

Report: 90 Acre Treatment Options for 2020-21 Annual Report and Work Plan
Author: California Department of Parks and Recreation
Date: November 16, 2020
SAG Response Date: November 20, 2020

Report: Oceano Dunes Coastal Development Permit 4-82-300 Review
Author: California Coastal Commission staff
Date: February 16, 2021
SAG Response Date: March 12, 2021

Report: Report to the SAG and Parks Evaluating the Potential for Developing a New Baseline Mass Emissions Rate and Target Reduction within the SOA
Authors: J.A Gillies, J. Mejia, and E. Furtak-Cole, Desert Research Institute
Date: April 27, 2021
SAG Response Date: April 30, 2021

In June 2021, the SAG also initiated preparing a "State of the Science" document to synthesize the state of knowledge regarding Oceano Dunes SVRA dust mitigation activities. Refer to Attachment 12 for the compilation of the SAG's responses to the studies listed above.

2.4.2 SAG Participation in Meetings

During the 2020-21 Annual Report period, the Scientific Advisory Group (SAG) participated in various meetings. Table 2-8 lists significant meetings of the full SAG, meetings of the SAG with other entities, and presentations by SAG members at public events. All meetings are virtual unless otherwise indicated.

Table 2-8: SAG Participation in Meetings, August 2020 - July 2021

Date(s)	Meeting Name	SAG Role	Participants
August 25, 2020	SLOAPCD meeting on ARWP	Discuss draft 2020 ARWP	SAG, CDPR, SLOAPCD, CARB
September 3, 2020	CDPR meeting with SAG	Discuss approach to SOA target	SAG, CDPR
September 28, 2020	SLOAPCD meeting on ARWP	Discuss draft 2020 ARWP	SAG, CDPR, SLOAPCD
October 19, 2020	SLOAPCD meeting on ARWP	Prep for Public Workshop and Hearing Board meeting	SAG, CDPR, SLOAPCD
October 23, 2020	SLOAPCD Public Workshop and Hearing Board meeting	Present on 2020 ARWP	SAG, CDPR, SLOAPCD
November 12, 2020	CDPR meeting with SAG	Discuss approach to SOA target	SAG, CDPR
November 19, 2020	SAG meeting	Discuss location of control measures	SAG
November 23, 2020	SLOACPD meeting on ARWP	Discuss location of control measures	SAG, CDPR, SLOAPCD
January 21, 2021	CDPR meeting with SAG	Discuss approach to SOA target	SAG, CDPR
February 23, 2021	CDPR meeting with SAG	Provide updates on SAG activities	SAG, CDPR
March 2, 2021	SLOAPCD Hearing Board prep meeting	Discuss planned presentations to SLOAPCD Hearing Board	SAG, CDPR, SLOAPCD

Date(s)	Meeting Name	SAG Role	Participants
March 22, 2021	SLOAPCD Hearing Board prep meeting	Discuss planned presentations to SLOAPCD Hearing Board	SAG, CPDR, SLOAPCD
March 24, 2021	SLOAPCD Hearing Board meeting	Present updates to SLOAPCD Hearing Board	SAG, CDPR, SLOAPCD
April 22, 2021	DRI meeting with SAG	Discuss approach to SOA target	SAG, DRI
May 18, 2021	SAG meeting	SAG organizational discussion	SAG
May 19, 2021	SAG meeting	Plan for 2021 ARWP	SAG, CDPR, SLOAPCD
June 18, 2021	SAG meeting	Plan "State of the Science" report	SAG
July 22-23, 2021	SAG meeting (in-person)	Discuss 2021 ARWP	SAG, CDPR, SLOAPCD

2.4.3 Influence of OHVs on Emissivity and PM_{10}

The COVID-19 closure of Oceano Dunes SVRA (from March to October 2020) provided an opportunity to preliminarily evaluate changes in emissivity (i.e., PI-SWERL measurements), dune geomorphic changes, and downwind PM_{10} concentrations during the closure of the SVRA to vehicle traffic. Refer to Attachment 13, Examining Dust Emissions and OHV Activity at the Oceano Dunes SVRA, for DRI's study of the COVID-19 closure period. The results of a recent study prepared by UCSB evaluating the COVID-19 closure period are under review. This review is expected to be completed by late Summer/Fall 2021.

2.4.4 Revisiting the SOA Target

Section 3.3 of the 2020 ARWP states:

> "All parties [i.e., SAG, DRI staff, and CDPR staff] will continue coordination on possible SOA Goal Alternatives, noting that the foremost goal is to achieve reductions in PM_{10} concentrations toward attaining state and federal air quality standards while minimizing impacts to public recreation opportunities."

SOA provision 2c directs that CDPR:

> "[establish] an initial target of reducing the maximum 24-hour PM_{10} baseline emissions by fifty percent (50%), based on air quality modeling based on a modeling scenario for the period May 1 through August 31, 2013."

whereas SOA provision 2d allows that

> "[t]he estimates of emission reductions identified in 2c may be modified based on air quality modeling conducted by CARB or another modeling subject to the review of the SAG."

As directed by the 2020 ARWP, the SAG discussed possible alternatives to the existing SOA dust emissions reduction target. In its preliminary discussions, the SAG considered that the Oceano Dunes SVRA is a naturally dusty environment. However, OHV impacts have led to an increase in PM_{10} mass emissions and airborne PM_{10} concentrations relative to air quality conditions before human disturbance of the dunes. Considering these factors, the SAG agreed that a reasonable goal would be to reduce PM_{10} mass emissions and airborne PM_{10} concentrations to levels commensurate with naturally occurring conditions before human disturbance of the dunes.

The SAG identified two primary impacts of human disturbance that may have contributed to increases in PM_{10} mass emissions relative to a pre-disturbance emissions scenario: (1) increased PM_{10} emissivity of OHV-impacted dune surfaces; and (2) decrease in vegetation and related dune-stabilizing features. Impact 1 (increased PM_{10} emissivity) is apparent from PI-SWERL surveys that reveal Riding Area dune surfaces are significantly more emissive than equivalent non-riding area dune surfaces. Impact 2 (decreased dune-stabilizing features) is apparent from air photos that show significantly less dune vegetation coverage within the SVRA's open riding and camping area in the 2013 baseline scenario than in historical aerial surveys. Therefore, should a pre-disturbance emissions scenario be identified as the basis for setting a new SOA dust mitigation target, this scenario should account for lower PM_{10} emissivity and increased dune-stabilizing vegetation relative to the current impacted conditions.

As a preliminary proof of concept of the pre-disturbance emissions scenario approach, the SAG recommended that DRI staff use the DRI model to simulate a simplified scenario in which the

PM_{10} emissivity of riding area surfaces is replaced with a new PM_{10} emissivity derived from the average emissivity of adjacent non-riding area surfaces. DRI staff performed the recommended proof-of-concept modeling, and the SAG reviewed the results and presented its findings to CDPR staff (see Attachment 12). The SAG identified the following outcomes of the proof-of-concept modeling: (1) pre-disturbance conditions produce substantial PM_{10} emissions and airborne PM_{10} concentrations (2) pre-disturbance PM_{10} emissions and concentrations are significantly lower than for post-disturbance conditions; (3) the pre-disturbance emissions scenario modeling approach is a feasible way to identify a potential alternative to the existing SOA target. In addition, the SAG agreed that further updates to the preliminary pre-disturbance scenario – including consideration of spatial gradients in naturally-occurring dust emissivity, an assessment of historical dune-stabilizing vegetation coverage and its effects on PM_{10} emissions, and quantification of model uncertainty – are needed before the pre-disturbance scenario modeling approach may be used to determine an alternative to the existing SOA target. ARWP Section 3.1.7.1 describes the next steps for developing proposed alternatives to the current SOA target.

2.4.5 Other Sources of Dust

As amended, SOA #17-01 recognizes that PM_{10} concentrations measured at CDF and on the Nipomo Mesa may come from a variety of sources external to Oceano Dunes SVRA (SOA pg. 6, lines 19 to 23 and SOA pg. 14, lines 13 to 15). Accordingly, CDPR and the SLOAPCD continued studying other potential PM_{10} emission sources and their relative contributions to PM_{10} concentrations on the Nipomo Mesa.

2.4.5.1 PM_{10} Speciation Sampling

In 2020, the SLOAPCD collected 13 PM_{10} samples for speciation analysis at CDF to further investigate the amount of salt, inorganic aerosols, crustal material, etc. there is the PM_{10} sampled at the CDF station. Each sample was a pair of filters, one Teflon and one quartz, exposed for 24 hours. These samples were analyzed by DRI for total PM_{10} mass concentration, certain ions (sodium, potassium, chloride, ammonium, nitrate, sulfate, and methanesulfonate), various organic and elemental fractions, and elements from sodium through uranium by XRF.

State Parks funded the processing of the samples, and Karl Tupper (from SLOAPCD) and Earl Withycombe (from CARB and SAG) have been analyzing the data.

Three samples were collected on "normal" days, uninfluenced by wind-blown dust or other obvious sources, and these are considered background samples. Eight samples were collected on days predicted to be wind-blown dust event days. However, it should be noted that in the 2020 wind event, PM_{10} concentrations were lower than in previous years, and the highest concentration of these eight samples was only 93 ug/m^3 (as measured by the Beta Attenuation Monitor (BAM)). One sample was collected on a day heavily influenced by wildfire smoke, and another sample was influenced by transport from the San Joaquin Valley.

A report on the results from 2020 is not yet available, but preliminary analysis indicates:

- The 13 samples are not enough to do a state-of-the-art apportionment analysis, i.e., positive matrix factorization (PMF). Attempts to run PMF with the data resulted in physically reasonable solutions; however, they were not stable. CARB's PMF specialist indicates that 150 samples are ideal, though there are examples of successful analyses with fewer.
- The correlation between the collocated APCD BAM concentrations and the DRI filter concentrations is good (r^2 = 0.97) - much better than Scripps reported for their PM2.5 filters (r^2 = 0.69).. In 2019, the District collected filter samples with this same equipment and weighed them by two different labs. There was also a good correlation with the BAM then, but with a slight bias in the opposite direction.
- The mass closure is poor. It refers to the difference between the measured total PM_{10} concentration and an estimate constructed by taking the raw concentrations of the measured elements and ions in each sample and applying standard equations and assumptions to estimate how much salt, inorganic aerosol, crustal material, etc., there is in the sample, and finally summing all these constituents up. The "reconstructed mass" should be close to the mass measured on the filter. While the mass closure is never perfect, for the samples, the comparison is poor. For the four background and smoke samples, the reconstructed mass is 91 to 103% of the measured mass—which is

acceptable—but for the eight wind event samples, the range is 71-98% with a mean of 82%, and for the lone SJV transport day, it is only 36%.

Refer to Attachment 14, 2021 Proposal for Speciation Sampling for more detailed information on the speciation analyses completed to date and the SLOAPCD's proposal for 2021 speciation sampling.

2.4.5.2 Scripps Institution of Oceanography Study

The Scripps Institution of Oceanography (Scripps), in collaboration with the OHMVR Division and CGS, continued into years two and three of its investigation of airborne PM_{10} constituents at Oceano Dunes SVRA and vicinity. In August 2020, the OHMVR Commission requested an update of findings from spring 2020 air filter sampling and analysis conducted by Scripps. In response, Scripps atmospheric chemistry professor Lynn Russel prepared a September 20, 2020 report entitled "Preliminary Results from May 2020 Aerosol Measurements," which she presented to the OHMVR Commission on September 24, 2020. Data presented indicate $PM_{2.5}$ mineral dust mass measured by Scripps is less than the $PM_{2.5}$ values measured by the APCD's CDF BAM instrument. Preliminary results from air filter sampling adjacent to the dune shoreline indicate measured airborne PM_{10} consists mostly of atmospheric water and contains approximately 20 percent mineral dust.

For 30 consecutive days, from April 27 through May 26, 2021, air filter samples were again collected at the APCD's CDF location but not along the dune shoreline. Consecutive-day sampling along the shore was not possible due to the nesting activity of protected shorebirds. The sampling effort at CDF was expanded to include collecting PM_{10} samples and collecting $PM_{2.5}$ samples using two types of particulate segregator cyclones—a sharp cut cyclone and a very sharp cut cyclone. Samples were collected on pre-weighed Teflon filters. Analyses conducted and conducted include gravimetric analysis, elemental speciation, and carbon-source identification using Fourier-transform infrared spectroscopy.

Refer to Attachment 15 for the 2020 Scripps study, APCD's comments on this study, and Scripps's response to the SAG's and APCD's comments. Refer to Attachment 12 for the SAG's comments on the Scripps study.

2.4.6 PUBLIC RELATIONS CAMPAIGN

According to SOA #17-01 (background statement "c"), in November 2020, CDPR prepared a draft public relations campaign for SAG review and comment. The public relations campaign intends to educate the public on regional air quality issues in southern San Luis Obispo County surrounding Oceano Dunes SVRA, how they are being addressed, and how they can be a part of the solution. CDPR's initial public relations campaign proposal focused on providing resource materials and educational videos via various public platforms, including social media, websites, outreach programs, and other forms of communication with the public. In January 2021, the SAG provided comments to CDPR on its proposed public relations campaign. State Parks is evaluating the SAG's comments and is preparing a revised public relations campaign for SAG review.

Refer to Attachment 16 for CDPR's updated draft public relations campaign.

3 WORK PLAN

The Work Plan proposes Dust Control Program activities between August 1, 2021, and July 31, 2022. It estimates progress towards achieving SOA goals and presents additional information on other activities related to the Dust Control Program undertaken by CDPR and/or the SAG.

3.1 DUST CONTROL ACTIVITIES PROPOSED FOR THE NEXT YEAR

For the period of approximately August 1, 2021, to July 31, 2022, CDPR is proposing to initiate, undertake, and/or complete the following dust control project activities:

- Install 90 acres of new, temporary dust control measures, including:
    - Wind fencing, straw, and vehicle exclosure measures. The specific type and locations of new, temporary dust control measures will be identified by CDPR, in consultation with the SAG, pending the results of DRI modeling currently being performed to evaluate different options/scenarios for 2021 ARWP dust control measures.
- Convert existing temporary dust control measures to permanent vegetation measures, including:
    - Approximately 20 acres of wind fencing were installed in 2019.
    - Approximately 20 to 25 acres of straw measures installed in 2020; and
    - Up to approximately five acres of temporary vehicle exclosures installed in 2020.
- Continue foredune monitoring and assessment.
- Dune emissivity (PI-SWERL) sampling campaign
- Supplemental vegetation planting in previous vegetation treatment areas (non-foredune only).
- Maintain existing wind fencing measures.
- Continue Dust Control Program field monitoring and air quality modeling activities.

- Continued SAG consultation, including updating the approach to evaluating SOA progress and requirements and facilitating adaptive management decisions based on monitoring results and assessment campaigns.
- Initiate a Dust Control Program public relations campaign in consultation with the SAG.
- Coordinate with the California Coastal Commission on 2021 ARWP permitting requirements.
- Continue Dust Control Program activities related to identifying other potential sources of dust and PM_{10} contributing to air quality conditions.

State Parks' description of proposed Dust Control Program projects and activities is provided below.

3.1.1 Install 90 Acres of New, Temporary Dust Control Measures

The DRI is currently modeling two different options for CDPR's proposed 90 acres of new, temporary dust control measures. Both options include dust control measures in locations selected to maximize PM_{10} mass emission (from within Oceano Dunes SVRA) and concentration (at the SLOAPCD's CDF and Mesa2 air quality monitoring stations) reductions. The preliminary location of the 90 acres of new dust control measures is shown in Figure 3-1A and Figure 3-1B.

- Option 1 places 90 acres of dust control measures in areas that maximize PM_{10} mass emission and concentration reductions. The SAG has approved and considers this their preferred option (see Figure 3-1A).
- Option 2 places 90 acres of dust control measures in substantially the same areas as Option 1 but adjusted to consider Park operation and resource protection needs better (see Figure 3-1B).

State Parks and DRI will report the results of these modeling exercises to the SAG in August 2021.

Figure 3-1A: Preliminary 2021/2022 Dust Control Projects (Option 1)

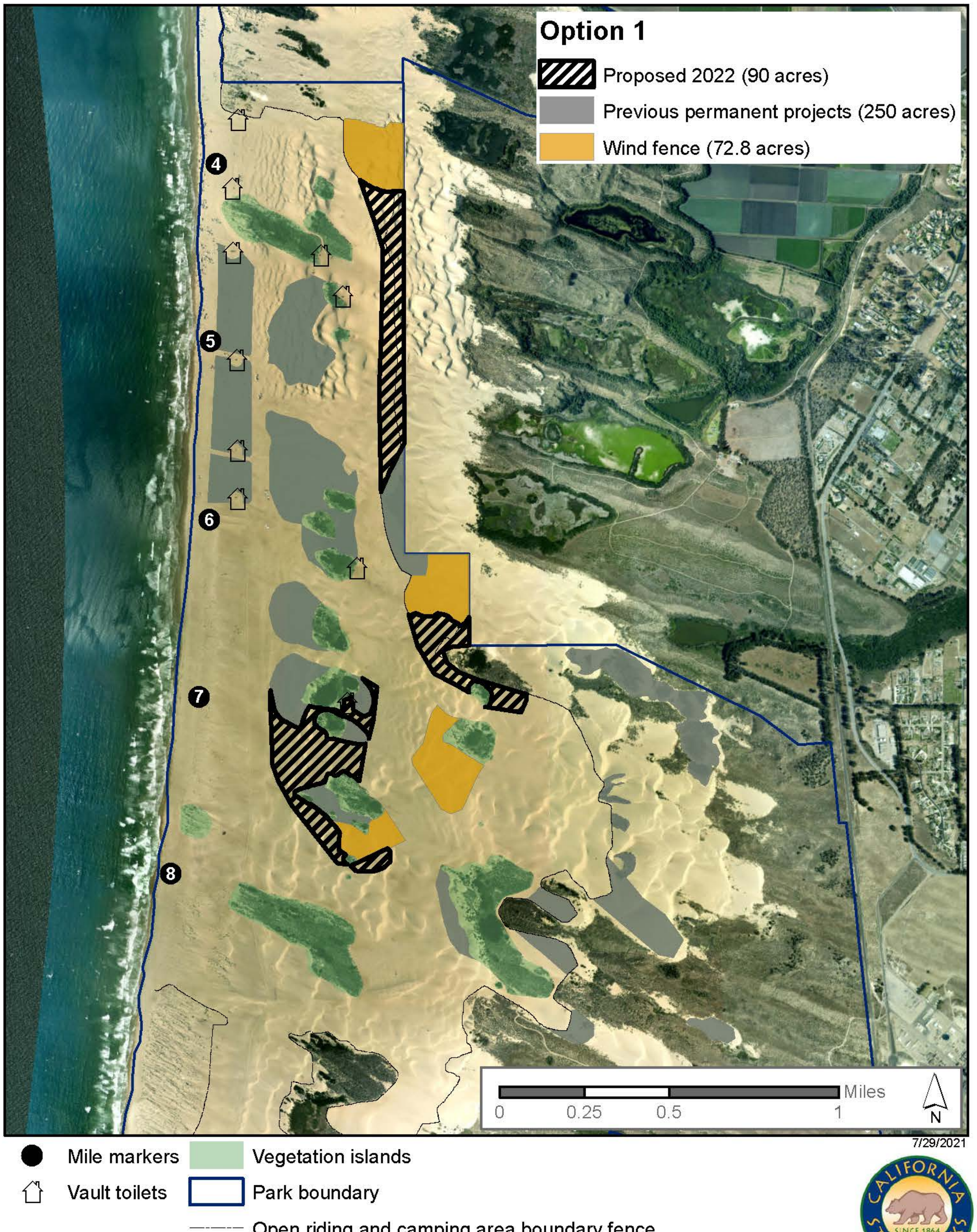


Figure 3-1A: Preliminary 2021/2022 Dust Control Projects

2021 ARWP

Figure 3-2B: Preliminary 2021/2022 Dust Control Projects (Option 2)

3.1.2 Convert Existing Temporary Dust Control Measures to Vegetation

State Parks proposes to convert a total of approximately 45 to 50 acres of existing temporary dust control measures to permanent, native dune vegetation:

- **Existing Wind Fencing:** State Parks proposes to convert approximately 20 acres of wind fencing installed in 2019 (20-WF-02, see Attachment 01, Figure A01-11) to native dune vegetation. This area is located along the eastern edge of the open riding and camping area, perpendicular to marker post 6.
- **Existing Straw:** State Parks proposes to convert approximately 20 to 25 acres of straw installed in 2020 to native dune vegetation. State Parks would select areas for conversion in consultation with the SAG. The straw areas that could be converted to vegetation include projects 21-SB-01 (up to five acres), 21-SB-02 (up to five acres), 21-SB-03 (up to seven acres), 21-SB-04 (up to five acres), and 21-SB-05 (up to six acres, see Figure 2-1). Straw control areas that are not converted to vegetation would remain in place to provide continued dust control benefits.
- **Existing Vehicle Exclosures:** State Parks proposes to convert up to five acres of temporary vehicle exclosures installed in 2020 to permanent native dune vegetation. This conversion would result in the permanent closure of these areas to vehicular recreation. State Parks would select areas for conversion in consultation with the SAG. The vehicle exclosure areas that could be converted to vegetation include projects 21-TV-02 (approximately 3 acres) and 21-TV-02 (approximately 2 acres, see Figure 2-1). Vehicle exclosure areas that are not converted to vegetation would remain in place to provide continued dust control benefits.

Following removal of existing dust control measures and/or preparation of treatment areas for vegetation plantings (e.g., reapplication of straw along upwind edges that may have become inundated with sand), CDPR will restore the project areas. State Parks' restoration methods are described in Chapter 6 of the June 2019 Draft PMRP. State Parks will schedule conversion efforts (e.g., the initial removal of fencing) to occur as late as possible, given other park operations requirements and the need to ensure sufficient planting time. State Parks will also perform these restoration efforts in a manner that minimizes the delay between removing the existing wind fencing and applying straw/initiating planting activities as much as possible given potential constraints (e.g., equipment, staffing, and material availability, other park operations requirements). For restoration work, the fencing must be removed before straw/mulch can be applied. During this time (when wind fencing may be removed but mulch not yet applied), CDPR will maintain a perimeter fence to prohibit OHV activity and camping in the restoration area.

3.1.2.1 Planting Palette / Estimate of Plants and Seed Needed for Conversions

State Parks will coordinate with the SAG to prepare a planting palette with targets for container stock and native seed needed for dust control projects over the next year. As of August 1, 2021, CDPR estimates up to approximately 107,000 plants and 500 pounds of native seed would be required to complete the conversion of approximately 45 to 50 acres of temporary dust control projects to native dune vegetation.

Additional plants would be required for CDPR's proposed supplemental planting activities (see Section 3.1.4). With this additional activity, CDPR estimates a total of up to approximately 117,000 plants and 725 pounds of native seed would be required to complete the proposed 2021 vegetation planting activities.

Refer to Attachment 17 for CDPR's proposed 2021/2022 planting projects and estimates of planting and seeding activity by the project.

3.1.3 Continued Foredune Monitoring and Assessment

State Parks will continue to coordinate with the SAG on foredune monitoring and assessment activities from August 1, 2021, to July 31, 2022. Vegetation monitoring includes transects within each treatment plot as outlined in Section 2.3.6.1 and collaboration with UCSB on topographic and vegetation changes based on UAS monitoring outlined in Section 2.3.6.2 and analysis of images from monitoring stations within the treatment area. State Parks will coordinate with the SAG on the monitoring methods for evaluating vegetation cover and species diversity in foredune treatment areas.

3.1.4 Continued Supplemental Planting in Previous Treatment areas

State Parks proposes to perform supplemental planting activities on up to approximately 30 acres of previously installed vegetation projects. Supplemental planting areas would include approximately two acres near the Eucalyptus Tree North vegetation island (19-VG-02, See Attachment 01, Figure A01-10), approximately one acre near the Eucalyptus Tree vegetation island (2021-VG-03), and approximately 26 acres located in the southeastern part of the SVRA, outside the SVRA's open riding and camping area (21-SE-01, 21-SE-02, and 21-SE-03). In addition, CDPR would conduct supplemental planting activities on approximately two acres of land near the Boy scout vegetation island. This area is near an existing dust control measure (2021-SB-03) but is not added to the dust control acreage values reported in this 2021 ARWP.

As of August 1, 2021, CDPR estimates up to approximately 10,000 plants and 225 pounds of native seed would be required to complete the supplemental planting activities on approximately 30 acres of temporary dust control projects. CDPR's supplemental planting activities would be in addition to other vegetation planting activities proposed in the 2021 ARWP (converting existing temporary dust control measures to vegetation; see Section 3.1.2). In total, CDPR estimates up to approximately 117,000 plants and 725 pounds of native seed would be required to complete all proposed 2021 vegetation planting activities identified in the 2021 ARWP.

Refer to Attachment 17 for CDPR's proposed 2021/2022 planting projects and estimates of planting and seeding activity by the project.

3.1.5 Maintenance of Existing Wind Fencing Measures

State Parks will maintain all existing wind fencing projects installed before August 1, 2021, including projects 20-WF-01 (approximately 20 acres, see Attachment 01, Figure A01-11), 21-WF-01 (approximately 22 acres), and 21-WF-02 (approximately 11 acres). State Parks will maintain these existing wind fence arrays through at least July 31, 2022. Potential maintenance activities that may be required to maintain effective dust control in wind fencing areas include repairing and/or replacing fencing components (poles and netting) and/or installing new fence extensions or rows (if warranted due to shifting sand conditions).

3.1.6 Field Monitoring and Air Quality Modeling Activities

State Parks, DRI, and the SAG propose to conduct the field monitoring and air quality modeling activities described below from August 1, 2021, to July 31, 2022.

3.1.6.1 Meteorological, PM, and Saltation Monitoring

In consultation and coordination with the RCD, DRI, and UCSB, State Parks will continue to operate and maintain the existing meteorological, PM, and saltation monitoring instruments/sites described shown in Figure 2-3 and described in Section 2.3. This effort will include post-deployment calibration of MetOne Particle Profilers and continued evaluation of NSF and other key evaluation metrics. In addition, CDPR, in consultation with the RCD, DRI, and the SAG, will deploy new instruments in proposed dust control measures intended to assess and evaluate the effectiveness of newly installed dust control measures at Oceano Dunes SVRA.

3.1.6.2 PI-SWERL Surveys

In consultation with DRI, State Parks will work with the SAG to determine if a useful PI-SWERL measurement campaign should be carried out to further the current understanding of the dust emissions system and inform air quality modeling and management of dust emissions at Oceano Dunes SVRA.

3.1.6.3 UAS Surveys

Consistent with previous years (see Section 2.3.3), UAS surveys for the next reporting period (August 1, 2021, to July 31, 2022) will occur in October 2021 and February 2022. Campaigns will involve flights with RGB and multispectral payloads as in the 2020-21 period. The same data products mentioned in Section 2.3.3 will be produced (georeferenced digital orthophoto mosaics, DEMs, GCD maps).

3.1.7 Continued SAG Consultation and Evaluation

Pursuant to the SLOAPCD SOA as amended, CDPR will continue to utilize the SAG for consultation and evaluation. Priority areas for State Parks consultation with the SAG in 2021-22 include (but are not limited to) the following:

- Update approach to evaluating SOA progress and requirements (see Section 3.1.7.1)
- Adaptive management process (see Section 3.1.7.2)
- Provide feedback on the Public Relations Campaign (see Section 3.1.8)
- Further refine modeling to determine the effectiveness of dust mitigation activities (see Section 3.2.2)

The SAG will continue to exercise its independent advisory role by preparing scientific reports and reviews that inform the implementation and monitoring of Oceano Dunes SVRA dust mitigation activities. In particular, the SAG anticipates publishing a "State of the Science" report in Fall 2021 to provide a synthesis and review of existing white papers, reports, and scientific literature relevant to dust mitigation efforts at Oceano Dunes SVRA. The SAG may consult with CDPR and SLOAPCD to ensure access to relevant context and information in preparing such reports and reviews. However, to ensure independence, the content and timeline for the final publication of SAG reports and reviews will be at the sole discretion of the SAG, although the SAG will consider timeline considerations from either agency.

3.1.7.1 Update Approach to Evaluating SOA Progress and Requirements

Section 2.4.4 described initial work by the SAG, DRI staff, and CDPR staff to identify a possible alternative to the existing SOA PM_{10} mass emissions reduction target. The SAG proposed an approach to modeling a PM_{10} "pre-disturbance emissions scenario" based on estimated dune conditions before human disturbance through this initial work. Preliminary proof-of-concept modeling of the pre-disturbance emissions scenario revealed the promise of this approach. In the coming year, the pre-disturbance emissions scenario approach will be refined to account for several important factors not included in the proof of concept, including (1) consideration of spatial gradients in naturally-occurring dust emissivity, (2) assessment of historical dune-stabilizing vegetation coverage, and its effects on PM_{10} emissions, and (3) quantification of model uncertainty. These planned refinements are described below:

1. **Spatial gradient in dust emissivity.** Instead of applying a uniform PM_{10} emissivity curve to the riding area domain, the refined model will include a spatial (north-south) gradient

in the PM_{10} emissivity that reflects the concomitant spatial gradient in PM_{10} emissivity in adjacent non-riding areas.

2. **Historical dune-stabilizing vegetation coverage.** Historical aerial photography dating back to 1939 will be used to identify and estimate pre-disturbance coverage of vegetation and related dune-stabilizing features (e.g., nebkhas) for incorporation into modeling the pre-disturbance emissions scenario, including possible indirect effects of historical vegetation on downwind emissivity.
3. **Uncertainty quantification.** Refinements in modeling PM_{10} emissions and concentrations for the pre-disturbance emissions scenario will include quantification of uncertainties associated with mapping historical vegetation coverage and pre-disturbance emissivity, along with other DRI model uncertainties.

Outcomes of the modeling of the refined pre-disturbance emissions scenario will then be used to determine if a modification to the existing SOA target is justifiable and, if so, what this revised target would look like. This work will occur in parallel with efforts (e.g., sand flux monitoring and CFD model development) to quantify additional indirect effects of dust mitigation activities, such as downwind sheltering effects and changes in sediment flux (Section 3.2.2) so that the full air quality improvement resulting from dune restoration activities is appropriately credited when determining progress toward current or potentially revised dust mitigation targets.

Timeline for Work

The following timeline is proposed to ensure timely progress on developing proposed alternatives for effective SOA goals:

August 1, 2021	Preliminary progress on the SOA target is reported in ARWP (see Section 2.4.4).
September 1, 2021	In consultation with DRI, the SAG finalizes the determination of inputs for the pre-disturbance scenario model (i.e., the spatial gradient in dust emissivity, historical dune-stabilizing vegetation coverage).
October 1, 2021	In consultation with DRI, the SAG finalizes the determination of the process to account for indirect effects in the DRI model.
November 1, 2021	The DRI, in consultation with SAG and CDPR, completes updates to the DRI model to account for pre-disturbance scenario and indirect effects.
December 1, 2021	The DRI completes updated model simulations for pre-disturbance scenarios (compared to the 2013 scenario and 2021 cumulative treatments) and presents results to CDPR and SAG.
December 31, 2021	The SAG reviews DRI model simulations and discusses the next steps for the SOA target with CDPR.
January 31, 2022	The SAG presents findings and recommendations on SOA targets to CDPR and the SLOAPCD.

3.1.7.2 Adaptive Management Process

The SOA implicitly recognizes the need for CDPR to update and improve its Dust Control Program as new information becomes available during each ARWP process. CDPR, The OHMVR Division’s 2009 Strategic Plan, defines adaptive management as: “A type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies and incorporating new knowledge into management approaches based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices.” The Dust Control Program involves testing modeling predictions, comparing real-world measurements to model predictions, and incorporating new information to refine model predictions and dust control strategies. CDPR, in consultation with the SAG, will use the latest information compiled in this 2021 ARWP, including the updated evaluation metrics outlined in Attachment 11, to refine the adaptive management process that will guide the Dust Control Program following the conclusion of the ARWP process outlined in SOA #17-01, as amended.

3.1.7.3 SAG Meetings and Workshops

The SAG anticipates the following meeting and workshop activities in 2021-22:

- Quarterly full-day SAG meetings, with the participation of CDPR and SLOAPCD staff as needed. Public health conditions permitting, it is anticipated that Winter 2022 and Summer 2022 meetings will be held in person at Oceano Dunes SVRA. Fall 2021 and Spring 2022 meetings will be held via videoconference.
- Regular monthly calls among the full SAG, with the participation of CDPR and SLOAPCD staff as needed.
- Additional ad hoc calls among subgroups of the SAG to address specific work tasks, with the participation of CDPR and SLOAPCD staff as needed.
- SAG presentations at public meetings and workshops, as requested by CDPR and SLOAPCD.

3.1.8 Public Relations Campaign

State Parks will build upon its initial public relations campaign development described in Section 2.4.6. State Parks will continue to coordinate and consult with the SAG to develop a clear public relations campaign that meaningfully engages Oceano Dunes SVRA visitors, surrounding community members, and other relevant stakeholders.

3.1.9 Coastal Commission Coordination

Some of CDPR's proposed Dust Control Program activities for August 1, 2020, to July 31, 2021 period constitute development under the California Coastal Act (e.g., installing wind fencing, monitoring equipment, etc.). Therefore, these activities require a Coastal Development Permit (CDP) from the California Coastal Commission (CCC) to be installed. In September 2017, the CCC approved CDP #3-12-050 to implement a five-year adaptive management Dust Control Program at Oceano Dunes SVRA. This permit is subject to certain conditions, including, but not limited to, the type and amount of Dust Control Program activities, the area in which Dust Control Program activities may occur, and the need for annual review of Dust Control Program activities at Oceano Dunes SVRA. In general, CDP #3-12-050 authorizes Dust Control Program activities that are the same as described in CDPR's 2017 Dust Control Program EIR; however, the CDP provides authorization to undertake these activities in areas necessary to meet CARB or SLOAPCD requirements. State Parks will coordinate with CCC staff on the appropriate CDP process for the proposed 2021 ARWP projects. The appropriate CDP process may include an amendment to CDP #3-12-050.

CDPR will submit a formal CDP application to the California Coastal Commission in early November, pending APCD approval of the ARWP by October 31, 2021. CDPR will coordinate weekly with the representative from Coastal Commission to track the progress of this application and answer questions or concerns that arise during the review of the application materials. The goal is to have an approved CDP for the 2021 ARWP projects no later than February 2022. This timeline is tentative and subject to change based on the complexity of the projects proposed in the ARWP and issues outside the control of CDPR, including Coastal Commission staff workload and other complex Coastal Act issues.

3.2 MODELED EMISSIONS REDUCTIONS

In consultation with CDPR and the SAG, DRI will provide foredune, backdune, and cumulative estimates of PM_{10} mass emission and concentration reductions for the dust control measure scenarios described in 3.1.1 by 09/01/21.

3.2.1 ADDITIONAL DUST CONTROLS NEEDED TO ACHIEVE SOA GOALS

In consultation with CDPR and the SAG, DRI will estimate the additional magnitude of dust controls needed to achieve SOA goals by 09/01/21.

3.2.2 FURTHER REFINEMENT OF MODELED REDUCTIONS IN PM_{10} EMISSIONS

The DRI will continue to evaluate CFD applications for the DRI air quality model's treatment of the foredune restoration area and, potentially, other dust control measures at Oceano Dunes SVRA.

The purpose of this evaluation will be to quantify the indirect effects of dust mitigation activities, such as downwind sheltering effects (as modeled by CFD) and changes in sediment flux. This evaluation is anticipated to be complete by October 31, 2021.

3.2.3 Increments of Progress Towards Air Quality Objectives, 2013 to 2021

The DRI will provide an updated evaluation regarding the incremental progress made toward achieving SOA air quality objectives based on dust control projects installed as of 07/31/21 and 07/31/22. This evaluation is expected to be reported on in CDPR's 2022 ARWP.

3.3 ADDITIONAL ASSESSMENTS

As described in 2.4.5, SOA #17-01, as amended, recognizes that PM_{10} concentrations measured at CDF and on the Nipomo Mesa may come from various sources external to Oceano Dunes SVRA. Accordingly, CDPR and the SLOAPCD proposed to continue studying other potential PM_{10} emission sources and their relative contributions to PM_{10} concentrations on the Nipomo Mesa, including the potential contribution of marine sources to measured PM_{10} levels.

3.3.1 Chemical Speciation

While data analysis of the 2020 samples is still ongoing, the SLOAPCD, with CARB, proposes a more ambitious speciation sampling plan for the 2021 ARWP reporting cycle (August 1, 2021, to July 31, 2022). The SLOAPCD's and CARB's proposed sampling plan is designed to generate enough data to run a successful PMF analysis and address some of the questions noted in the preliminary review of the data. The proposed 2021 plan includes a greater sampling frequency, possible quantitative elemental results for chlorine, sodium, and magnesium (components of Oceano Dunes SVRA sand), possible sampling for the actual mineral composition of sand at Oceano Dunes SVRA, and improved data quality assurance procedures. The SLOAPCD would lead the proposed sampling and data analysis with analytical support provided by CARB and DRI and funding support provided by CDPR.

Refer to Attachment 14, 2021 Proposal for Speciation Sampling for more detailed information on the speciation analyses completed to date and the SLOAPCD/CARB proposal for 2021 speciation sampling.

3.3.2 Scripps Study

The analytical work related to the Scripps' spring 2021 sampling will be completed by late summer/early fall 2021. Data analysis and preparation of a report of findings will continue through 2021. The report of findings is due to the OHMVR Division in February 2022. Preparation of a related document to be submitted for scientific journal publication will begin subsequently and continue through June 2022.

3.3.3 Scientific Review Process

State Parks will coordinate with the SAG on developing a process for how scientific data collected for or related to the Oceano Dunes SVRA Dust Control Program is reviewed and reported on by State Parks and its representatives. This document will include an anticipated timeline and process for SAG review.

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4 BUDGETARY CONSIDERATIONS

The OHMVR Division's estimated budget to develop and implement the 2021/2022 dust control actions described in Chapter 3 is $2,924,727. A detailed breakdown of this estimated budget is provided in Table 4-1. This budget covers all activities from July 1, 2021, through June 30, 2022, including existing contracts with SAG members. The approximately $2.92 million budget shown in Table 4-1 is slightly higher than the costs CDPR identified in proposed activities in the 2020 ARWP ($2.64 million).

Table 4-1: Estimated 2021 Work Plan Budget

Dust Control Activity	3rd Party Contract Costs	Other Costs	Total Costs(A)
Vegetation Plantings (Conversion of Wind Fencing, Foredune, and Supplemental Plantings)			
Labor	$298,000.00	$124,000.00	$422,000.00
Materials	$0	$135,000.00	$135,000.00
Equipment	$70,000.00	$0	$70,000.00
Greenhouse Facilities	$190,000.00	$0	$190,000.00
Subtotals	$558,000.00	$259,000.00	$817,000.00
Maintenance and Installation of Wind Fencing			
Labor	$297,000.00	$96,000.00	$393,000.00
Materials	$0	$120,000.00	$120,000.00
Equipment	$135,000.00	$0	$135,000.00
Subtotals	$432,000.00	$216,000.00	$648,000.00
Monitoring (Sand Flux, Air Quality, Meteorological, and Other Monitoring) and Modeling			
Instrument Operations	$165,000.00	$29,000.00	$194,000.00
Data Analysis	$300,000.00	$0	$300,000.00
Subtotals	$465,000.00	$29,000.00	$494,000.00
Dust Control Project Design and Technical Assistance			
Scientific Expertise	$228,000.00	$0	$228,000.00
Subtotals	$228,000.00	$0	$228,000.00
Other Items of Expense			
Miscellaneous	$737,727.00	$0	$737,727.00
Subtotals	$737,727.00	$0	$737,727.00
TOTAL COSTS	**$2,420,727.00**	**$504,000.00**	**$2,924,727.00**

(A) The cost estimate does not include permanent CDPR staff positions assigned to these duties but includes seasonal staff time and overtime for permanent staff.
(B) Miscellaneous costs include SAG contracts for greenhouse assistance, fuel costs, equipment repairs, purchases, and other costs related to Dust Control Program support.

5 IMPLEMENTATION SCHEDULE

The tables below present schedules for implementing the dust control activities identified in Chapter 3. The tables cover an approximately 14-month period from June 2021 to July 2022.

Table 5-1: Install 90 Acres of New Dust Control Measures

CDPR Task/Activity	**2021**							**2022**						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on dust control measure locations	O	→	X										O	→
Obtain Amendment to Coastal Development Permit #3-12-50						O	→	→	X					
Install perimeter fence around new, temporary dust control measures									O	X				
Install new wind fencing measures									O	→	X			
Install new straw mulch measures									O	→	X			
Install new vehicle exclosure measures									O	→	X			
KEY:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-2: Convert Existing Temporary Dust Control Measures to Vegetation

CDPR Task/Activity	2021							2022						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on project selection		O	→	→	X								O	→
Collect native seed and plants, cultivate growth, procure additional plants from nurseries	→	→	→	→	→	X								
Remove existing wind fences				O	X									
Distribute straw mulch					O	→	X							
Initiate seeding and planting							O	→	→	X				
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-3: Continued Foredune Monitoring and Assessment

CDPR Task/Activity	2021							2022						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on monitoring		O	→	X									O	→
Transect sampling				O	→	→	→	→	X					
Photo point monitoring					O X									
Data analysis										O	→	X		
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-4: Supplemental Planting in Previous Treatment Areas

CDPR Task/Activity	2021							2022						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Collect native seed and plants, cultivate growth, procure additional plants from nurseries	→	→	→	→	→	X								
Initiate seeding and planting							O	→	→	X				
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-5: Maintenance of Existing Wind Fencing Measures

CDPR Task/Activity	2021							2022						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Repair and/or replace fencing components, add new fence extensions or rows if needed									O	→	→	X		
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-6: Field Monitoring and Air Quality Modeling Activities

CDPR Task/Activity	2021							2022						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Meteorological, PM, and saltation data acquisition	→	→	→	→	→	→	→	→	→	→	→	→	→	→
PI-SWERL Surveys	Not Proposed in 2021 ARWP													
UAS Surveys					O X				O X					
Improve DRI air quality model performance	→	→	→	→	→	→	→	→	→	→	→	→	→	→
KEY:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-7: Continued SAG Consultation and Evaluation														
CDPR Task/Activity	**2021**							**2022**						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on 2021 ARWP	O	→	→	→	X									
Update approach to evaluating SOA progress			O	→	→	→	→	X						
SAG quarterly meetings			X			X			X			X		
Prepare 2022 ARWP outline for SAG review												O X		
Consult with SAG on 2022 ARWP												O	→	→
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-8: Public Relations Campaign														
CDPR Task/Activity	**2021**							**2022**						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on Public Relations Campaign	→	→	→	→	→	→	→	→	→	→	→	→	→	→
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Oceano Dunes State Vehicular Recreation Area Dust Control Program

DRAFT 2021 Annual Report and Work Plan

<u>ATTACHMENT 01</u>

2011 to 2021 Dust Control Measures

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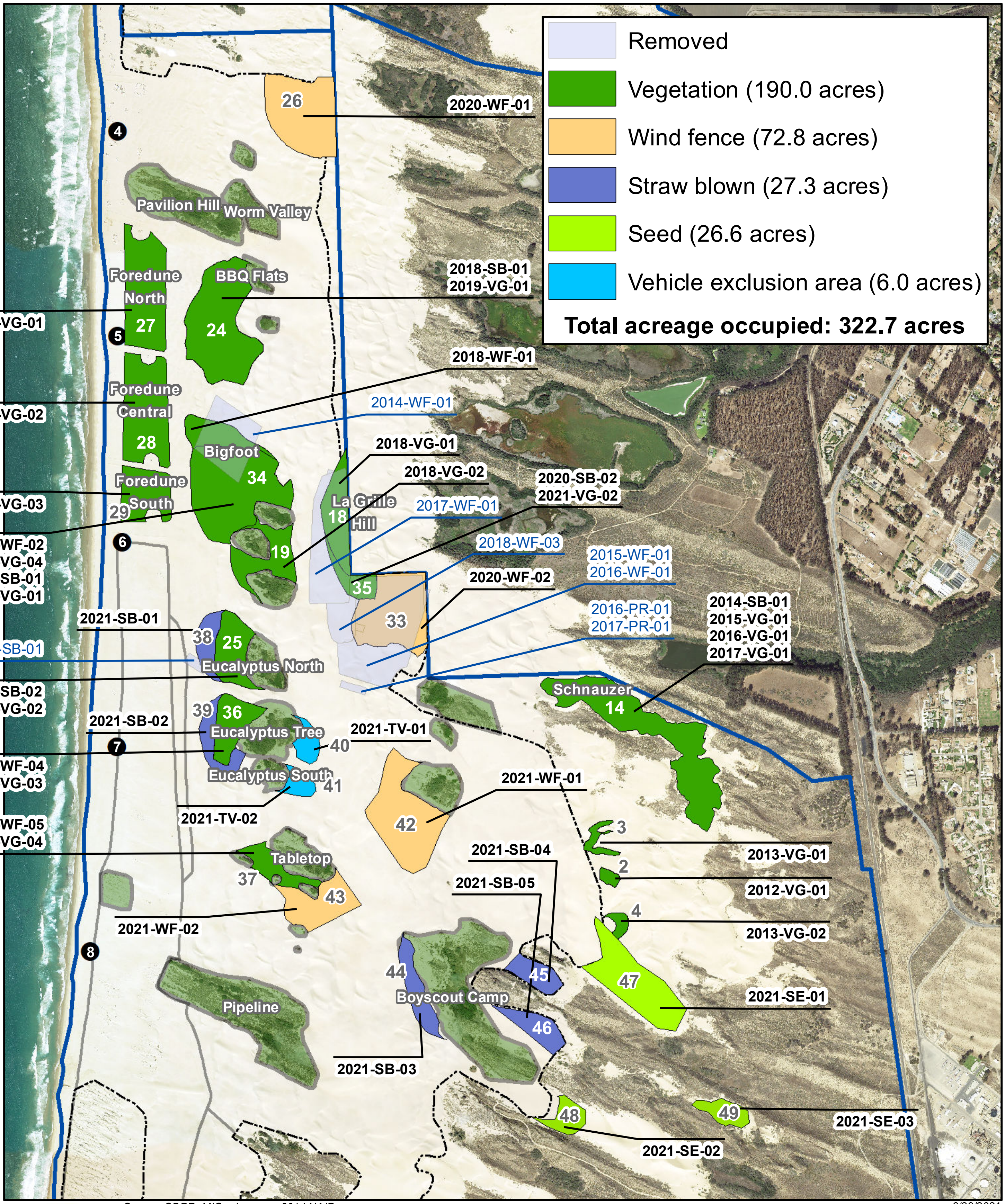


Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

0 500 1,000 2,000 3,000 4,000 Feet

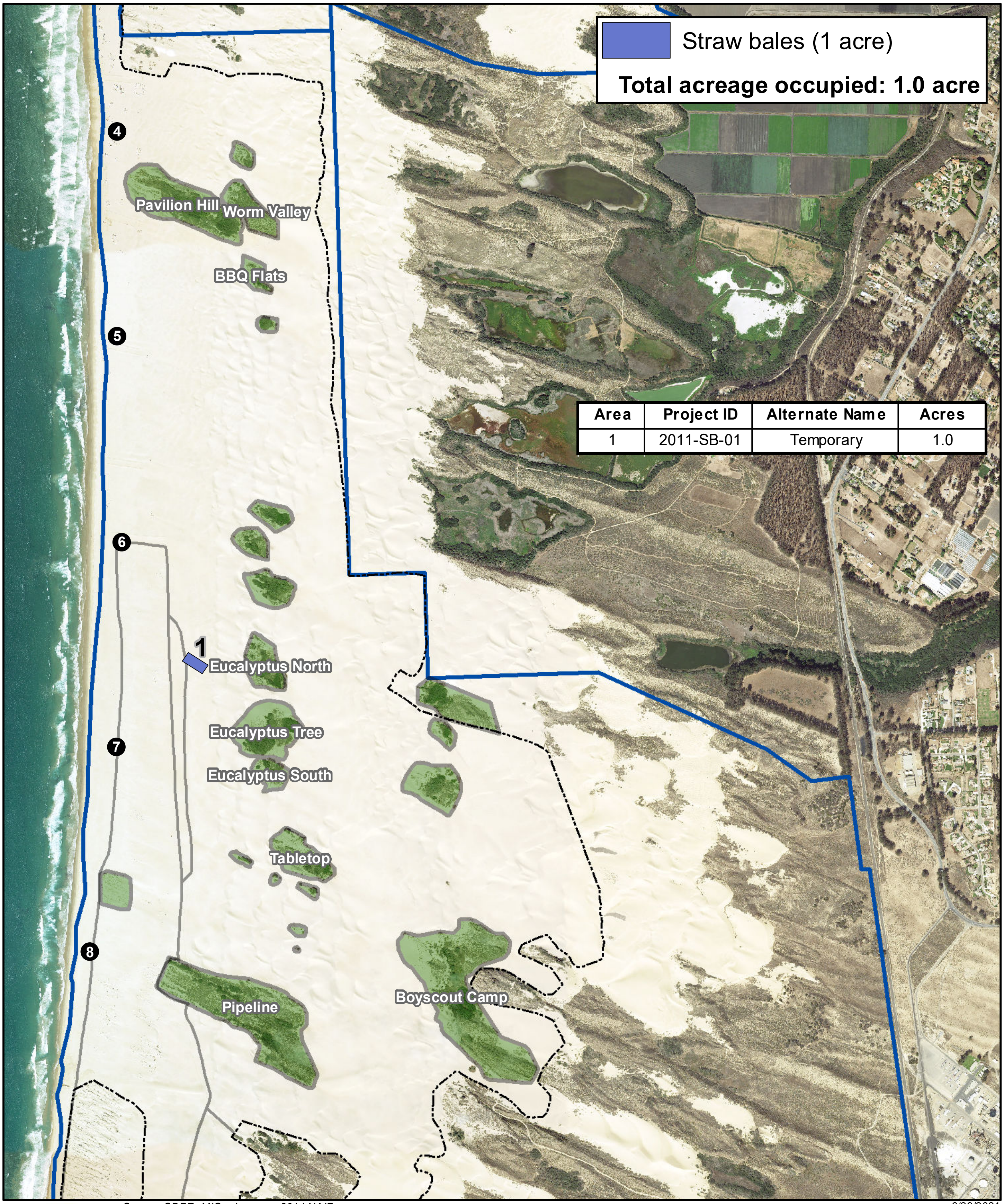
A01-01: Cumulative as of 07/31/2021

2021 ARWP

CALIFORNIA STATE PARKS SINCE 1864 OHV

N

Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
1	2011-SB-01	Temporary	1.0

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

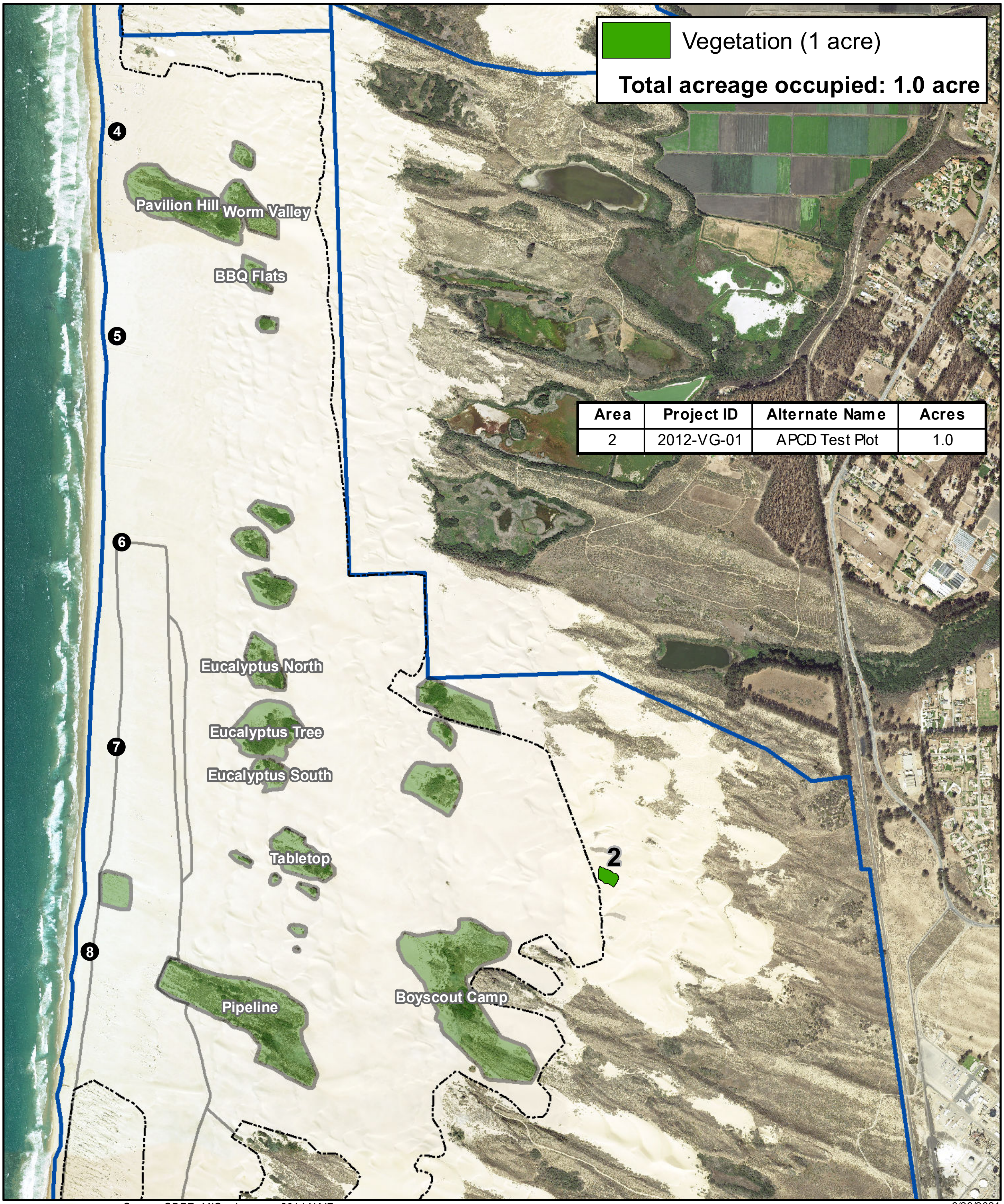
0 500 1,000 2,000 Feet

N

A01-02: 2011 | Dust Control Treatment Areas

2021 ARWP

Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
2	2012-VG-01	APCD Test Plot	1.0

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

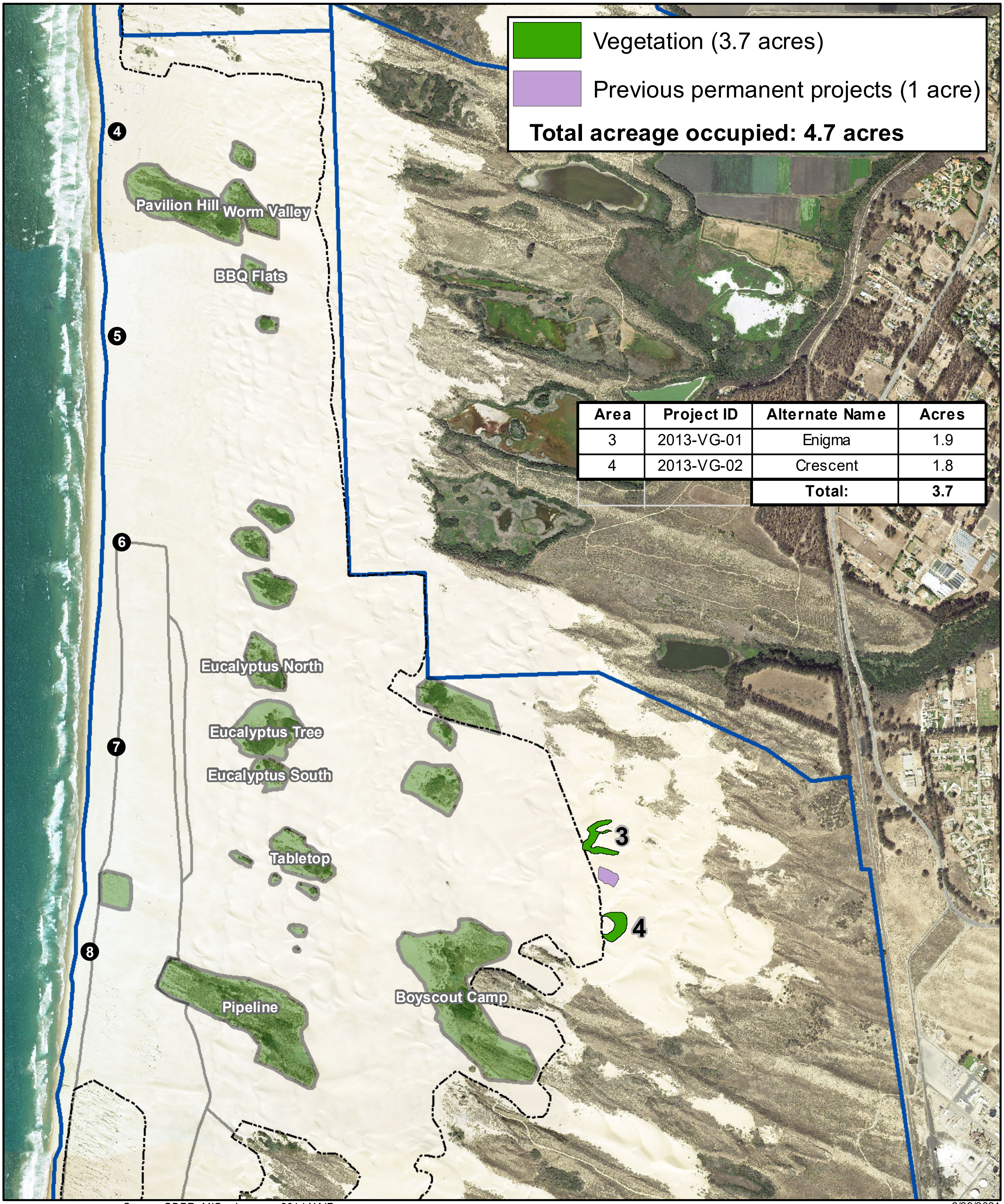
0 500 1,000 2,000 Feet

N

A01-03: 2012 | Dust Control Treatment Areas

2021 ARWP

Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
3	2013-VG-01	Enigma	1.9
4	2013-VG-02	Crescent	1.8
		Total:	**3.7**

Source: CDPR, MIG   Imagery: 2014 NAIP

6/29/2021

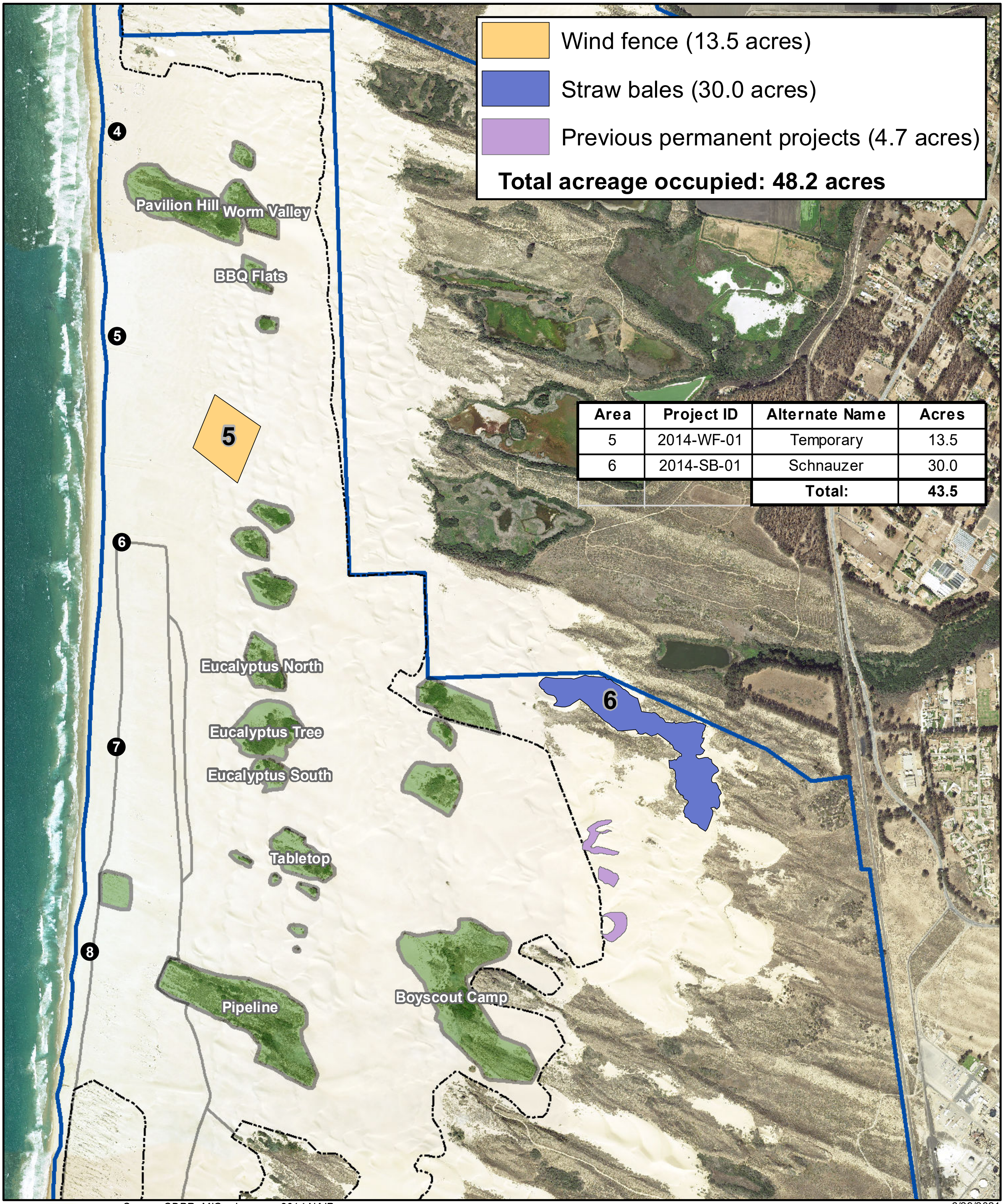
0 500 1,000 2,000 Feet

N

A01-04: 2013 | Dust Control Treatment Areas

2021 ARWP

● Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
5	2014-WF-01	Temporary	13.5
6	2014-SB-01	Schnauzer	30.0
		Total:	**43.5**

Source: CDPR, MIG   Imagery: 2014 NAIP

6/29/2021

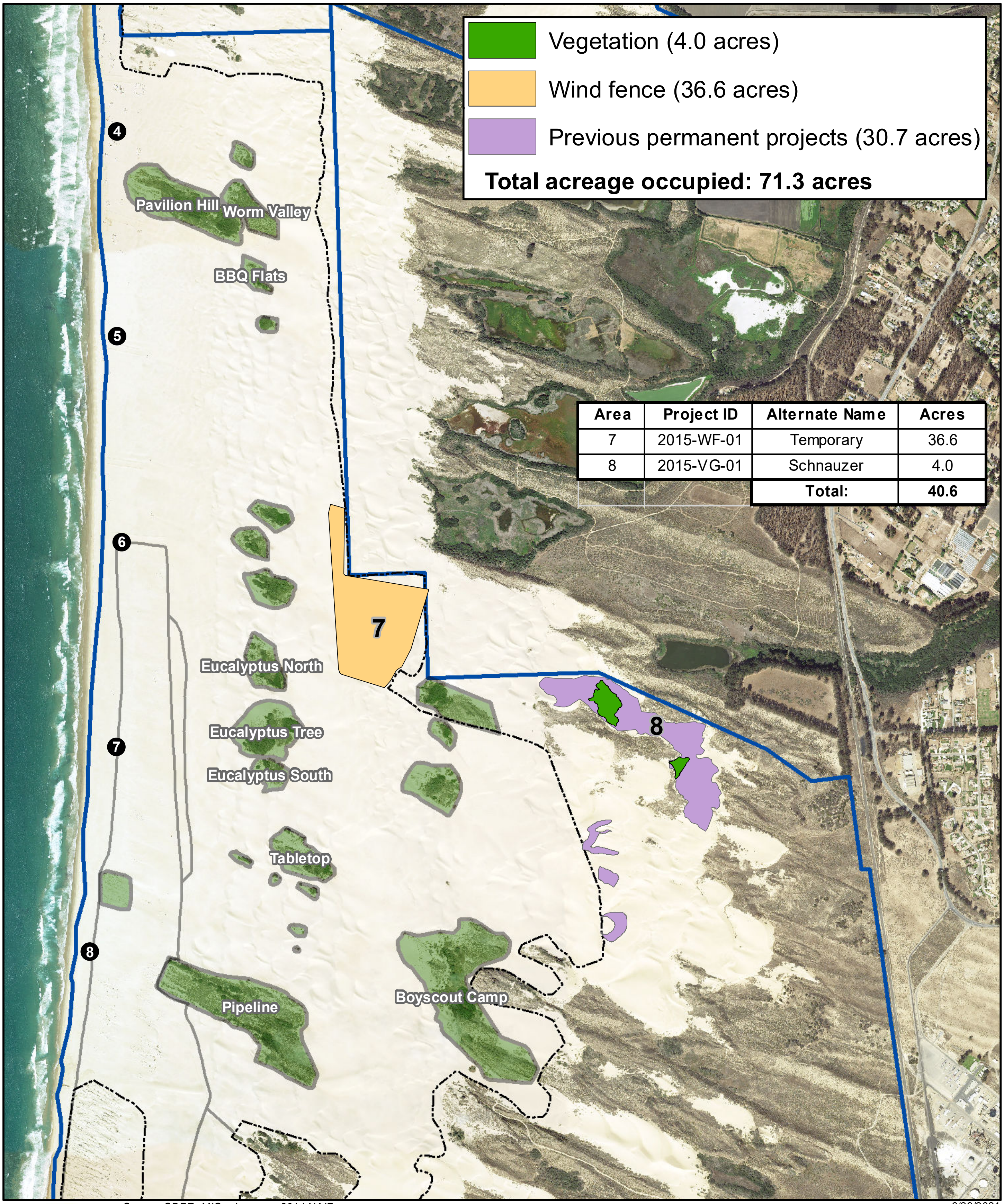
Feet
0 500 1,000 2,000

A01-05: 2014 | Dust Control Treatment Areas

2021 ARWP

N

Marker post
Nesting exclosure from 2020
Existing fenced vegetated islands
Open riding and camping area boundary fence
Park boundary



Area	Project ID	Alternate Name	Acres
7	2015-WF-01	Temporary	36.6
8	2015-VG-01	Schnauzer	4.0
		Total:	**40.6**

Source: CDPR, MIG   Imagery: 2014 NAIP

6/29/2021

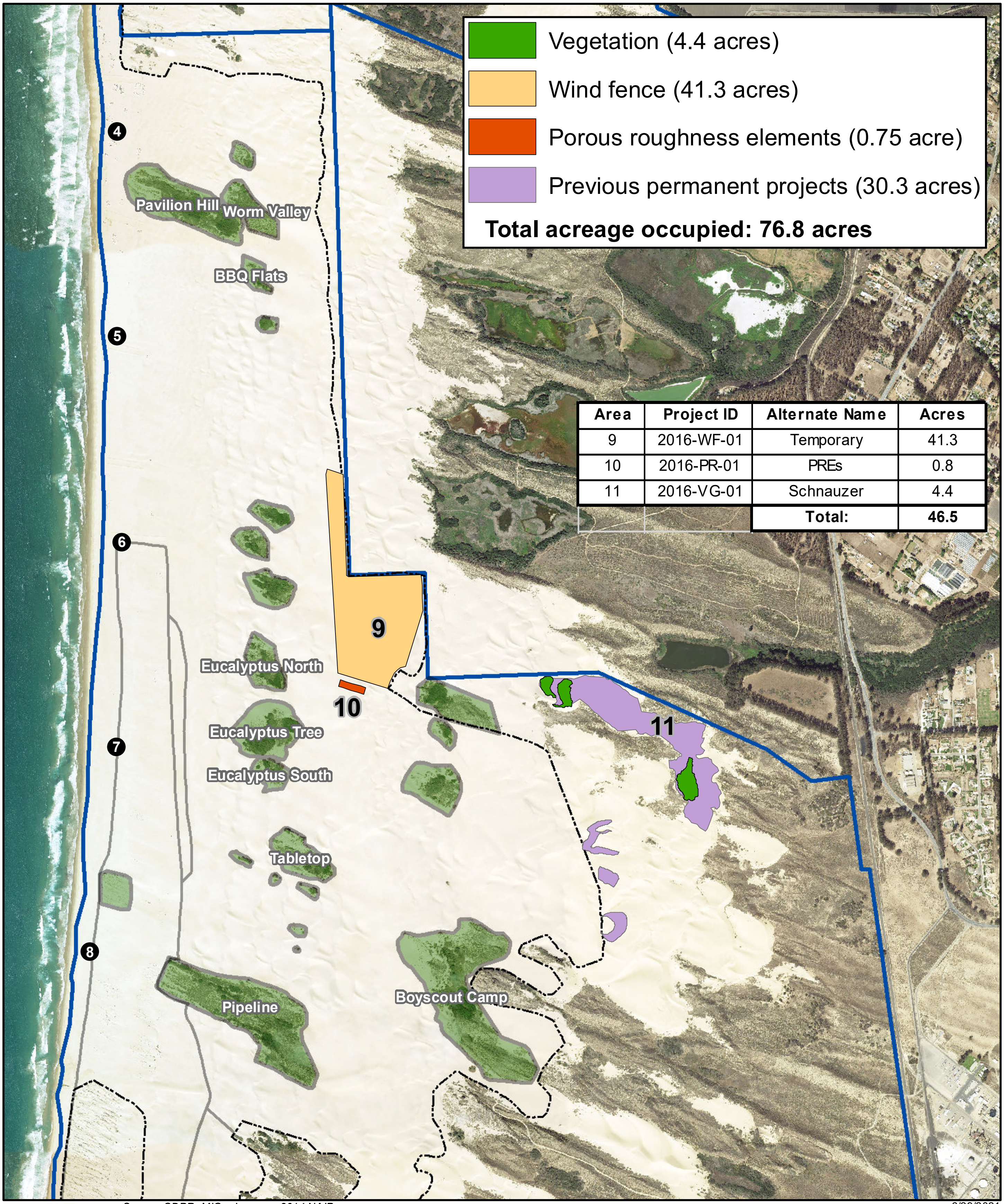
Feet
0 500 1,000 2,000

N

A01-06: 2015 | Dust Control Treatment Areas

2021 ARWP

Marker post
Nesting exclosure from 2020
Existing fenced vegetated islands
Open riding and camping area boundary fence
Park boundary



Area	Project ID	Alternate Name	Acres
9	2016-WF-01	Temporary	41.3
10	2016-PR-01	PREs	0.8
11	2016-VG-01	Schnauzer	4.4
		Total:	46.5

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

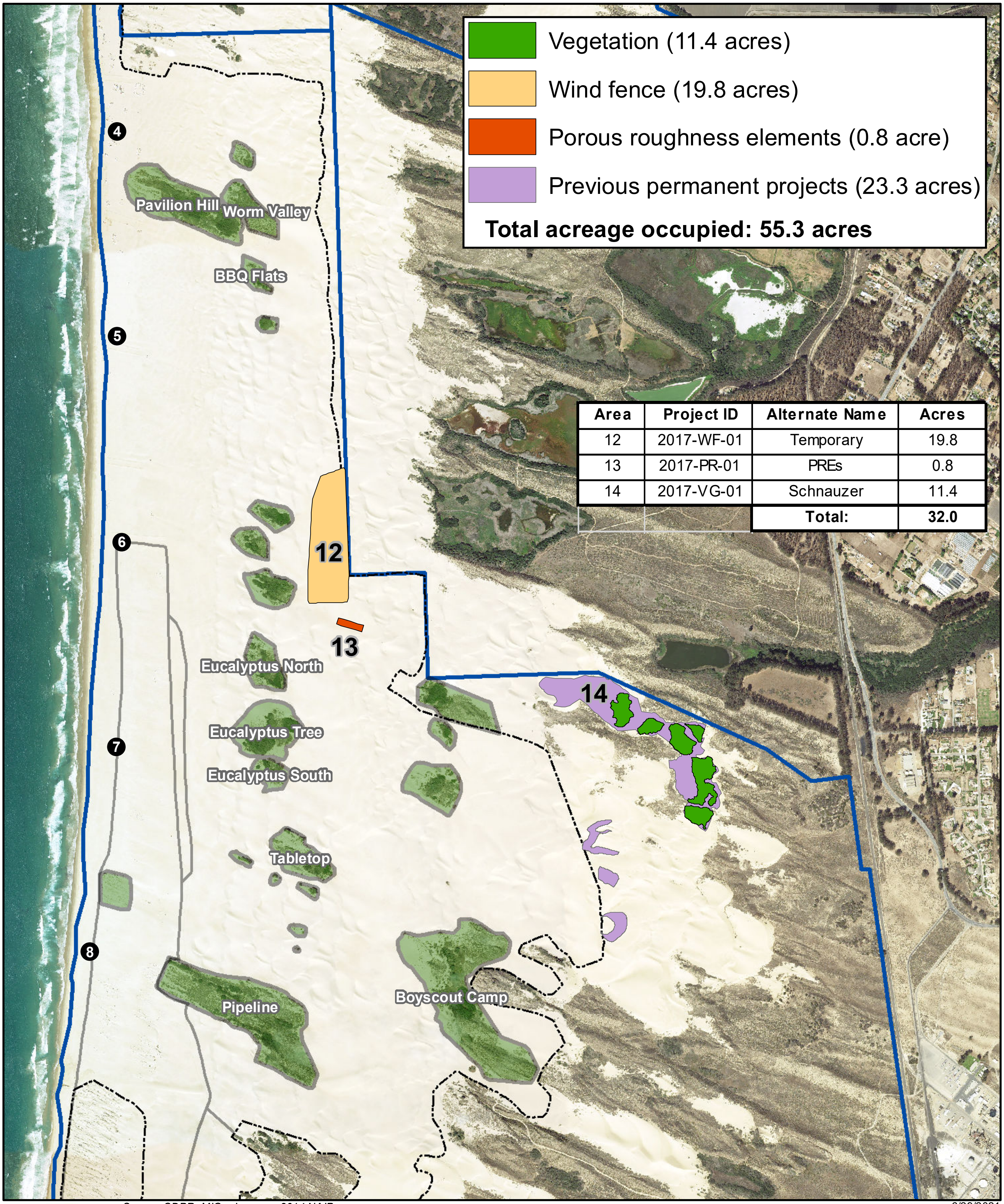
Feet
0 500 1,000 2,000

N

A01-07: 2016 | Dust Control Treatment Areas

2021 ARWP

- Marker post
- Nesting exclosure from 2020
- Existing fenced vegetated islands
- Open riding and camping area boundary fence
- Park boundary



Area	Project ID	Alternate Name	Acres
12	2017-WF-01	Temporary	19.8
13	2017-PR-01	PREs	0.8
14	2017-VG-01	Schnauzer	11.4
		Total:	32.0

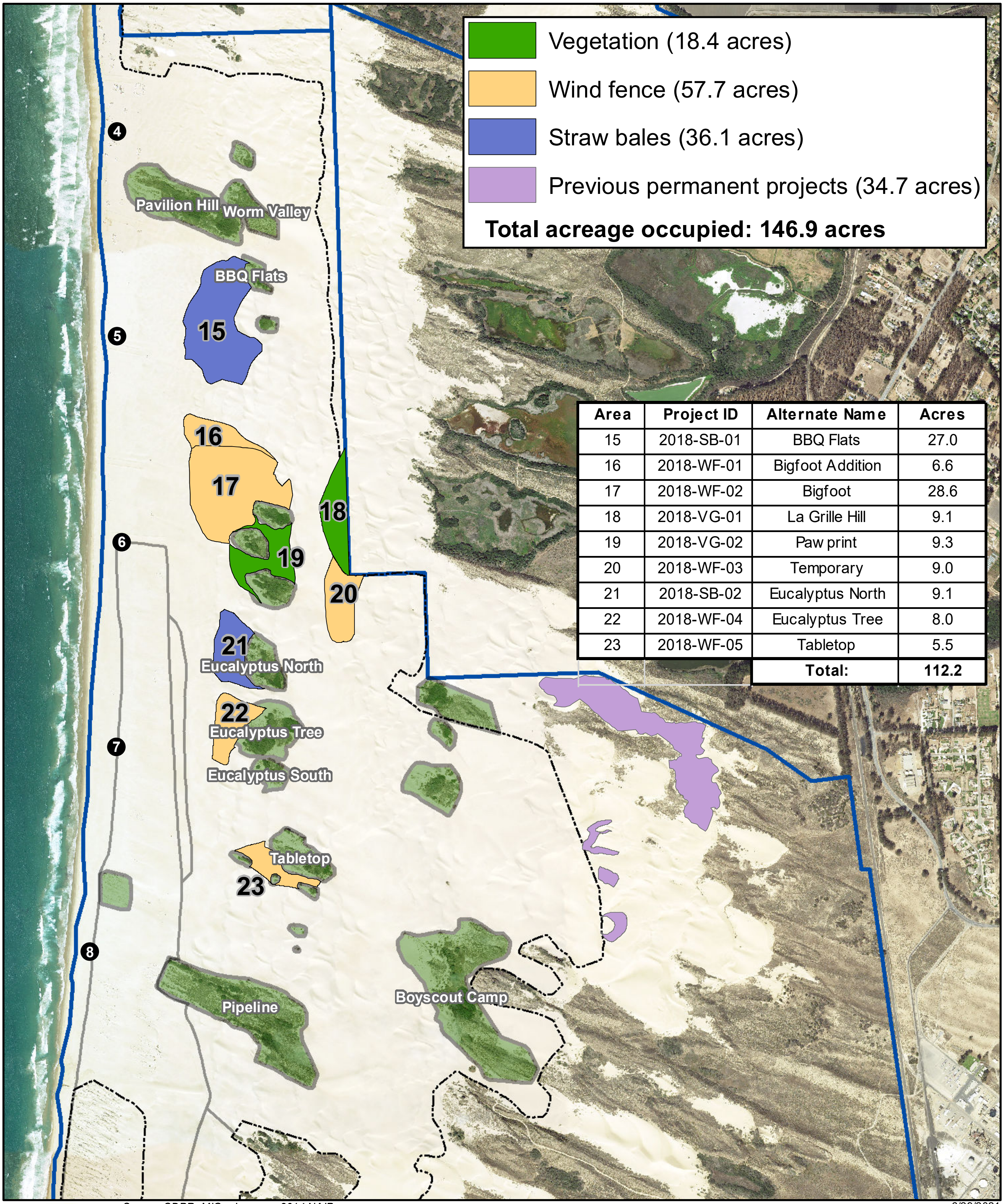
Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

A01-08: 2017 | Dust Control Treatment Areas

2021 ARWP

Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
15	2018-SB-01	BBQ Flats	27.0
16	2018-WF-01	Bigfoot Addition	6.6
17	2018-WF-02	Bigfoot	28.6
18	2018-VG-01	La Grille Hill	9.1
19	2018-VG-02	Paw print	9.3
20	2018-WF-03	Temporary	9.0
21	2018-SB-02	Eucalyptus North	9.1
22	2018-WF-04	Eucalyptus Tree	8.0
23	2018-WF-05	Tabletop	5.5
		Total:	**112.2**

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

Feet
0 500 1,000 2,000

N

A01-09: 2018 | Dust Control Treatment Areas

2021 ARWP

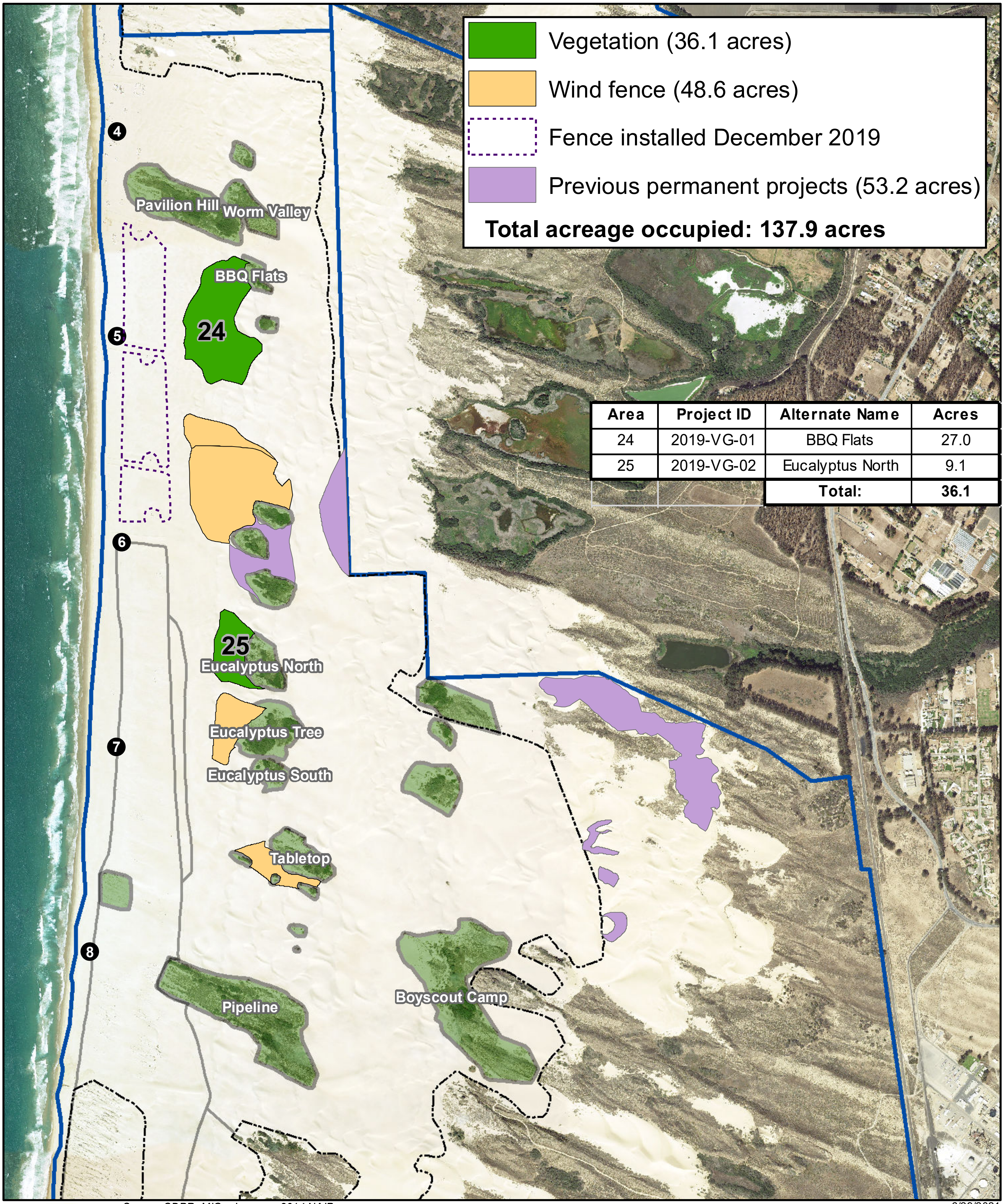
Marker post

Nesting exclosure from 2020

Existing fenced vegetated islands

Open riding and camping area boundary fence

Park boundary



Area	Project ID	Alternate Name	Acres
24	2019-VG-01	BBQ Flats	27.0
25	2019-VG-02	Eucalyptus North	9.1
		Total:	**36.1**

Source: CDPR, MIG Imagery: 2014 NAIP 6/29/2021

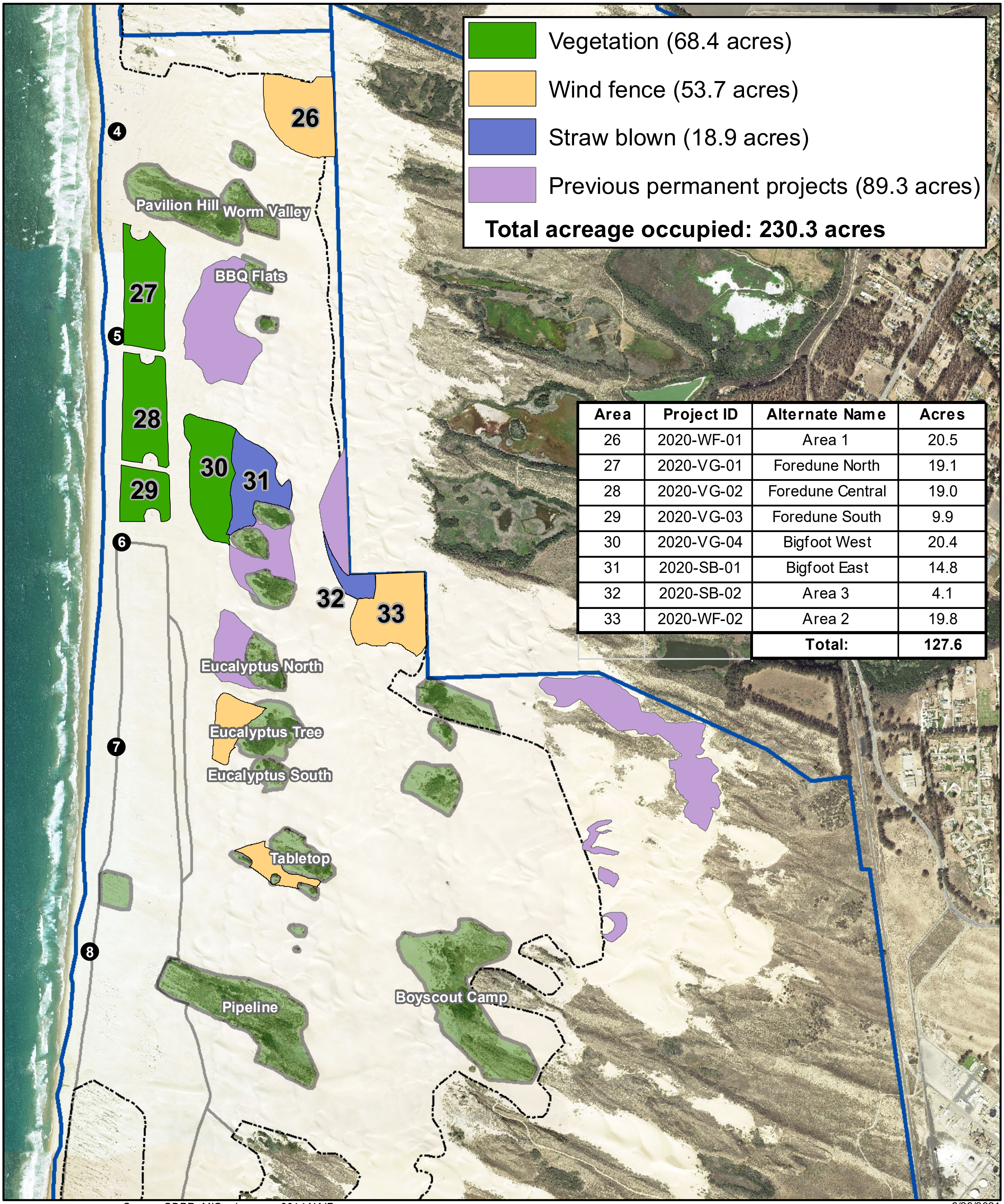
Feet
0 500 1,000 2,000

A01-10: 2019 | Dust Control Treatment Areas

2021 ARWP

N

Marker post
Existing fenced vegetated islands
Park boundary
Nesting exclosure from 2020
Open riding and camping area boundary fence



Area	Project ID	Alternate Name	Acres
26	2020-WF-01	Area 1	20.5
27	2020-VG-01	Foredune North	19.1
28	2020-VG-02	Foredune Central	19.0
29	2020-VG-03	Foredune South	9.9
30	2020-VG-04	Bigfoot West	20.4
31	2020-SB-01	Bigfoot East	14.8
32	2020-SB-02	Area 3	4.1
33	2020-WF-02	Area 2	19.8
		Total:	**127.6**

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

0 500 1,000 2,000 Feet

N

A01-11: 2020 | Dust Control Treatment Areas

2021 ARWP

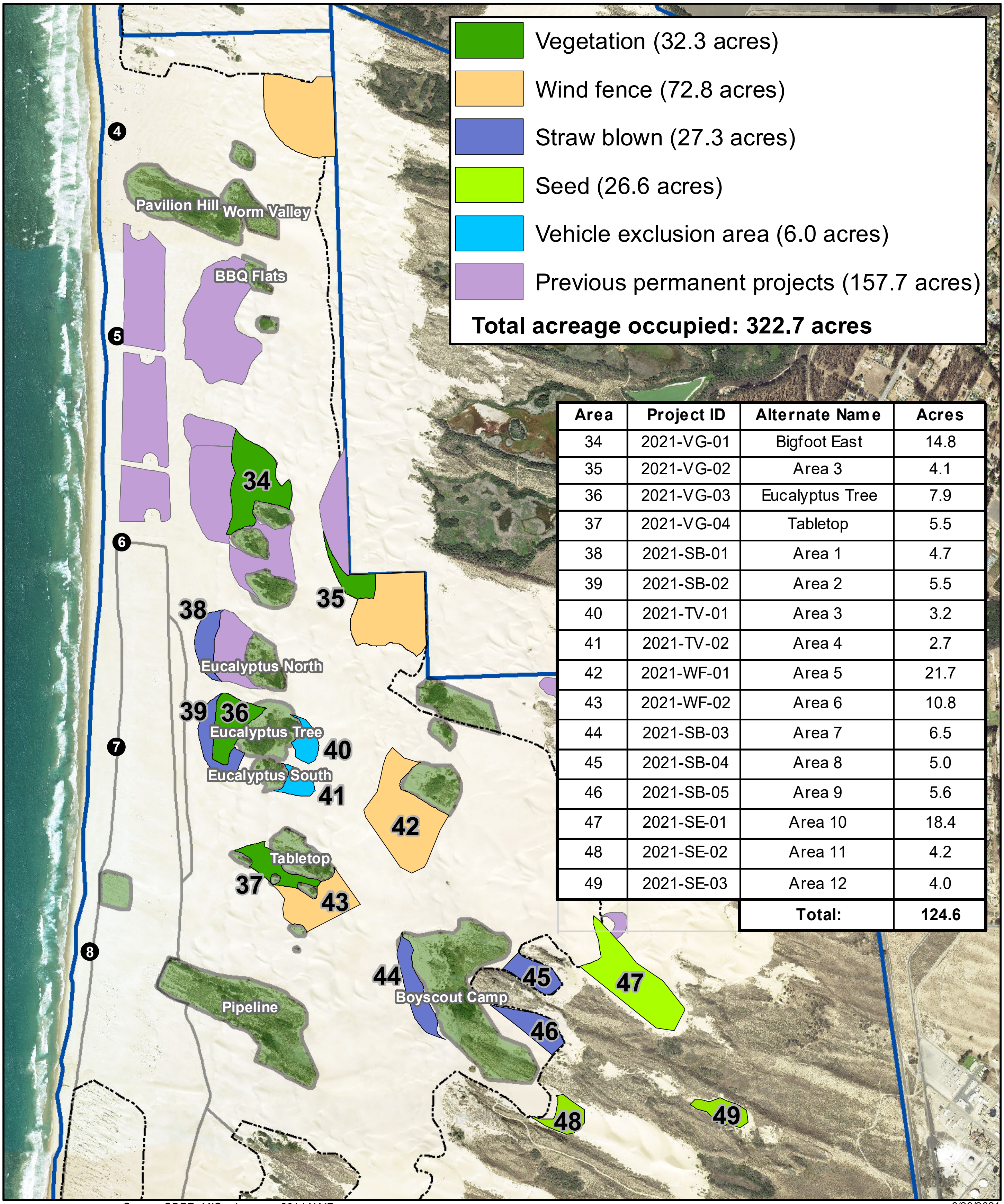
Marker post

Nesting exclosure from 2020

Existing fenced vegetated islands

Open riding and camping area boundary fence

Park boundary



Area	Project ID	Alternate Name	Acres
34	2021-VG-01	Bigfoot East	14.8
35	2021-VG-02	Area 3	4.1
36	2021-VG-03	Eucalyptus Tree	7.9
37	2021-VG-04	Tabletop	5.5
38	2021-SB-01	Area 1	4.7
39	2021-SB-02	Area 2	5.5
40	2021-TV-01	Area 3	3.2
41	2021-TV-02	Area 4	2.7
42	2021-WF-01	Area 5	21.7
43	2021-WF-02	Area 6	10.8
44	2021-SB-03	Area 7	6.5
45	2021-SB-04	Area 8	5.0
46	2021-SB-05	Area 9	5.6
47	2021-SE-01	Area 10	18.4
48	2021-SE-02	Area 11	4.2
49	2021-SE-03	Area 12	4.0
		Total:	**124.6**

Source: CDPR, MIG Imagery: 2014 NAIP

6/29/2021

0 500 1,000 2,000 Feet

N

A01-12: 2021 | Dust Control Treatment Areas

2021 ARWP

Marker post
Nesting exclosure from 2020
Existing fenced vegetated islands
Open riding and camping area boundary fence
Park boundary

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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2020/2021 APCD and Supplemental Restoration Projects

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2020/2021 APCD and Supplemental Restoration Projects									
				Treatment Areas					
		Totals		Bigfoot		BBQ Flats		Eucalyptus Tree North	
	Area (Acres)	**8.3**		4.6		2.6		1.1	
Scattered Straw	Bales (3X4X8 foot)	**75**		37		27		11	
Native Seed	Weight (lbs)	**45.6**		23		17		5.6	
Triticale (Sterile) Seed	Weight (lbs)	**300**		160		100		40	
Species	Common Name	**Total Plants**	**Total Seed**	Plants	Seed (lbs)	Plants	Seed (lbs)	Plants	Seed (lbs)
Abronia latifolia	Yellow sand verbena		**0.177**				0.13		0.047
Abronia maritima	Sticky sand verbena		**3.53**				2.6		0.93
Achillea millefolium	Common yarrow	**1568**	**4.518**	784	2.4	490	1.56	294	0.558
Acmispon glaber	Deerweed	**686**	**0.377**	392	0.2	245	0.13	49	0.047
Ambrosia chamissonis	Beach bur	**882**	**12.4**	392	6.6	490	4.3		1.5
Camissoniopsis cheiranthifolia	Beach evening-primrose	**2401**	**1.106**	1372	0.4	735	0.52	294	0.186
Corethrogyne filaginifolia	Common sandaster	**980**	**0.16**	392	0.16	490		98	
Ericameria ericoides	Mock heather	**1054**	**4.142**	588	2.2	368	1.43	98	0.512
Erigeron blochmaniae	Blochman's leafy daisy	**2107**	**0.377**	1176	0.2	735	0.13	196	0.047
Eriogonum parvifolium	Coastal buckwheat	**686**	**4.142**	392	2.2	245	1.43	49	0.512
Eriophyllum staechadifolium	Seaside golden yarrow	**637**	**1.883**	196	1	245	0.65	196	0.233
Erysimum suffrutescens	Suffrutescent wallflower	**1421**	**0.075**	784	0.04	490	0.026	147	0.009
Lupinus chamissonis	Dune bush lupine	**5096**	**1.506**	2744	0.8	1470	0.52	882	0.186
Malacothrix incana	Dunedelion	**441**	**0**	196		245			
Monardella undulata ssp crispa	Crisp monardella	**2793**	**3.765**	1568	2	980	1.3	245	0.465
Phacelia ramosissima	Branching phacelia	**2156**	**6.36**	1176	5	735	1.36	245	
Senecio blochmaniae	Dune ragwort	**1887**	**1.236**	980		613	0.91	294	0.326
Total		**24795**	**45.754**	**13132**	**23.2**	**8576**	**16.996**	**3087**	**5.558**

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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Desert Research Institute (DRI) Oceano Dunes: Status 2021

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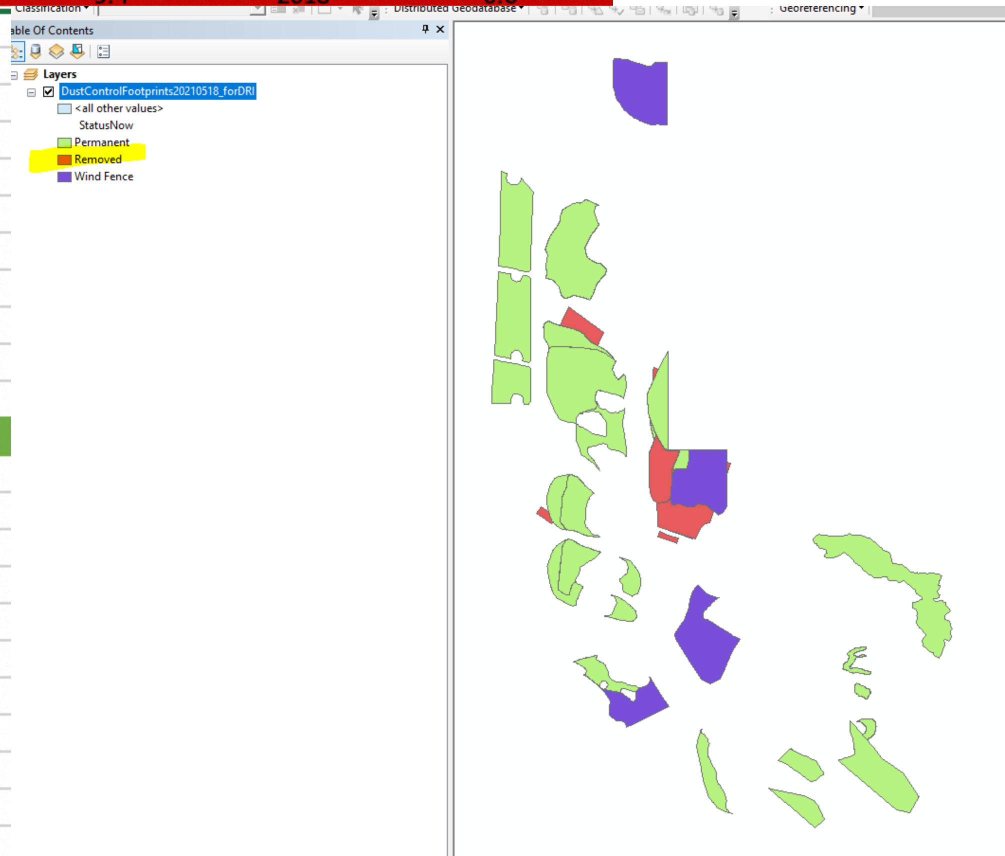
DRI

Desert Research Institute

Oceano Dunes: Status 2021

Scenario	Polygon ID	Name area	Description	Year Impleme	Year Removed	Status	Area Polygon [Acres]	Area Model [Acres]	Year Impleme	Area treated [Acres]
Pre2020	55	straw bales ne	Removed	2011		Removed	1.0	1.1	2011	1.1
Pre2020	53	APCD Test Plot	APCD Test Plot	2012		Permanent	1.1	1.1	2012	0.0
Pre2020	54	Enigma	Enigma	2013		Permanent	2.0	2.0	2013	0.3
Pre2020	52	Crescent	Crescent	2013		Permanent	1.8	1.9	2013	0.1
Pre2020	3	'14	Removed	2014	2014	Removed	13.5	13.5	2014	0.0
Pre2020	47	Trial area 2014	Schnauzer	2014		Permanent	30.1	29.9	2014	28.0
Pre2020	2	'15	Removed	2015	2015	Removed	36.6	37.2	2015	0.0
Pre2020	4	'16	Removed	2016	2016	Removed	41.3	42.2	2016	0.0
Pre2020	5		PREs	2016		Removed	0.7	0.8	2016	0.0
Pre2020	8		PREs	2017		Removed	0.7	0.8	2017	0.0
Pre2020	45	Dust reduction	La Grille Hill	2017		Permanent	9.1	8.8	2017	2.6
Pre2020	44	Dust reduction	Pawprint	2017		Permanent	9.3	9.4	2017	9.4
Pre2020	48	SAO installed a	Removed	2018	2018	Removed	9.0	9.4	2018	0.0
Pre2020	46	Dust reduction	Bigfoot	2018		Permanent	28.6			
Pre2020	40	Stipulated Aba	Bigfoot Addition	2018		Permanent	6.6			
Pre2020	42	Stipulated Aba	Eucalyptus Tree	2018		Permanent	7.9			
Pre2020	41	Stipulated Aba	Eucalyptus North	2018		Permanent	9.1			
Pre2020	39	Stipulated Aba	BBQ Flats	2018		Permanent	27.0			
Pre2020	43	Stipulated Aba	Tabletop	2018		Permanent	5.5			
Pre2020	51	Foredune Dece	Foredune North	2019		Permanent	19.1			
Pre2020	49	Foredune Dece	Foredune South	2019		Permanent	9.9			
Pre2020	50	Foredune Dece	Foredune Central	2019		Permanent	19.0			
Pre2020	11	Wind Fence	Wind Fence 2020	2020		Wind Fence	20.5			
Pre2020	10	Wind Fence	Wind Fence 2020	2020		Wind Fence	19.8			
Pre2020	9	Vegetation	Permanent 2020	2020		Permanent	4.1			
2021	71	Actual GPSd 3/	Temporary Vehicl	2021		Permanent	2.8			
2021	56	Proposed shap	Wind Fence	2021		Wind Fence	10.8			
2021	57	Proposed shap	Wind Fence	2021		Wind Fence	21.7			
2021	63	Proposed shap	Straw	2021		Permanent	5.6			
2021	64	Proposed shap	Straw	2021		Permanent	5.0			
2021	65	Proposed	Seed	2021		Permanent	4.2			
2021	66	Proposed	Seed	2021		Permanent	4.0			
2021	67	Proposed	Seed	2021		Permanent	18.4			
2021	68	Actual GPSd 3/	Straw	2021		Permanent	4.7			
2021	69	Actual GPSd 3/	Straw	2021		Permanent	5.5			
2021	70	Actual GPSd 3/	Temporary Vehicl	2021		Permanent	3.2			
2021	72	Actual GPSd 3/	Straw	2021		Permanent	6.5			



Tamar Carmonia, Parks

2013 Emissions: reduction per treatment area - 10 baseline days

		Riding and non-riding areas				Riding areas only			
Year Implem	Area treated [Acres]	Emissions [Metric Tons/day	Abatement [Metric Tons/day]	Cumulative Abatement [Met	Cumulative Abatement [%]	Emissions [Metric Tons/day]	Abatement [Metric Tons/day]	Cumulative Abatement [Metric Tons/day]	Cumulative Abatement [%]
2011	1.1	243.5	0.0	0.0	100.0	182.8	0.0	0.0	100.0
2012	0.0	243.5	0.0	0.0	100.0	182.8	0.0	0.0	100.0
2013	0.3	243.5	0.0	0.0	100.0	182.8	0.0	0.0	100.0
2013	0.1	243.5	0.0	0.0	100.0	182.8	0.0	0.0	100.0
2014	0.0	243.5	0.0	0.0	100.0	182.8	0.0	0.0	100.0
2014	28.0	242.2	1.3	1.3	99.5	182.8	0.0	0.0	100.0
2015	0.0	242.2	0.0	1.3	99.5	182.8	0.0	0.0	100.0
2016	0.0	242.2	0.0	1.3	99.5	182.8	0.0	0.0	100.0
2016	0.0	242.2	0.0	1.3	99.5	182.8	0.0	0.0	100.0
2017	0.0	242.2	0.0	1.3	99.5	182.8	0.0	0.0	100.0
2017	2.6	240.8	1.5	2.8	98.9	182.8	0.0	0.0	100.0
2017	9.4	239.4	1.3	4.1	98.3	181.4	1.4	1.4	99.2
2018	0.0	239.4	0.0	4.1	98.3	181.4	0.0	1.4	99.2
2018	23.5	234.9	4.5	8.7	96.4	176.7	4.7	6.1	96.7
2018	2.2	233.8	1.0	9.7	96.0	175.6	1.1	7.1	96.1
2018	8.0	232.9	1.0	10.6	95.6	174.7	1.0	8.1	95.6
2018	8.8	231.9	1.0	11.6	95.2	173.7	1.0	9.1	95.0
2018	26.8	228.0	4.0	15.6	93.6	169.6	4.1	13.2	92.8
2018	5.4	227.0	1.0	16.6	93.2	168.5	1.0	14.2	92.2
2019	19.3	223.7	3.3	19.8	91.9	165.2	3.4	17.6	90.4
2019	9.9	221.9	1.8	21.7	91.1	163.3	1.9	19.5	89.3
2019	19.4	218.7	3.2	24.8	89.8	160.0	3.3	22.8	87.5
2020	21.0	216.4	2.3	27.1	88.9	158.0	2.1	24.8	86.4
2020	2.6	214.4	2.0	29.1	88.1	155.9	2.1	26.9	85.3
2020	0.2	213.9	0.6	29.7	87.8	155.3	0.6	27.5	85.0
2021	2.9	213.2	0.7	30.3	87.5	154.6	0.7	28.2	84.6
2021	10.7	211.1	2.1	32.5	86.7	152.4	2.2	30.4	83.4
2021	21.5	208.3	2.8	35.3	85.5	149.6	2.9	33.2	81.8
2021	5.8	207.7	0.6	35.9	85.3	148.9	0.6	33.9	81.5
2021	5.1	207.1	0.6	36.4	85.0	148.3	0.6	34.5	81.1
2021	4.4	206.9	0.2	36.7	84.9	148.3	0.0	34.5	81.1
2021	4.0	206.7	0.2	36.9	84.9	148.3	0.0	34.5	81.1
2021	17.9	205.8	0.9	37.8	84.5	148.3	0.0	34.5	81.1
2021	4.2	205.3	0.5	38.2	84.3	147.9	0.5	34.9	80.9
2021	5.4	204.4	1.0	39.2	83.9	146.9	1.0	35.9	80.3
2021	3.2	203.6	0.8	39.9	83.6	146.1	0.8	36.7	79.9
2021	6.0	202.8	0.8	40.8	83.3	145.2	0.8	37.6	79.4

Riding and non-riding Area: 83.3%

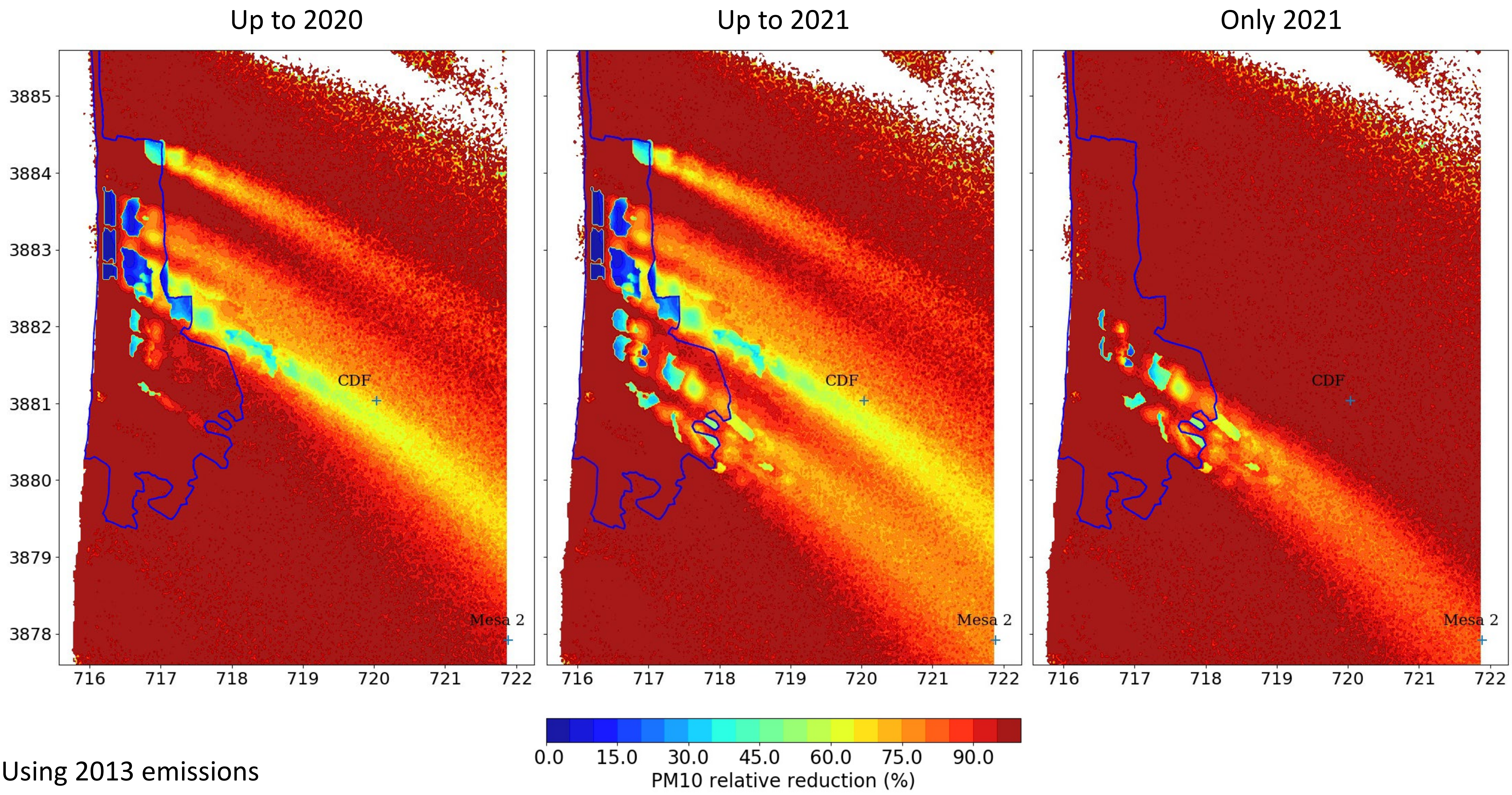
Riding area: 79.4%

2019 Emissions: reduction per treatment area - 10 baseline days

Year Implemented	Area treated [Acres]	Riding and non-riding areas: Emissions [Metric Tons/day]	Riding and non-riding areas: Abatement [Metric Tons/day]	Riding and non-riding areas: Cumulative Abatement [Metric Tons/day	Riding and non-riding areas: Cumulative Abatement [%]	Riding areas only: Emissions [Metric Tons/day]	Riding areas only: Abatement [Metric Tons/day]	Riding areas only: Cumulative Abatement [Metric Tons/day]	Riding areas only: Cumulative Abatement [%]
2011	1.1	227.73	0.000	0.000	100.000	159.71	0.000	0.000	100.000
2012	0.0	227.73	0.000	0.000	100.000	159.71	0.000	0.000	100.000
2013	0.3	227.70	0.026	0.026	99.988	159.71	0.000	0.000	100.000
2013	0.1	227.69	0.007	0.034	99.985	159.71	0.000	0.000	100.000
2014	0.0	227.69	0.000	0.034	99.985	159.71	0.000	0.000	100.000
2014	28.0	226.39	1.302	1.336	99.413	159.71	0.000	0.000	100.000
2015	0.0	226.39	0.000	1.336	99.413	159.71	0.000	0.000	100.000
2016	0.0	226.39	0.000	1.336	99.413	159.71	0.000	0.000	100.000
2016	0.0	226.39	0.000	1.336	99.413	159.71	0.000	0.000	100.000
2017	0.0	226.39	0.000	1.336	99.413	159.71	0.000	0.000	100.000
2017	2.6	225.01	1.384	2.720	98.806	159.71	0.000	0.000	100.000
2017	9.4	223.19	1.819	4.539	98.007	157.83	1.878	1.878	98.824
2018	0.0	223.19	0.000	4.539	98.007	157.83	0.000	1.878	98.824
2018	23.5	218.22	4.964	9.503	95.827	152.70	5.126	7.004	95.614
2018	2.2	217.11	1.118	10.621	95.336	151.55	1.154	8.158	94.892
2018	8.0	216.52	0.588	11.209	95.078	150.94	0.607	8.766	94.511
2018	8.8	215.27	1.243	12.452	94.532	149.66	1.283	10.049	93.708
2018	26.8	212.04	3.237	15.689	93.111	146.31	3.342	13.391	91.615
2018	5.4	211.44	0.597	16.286	92.849	145.70	0.617	14.007	91.229
2019	19.3	208.71	2.734	19.020	91.648	142.87	2.823	16.830	89.462
2019	9.9	207.28	1.423	20.443	91.023	141.41	1.469	18.299	88.542
2019	19.4	204.83	2.453	22.896	89.946	138.87	2.533	20.832	86.956
2020	21.0	203.29	1.538	24.434	89.270	137.55	1.321	22.154	86.128
2020	2.6	201.53	1.757	26.191	88.499	135.74	1.814	23.967	84.993
2020	0.2	201.04	0.496	26.687	88.281	135.23	0.512	24.479	84.672
2021	2.9	200.68	0.357	27.043	88.125	134.86	0.368	24.847	84.442
2021	10.7	199.16	1.520	28.564	87.457	133.29	1.570	26.417	83.459
2021	21.5	196.93	2.227	30.791	86.479	130.99	2.300	28.717	82.019
2021	5.8	196.41	0.522	31.313	86.250	130.45	0.539	29.256	81.681
2021	5.1	195.88	0.531	31.844	86.017	129.90	0.548	29.804	81.338
2021	4.4	195.62	0.258	32.102	85.903	129.90	0.000	29.804	81.338
2021	4.0	195.32	0.303	32.405	85.770	129.90	0.000	29.804	81.338
2021	17.9	194.32	0.998	33.403	85.332	129.90	0.000	29.804	81.338
2021	4.2	193.68	0.647	34.050	85.048	129.23	0.668	30.472	80.920
2021	5.4	193.31	0.365	34.415	84.888	128.86	0.377	30.849	80.684
2021	3.2	192.74	0.575	34.990	84.635	128.26	0.594	31.442	80.312
2021	6.0	192.22	0.517	35.507	84.408	127.73	0.534	31.976	79.978

Riding and non-riding Area: 84.4%

Riding area: 79.9%



Using 2013 emissions

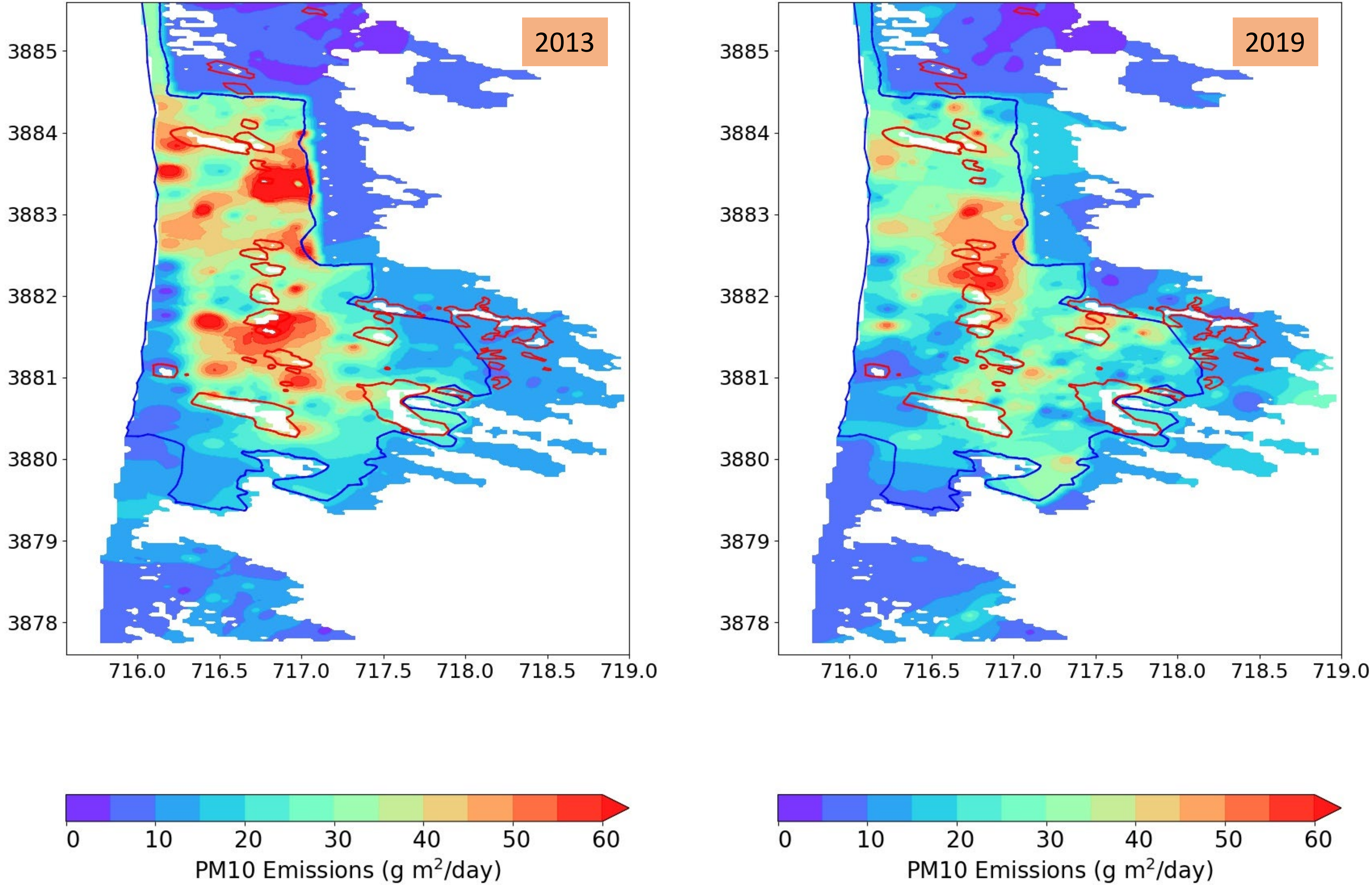
Concentration reductions (2013 emissions) Mean 15 May- 15 July & 10 baseline days

CDF

Concentration at CDF (24-hour means)	PM10 [microg/m^3]	% left after Removing
Observations	52.4	
Modeled Baseline	51.1	100.0
Modeled Removing 2011-2020	33.8	62.5
Modeled Removing 2011-2021	33.5	65.5
10 Highest Emission Days	PM10 [microg/m^3]	% left after Removing
Observations	128.2	
Modeled Baseline	124.7	100
Modeled Removing 2011-2020	72.4	58.1
Modeled Removing 2011-2021	72.2	57.9

Mesa 2

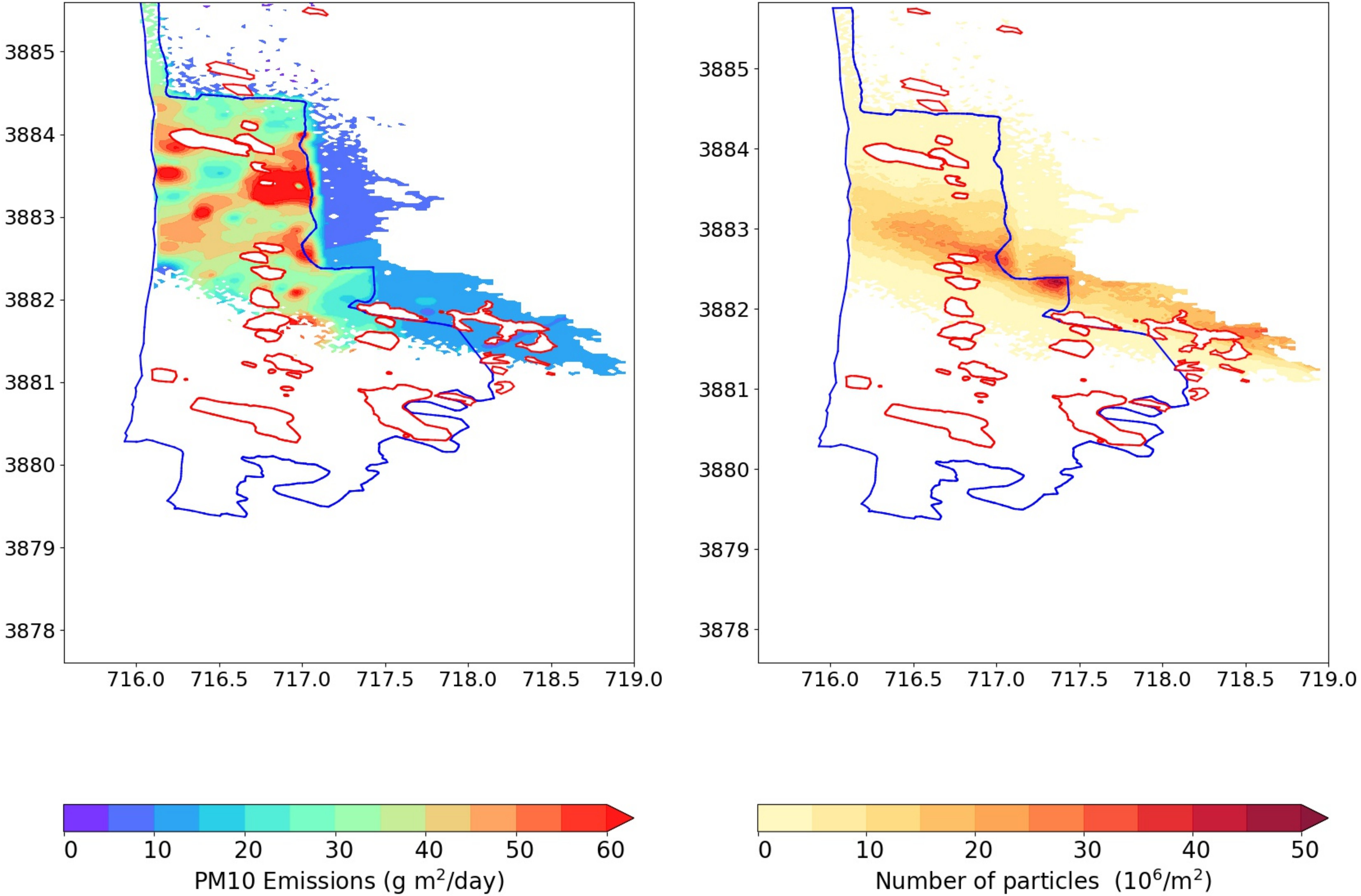
Concentration at Mesa 2 (24-hour means)	PM10 [microg/m^3]	% left after Removing
Observations	39.7	
Modeled Baseline	34.4	100.0
Modeled Removing 2011-2020	32.2	93.6
Modeled Removing 2011-2021	27.1	78.8
10 Highest Emission Days	PM10 [microg/m^3]	% left after Removing
Observations	95.4	
Modeled Baseline	97.5	100.0
Modeled Removing 2011-2020	91.2	93.6
Modeled Removing 2011-2021	73.8	75.8


2013
2019
3885
3884
3883
3882
3881
3880
3879
3878
716.0
716.5
717.0
717.5
718.0
718.5
719.0
0
10
20
30
40
50
60
PM10 Emissions (g m^2/day)

Baseline

2013 Emissions

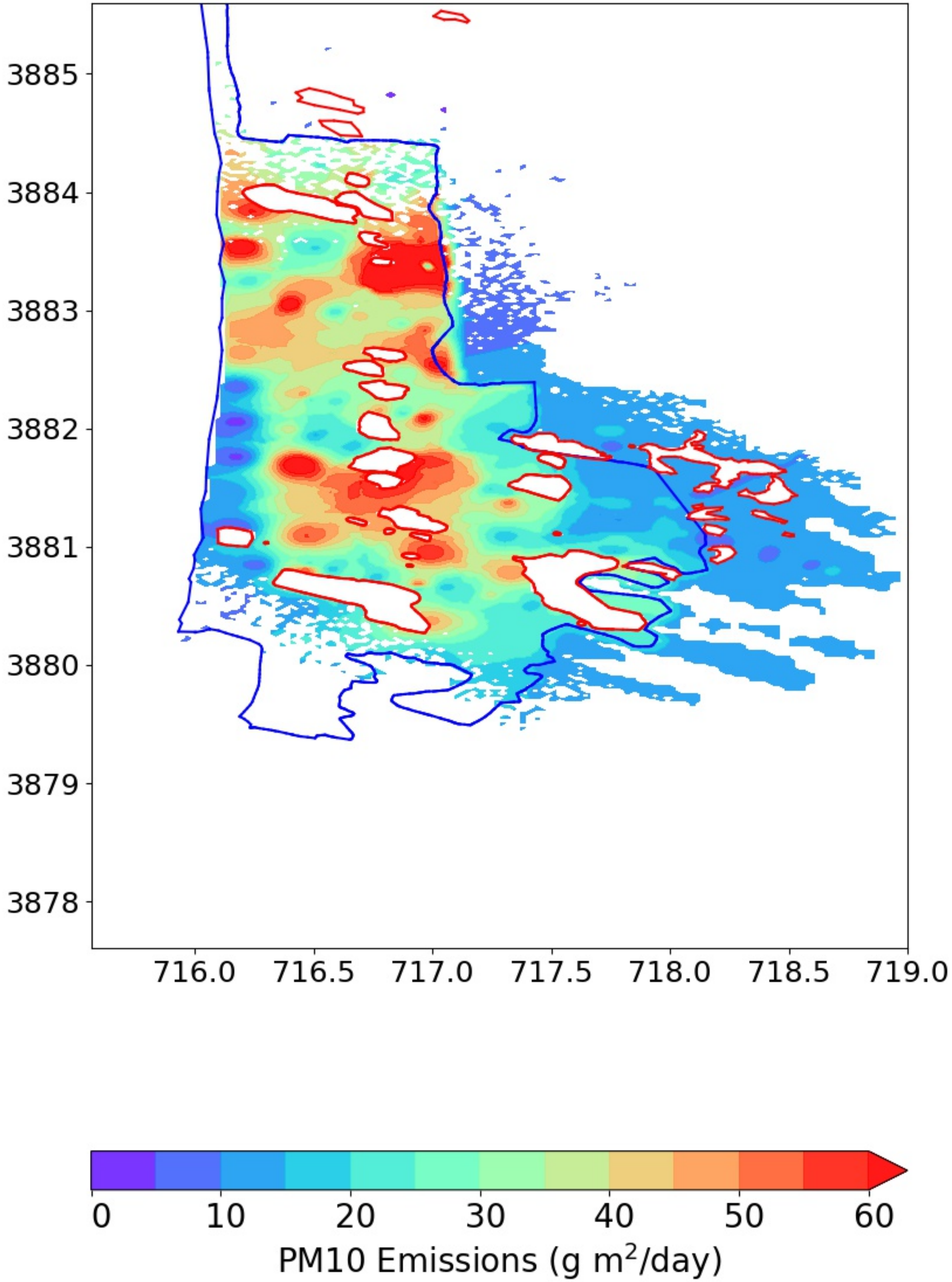
CDF

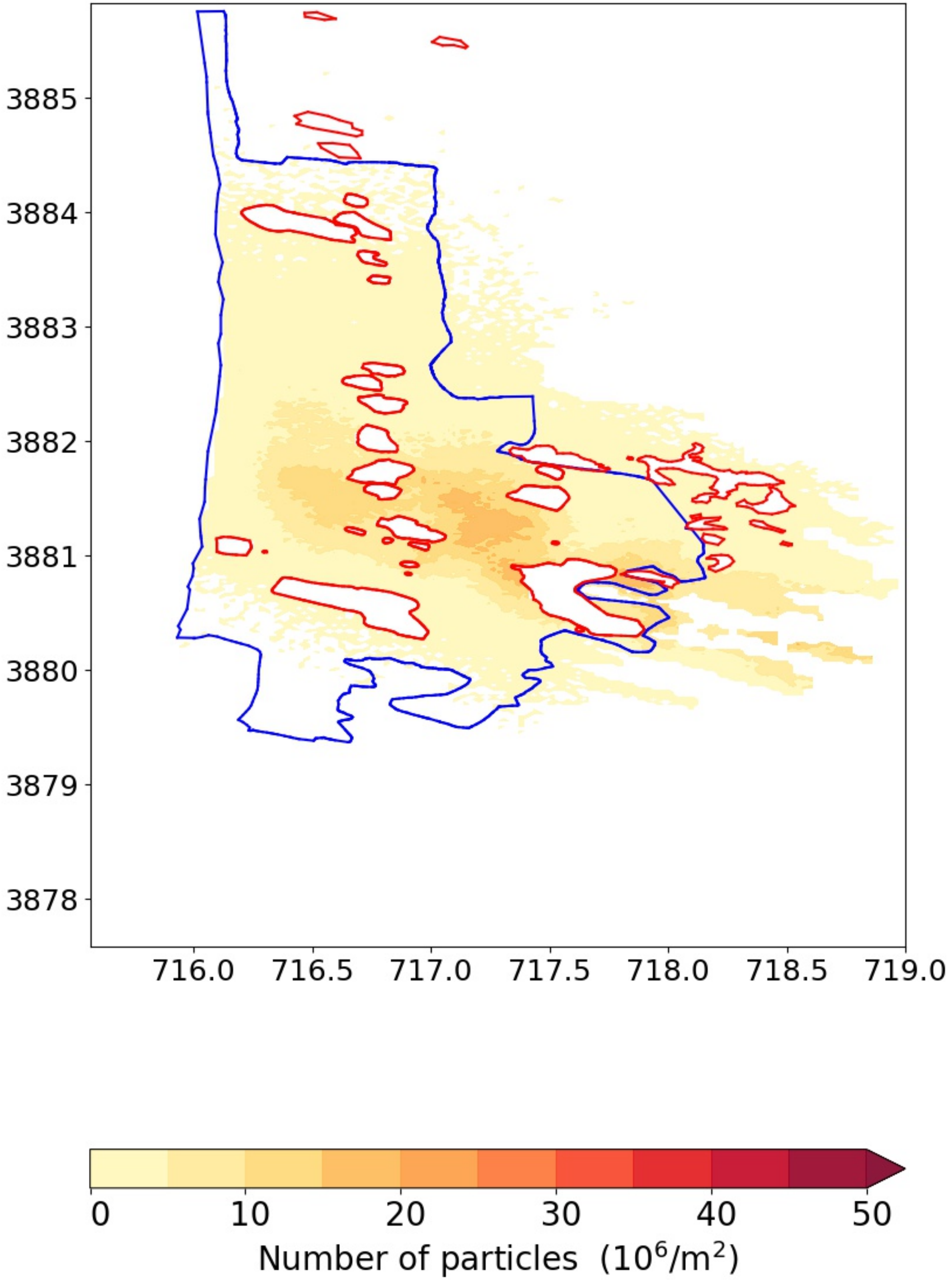


Baseline

2013 Emissions

Mesa 2

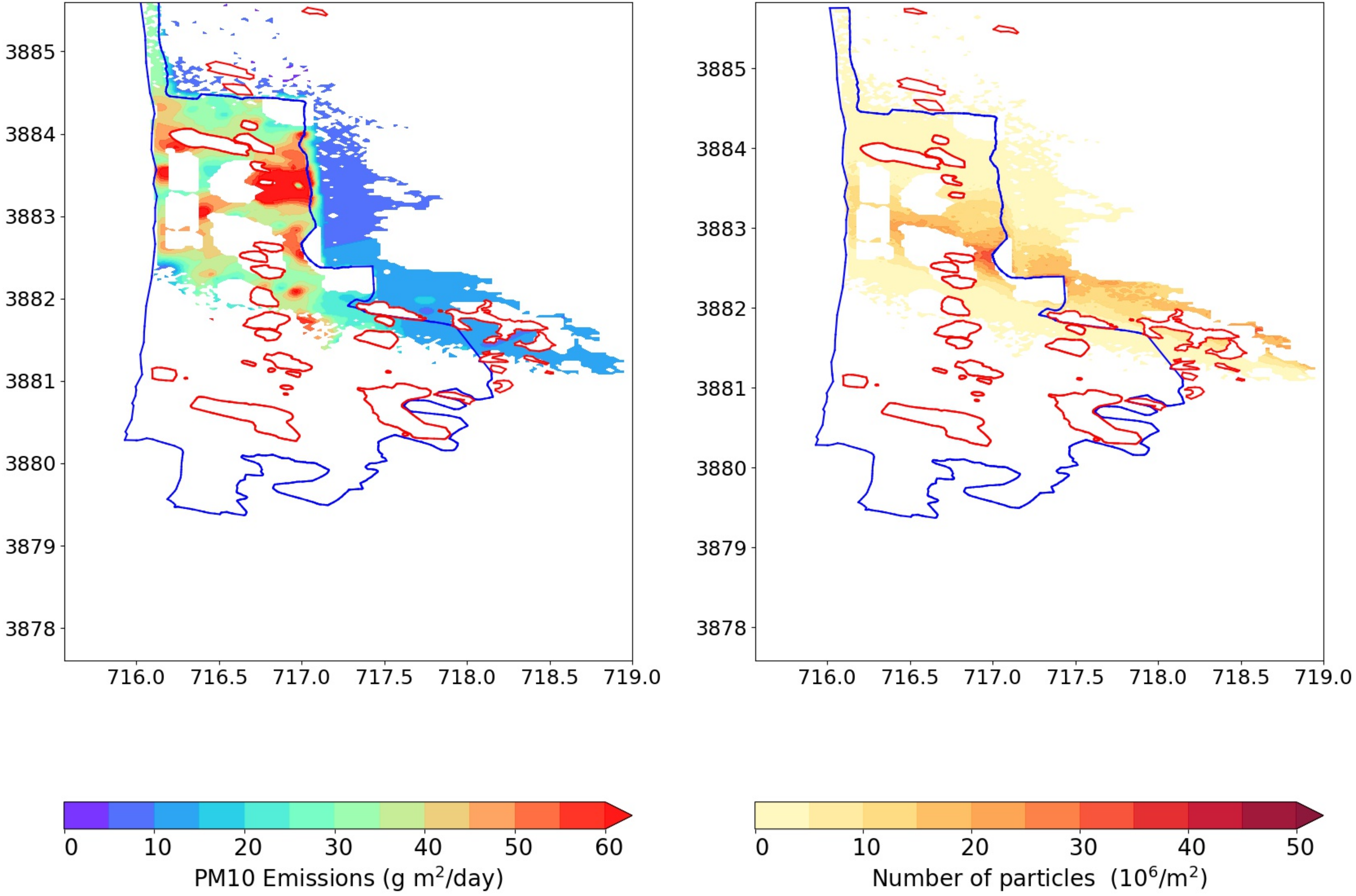




2021 treatment

2013 Emissions

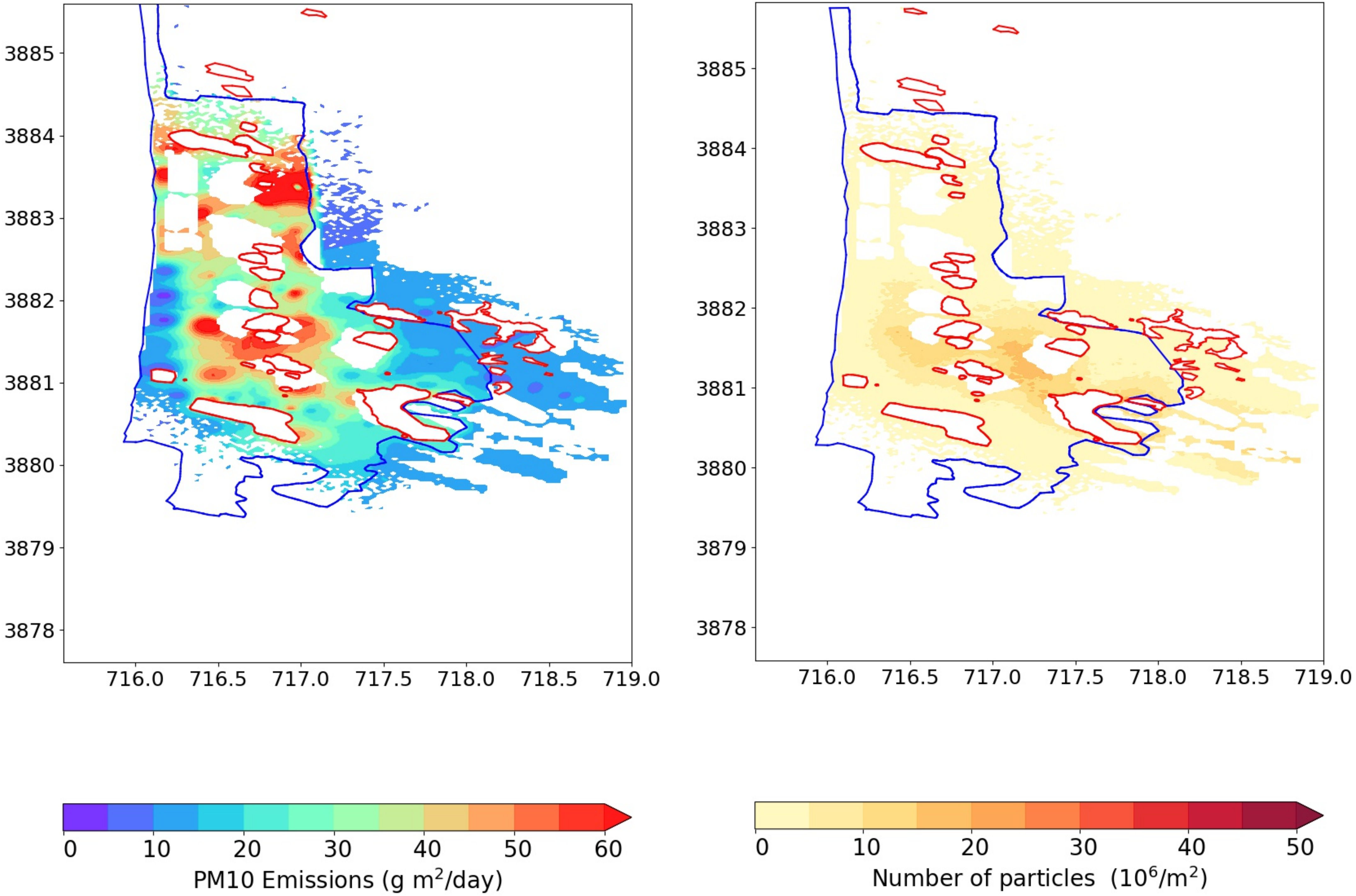
CDF



2021 treatment

2013 Emissions

Mesa 2



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Oceano Dunes State Vehicular Recreation Area Dust Control Program

DRAFT 2021 Annual Report and Work Plan

ATTACHMENT 04

Increments of Progress Towards Air Quality Objectives, 2013 – 2020 (prepared by DRI)

Wind and PM_{10} Relations Between May/June 2019 and May/June 2020 (prepared by DRI)

California Geological Survey Analysis of May and June Wind Strength Year to Year and State PM10 Exceedances with and without OHV Recreation, Oceano Dunes SVRA

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Increments of Progress Towards Air Quality Objectives, 2013 – 2020 (Prepared by DRI)

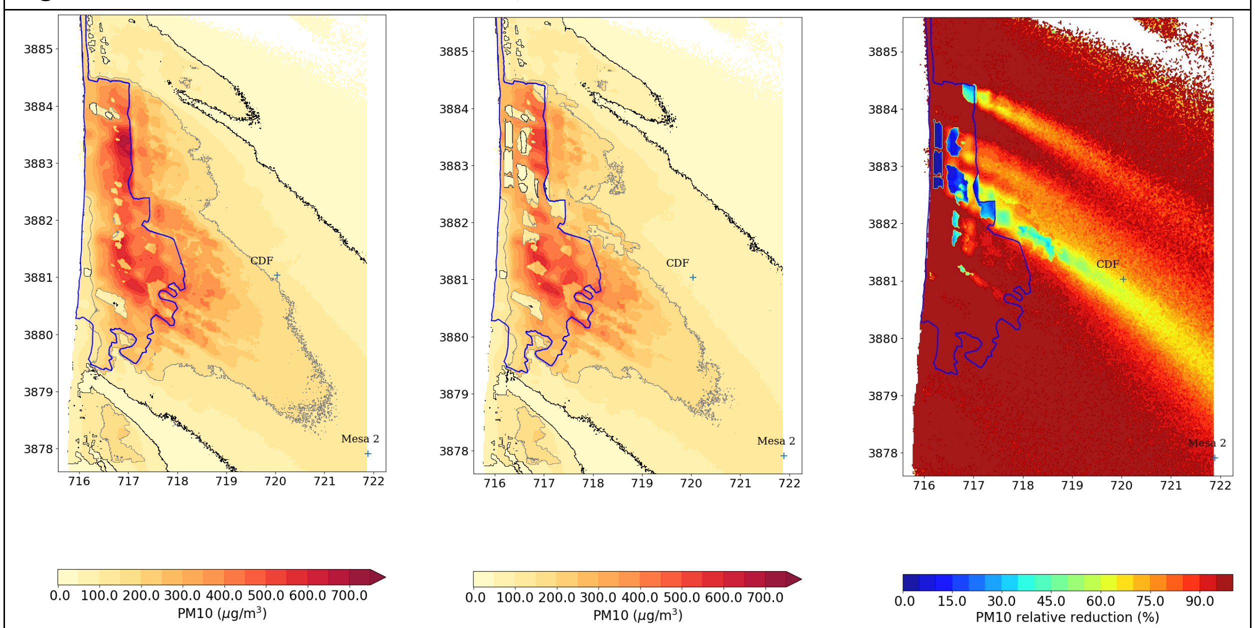
Wind and PM_{10} Relations Between May/June 2019 and May/June 2020 (Prepared by DRI)

Analysis of May and June Wind Strength Year to Year and State PM10 Exceedances with and without OHV Recreation, Oceano Dunes SVRA (prepared by CGS)

Increments of Progress Towards Air Quality Objectives

Dust control measures have been used within Oceano Dunes SVRA to reduce mass emissions of PM_{10} originating from within the Park, primarily from within the Park's open riding and camping area. These controls are also expected to lower the regional PM_{10} burden and help meet SOA goals. As of July 31, 2020, approximately 223 acres of dust control measures were installed at Oceano Dunes SVRA. According to emission and dispersion modeling undertaken by DRI, the 223 acres reduce baseline modeled PM_{10} at the CDF station by approximately 42% (see Figure A).

Figure A: PM_{10} Concentration Reductions, 2013 to 2020



The modeled PM_{10} concentration maps for ten baseline days during 2013 with no controls (left panel) and 2020 controls (middle panel). The right panel shows a PM_{10} percent change between 2013 and 2020 resulting from reducing emissions created by dust controls. The black line in the left and center panel surrounds the area wherein the 24-hour mean PM_{10} concentration is >50 μg m^{-3}, above the State standard; the grey line surrounds the area wherein the 24 hours mean PM_{10} concentration is >150 μg m^{-3}, above the Federal standard.

Measurements of PM_{10} at CDF and wind speed at the S1 tower in Oceano Dunes SVRA are demonstrate that the dust emission system in locations where controls have been placed produces less PM10 than prior to these controls. This reduction is consistent with the increase in acres of dust control. The analysis of observational data also converges with model results that indicate PM_{10} reduction at the CDF receptor site is due to the dust controls.

Hourly wind speed measured at the S1 tower was converted to Wind Power Density (W m^{-2}) by the relation:

WPD = air density×(wind speed^3).

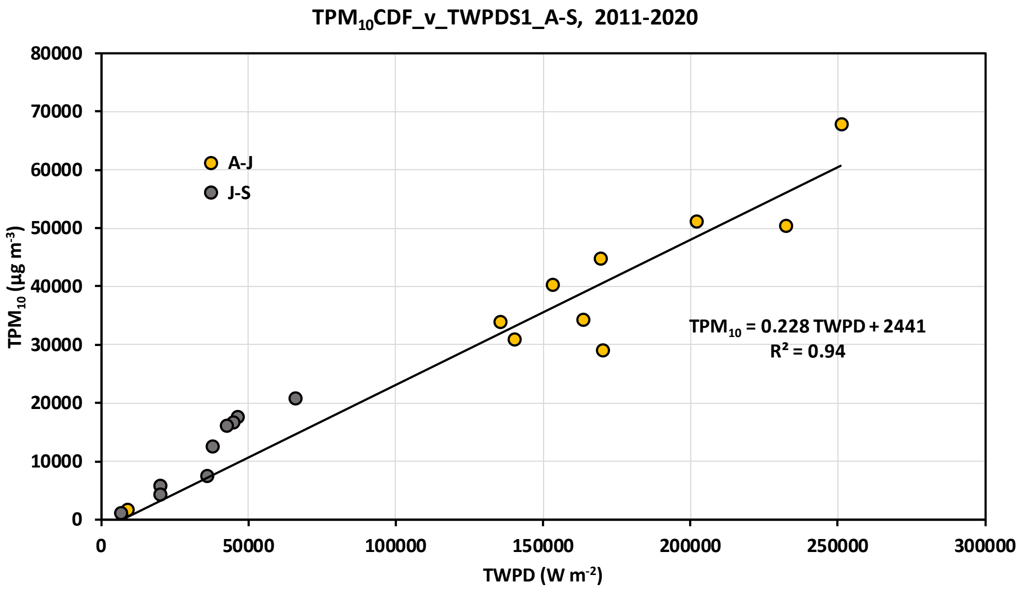
Wind Power Density is a measure of the ability of the wind to cause sand to saltate and emit dust and suspended particulate matter (PM_{10}). Totals (i.e., summations) of WPD (TWPD) and PM_{10} concentration (TPM_{10}) relate total wind energy in a specific period with total PM_{10} generated in that same period.

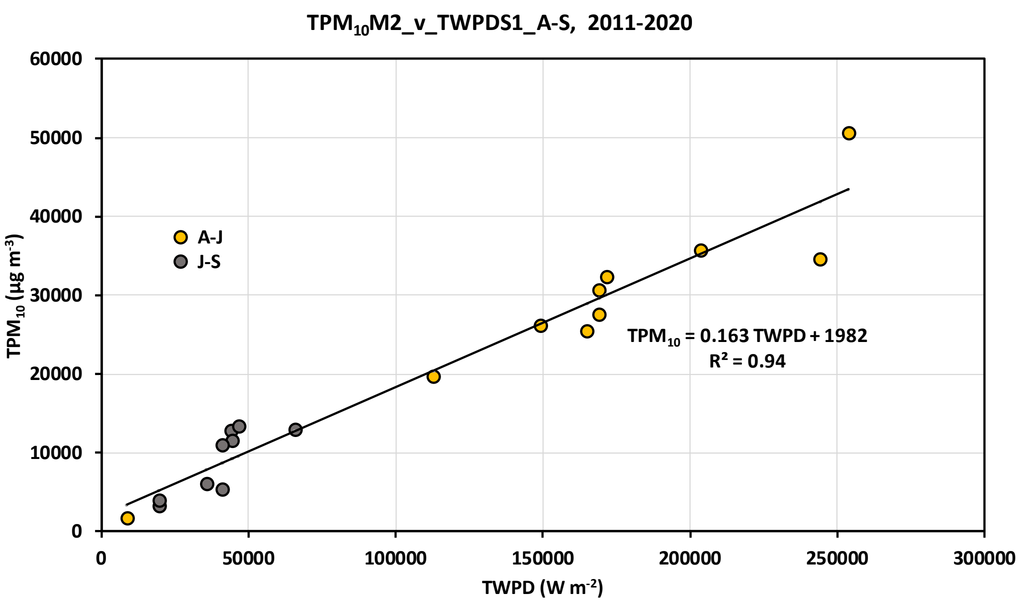
Since the strength of the relation between TPM_{10} and TWPD observed at monitoring stations in and exterior to Oceano Dunes SVRA (see Figure B), their ratio can serve as a metric to evaluate how landscape changes change the dust emission system. With no surface changes where the emissions originate, this ratio will reflect the efficiency of the wind and saltation system to generate PM_{10} for the prevailing environmental conditions during the period. If, however, the surface from which the emissions originate is systematically being altered—by altering the size of the source area by applying dust controls, for example—the ratio should diminish as more area is removed from dust production. For an equivalent WPD, there should be less PM_{10} produced because of the reduction in source area size.

Based on the number of acres of dust control established from 2011 through 2020 shows that there has been a downward trend in the TPM_{10} to TWPD ratio for the April through September period, with increasing amounts of dust control acreage. It suggests that emplacement of dust controls upwind of CDF reduced PM_{10} production by 48% for equivalent WPD with the controls in place in 2020 compared with the no-control conditions of 2011–2013 (see Figure C). It is consistent with the 42% reduction in mean PM_{10} at CDF predicted by the particle dispersion model with the 223 acres set to zero emissions for the 2013 baseline wind conditions.

See Figure D for the TPM_{10} to TWPD ratio for Mesa2 and S1 data for April through September as a function of acres of dust control. These data show that, unlike CDF, there has been no clear downward trend in the ratio with increasing acres of dust control. Considering only the difference in the TPM_{10}:TWPD ratio between 2011–2013 and 2020, it could be argued that there has been an 11% decrease in PM_{10} dust production in 2020, which is in line with the dispersion modeling results shown that indicate PM_{10} levels at Mesa2 decrease by approximately 7% (compared to the 42% modeled reduction at CDF) with the 2020 dust controls in place.

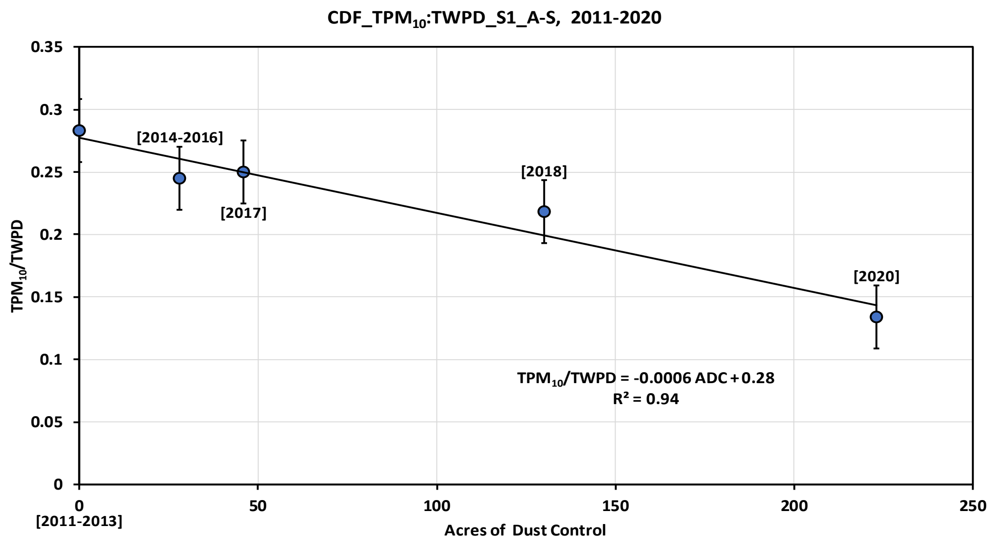
Figure B: TPM_{10} as a Function of S1 WPD





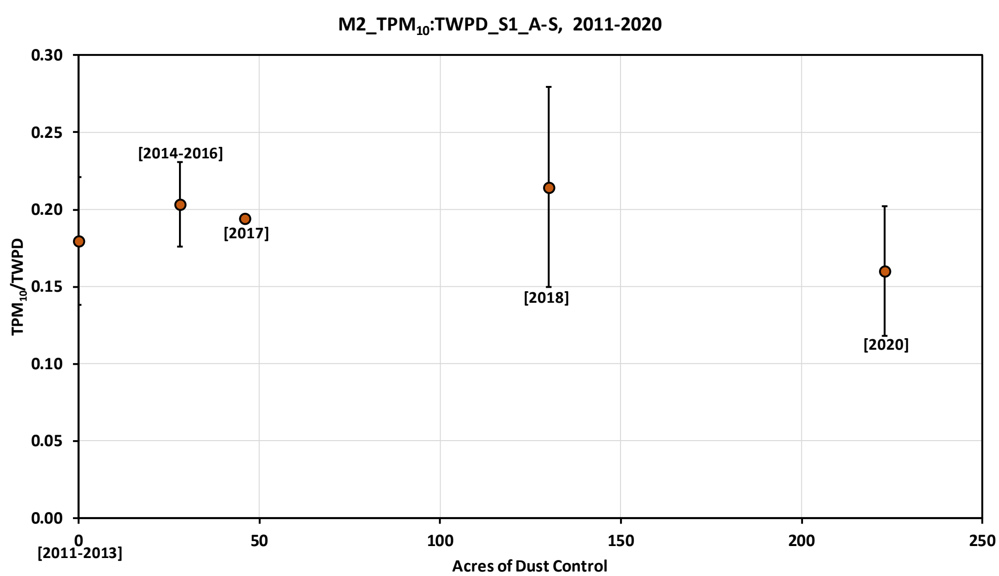
Total PM_{10} as a function of total WPD for the combined spring (A–J, yellow circles) and summer period (J–S, grey circles) for CDF and S1 tower (top panel) as well as Mesa2 and S1 tower (bottom panel) based on available data from 2011-2020.

Figure C: TPM_{10}: TPWD Ratio and Dust Control Acres, April to September 2020 (CDF)



The relationship between the TPM_{10}: TWPD ratio and acres of dust control for CDF total PM_{10} data and the S1 total WPD data from 2011-2020 for the April through September period. Dates for the amounts of acres of dust control are shown in parentheses, and the error bars represent the Standard Error (std d/(#obs-1)$^{0.5}$).

Figure D: TPM_{10}: TPWD Ratio and Dust Control Acres, April to September 2020 (Mesa2)



The relation between the TPM_{10}: TWPD ratio and acres of dust control for Mesa2 from 2011 to 2020 (April through September). Dates for the dust control acreage are shown in parentheses, and the error bars represent the Standard Error.

Increments of Progress

J. Gillies, E. Furtak-Cole, J. Mejia, V. Etyemezian,
Desert Research Institute
January 5, 2021

Desert Research Institute

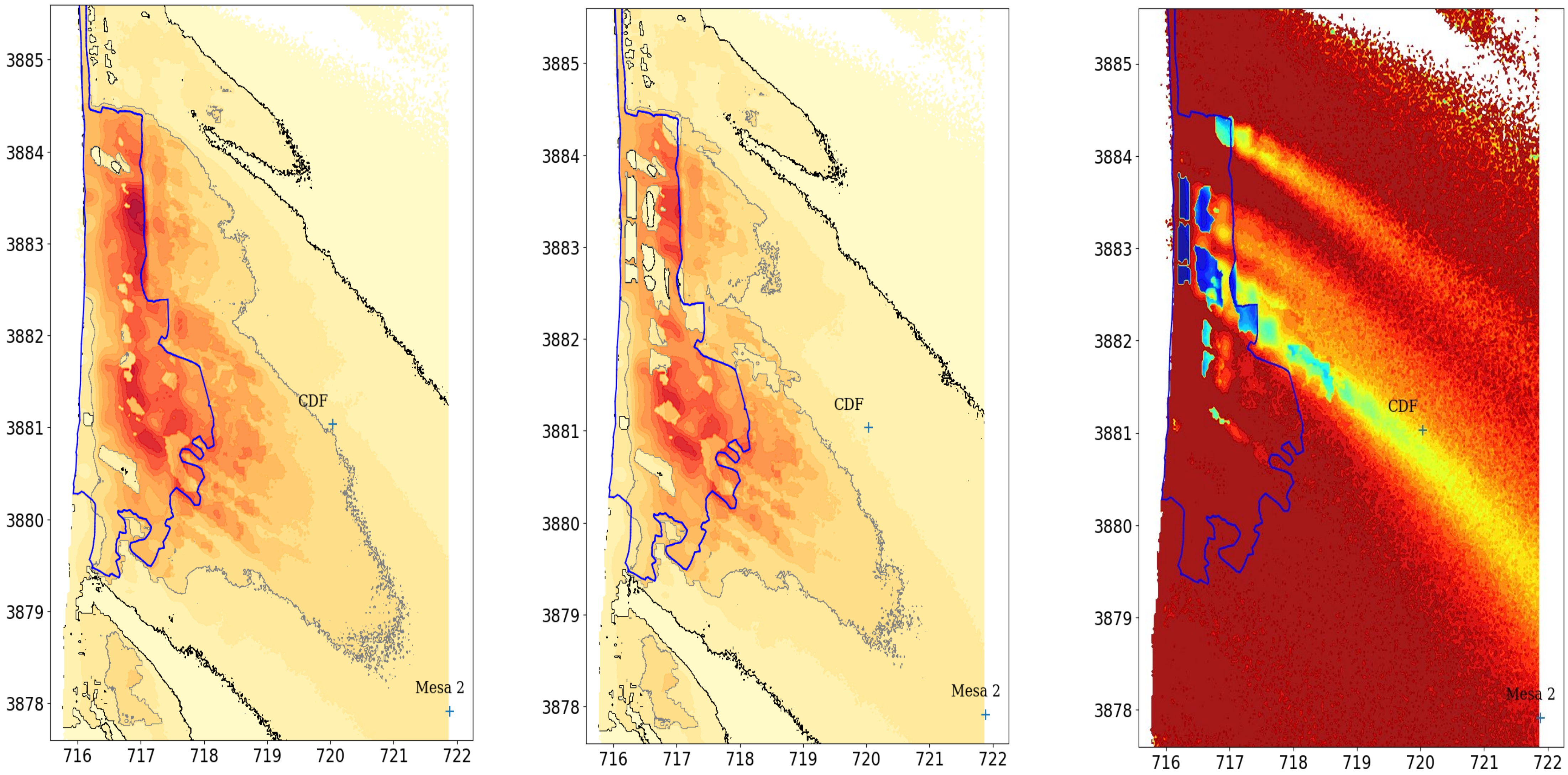
Increments of Progress Demonstrating Progress to Achieving SOA Goals

Reduce PM_{10} mass emissions ($mg\ m^{-2}\ s^{-1}$) by 50%

Reduce PM_{10} levels across the area downwind of the ODSVRA and exceedances of the Federal and State 24-hour mean PM_{10} standards

Beginning in 2014, 28 acres of dust controls were implemented, and the acreage has increased to 223 acres in 2020.

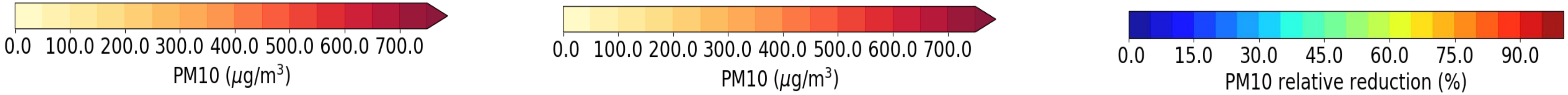
According to emission and dispersion modeling undertaken by DRI, the 223 acres reduces PM_{10} measured at the CDF monitoring station



2013 No controls

2020 Controls

PM_{10} percent change between 2013 and 2020



Do air quality and meteorological data corroborate the model results?

Can incremental progress in improved air quality be demonstrated from 2013 to 2020 from the dust control actions?

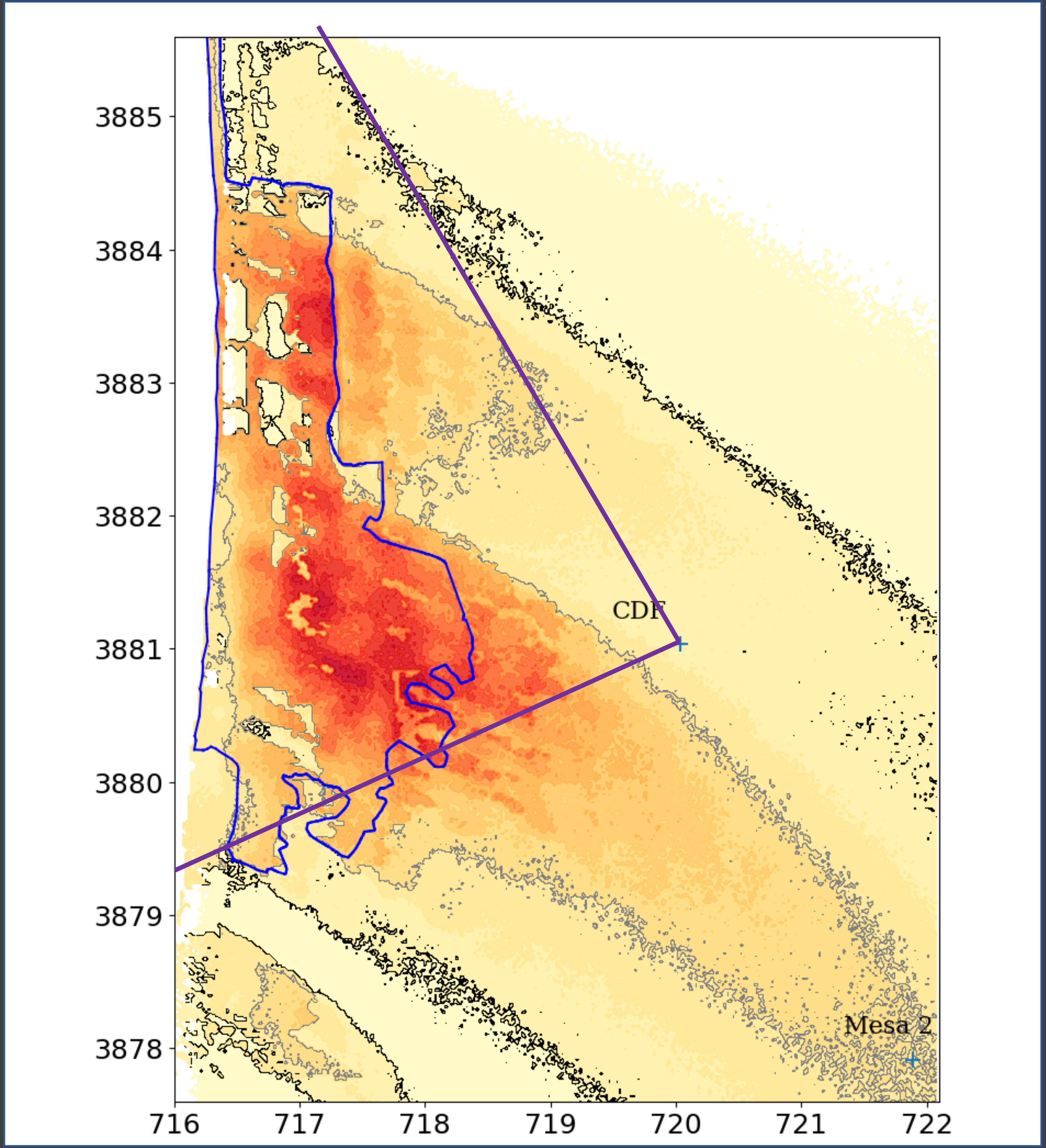
Available data:

Hourly mean PM_{10} from CDF and Mesa2

Hourly meteorological data (hourly mean wind speed and wind direction) from CDF, Mesa2, and S1 tower (within the ODSVRA)

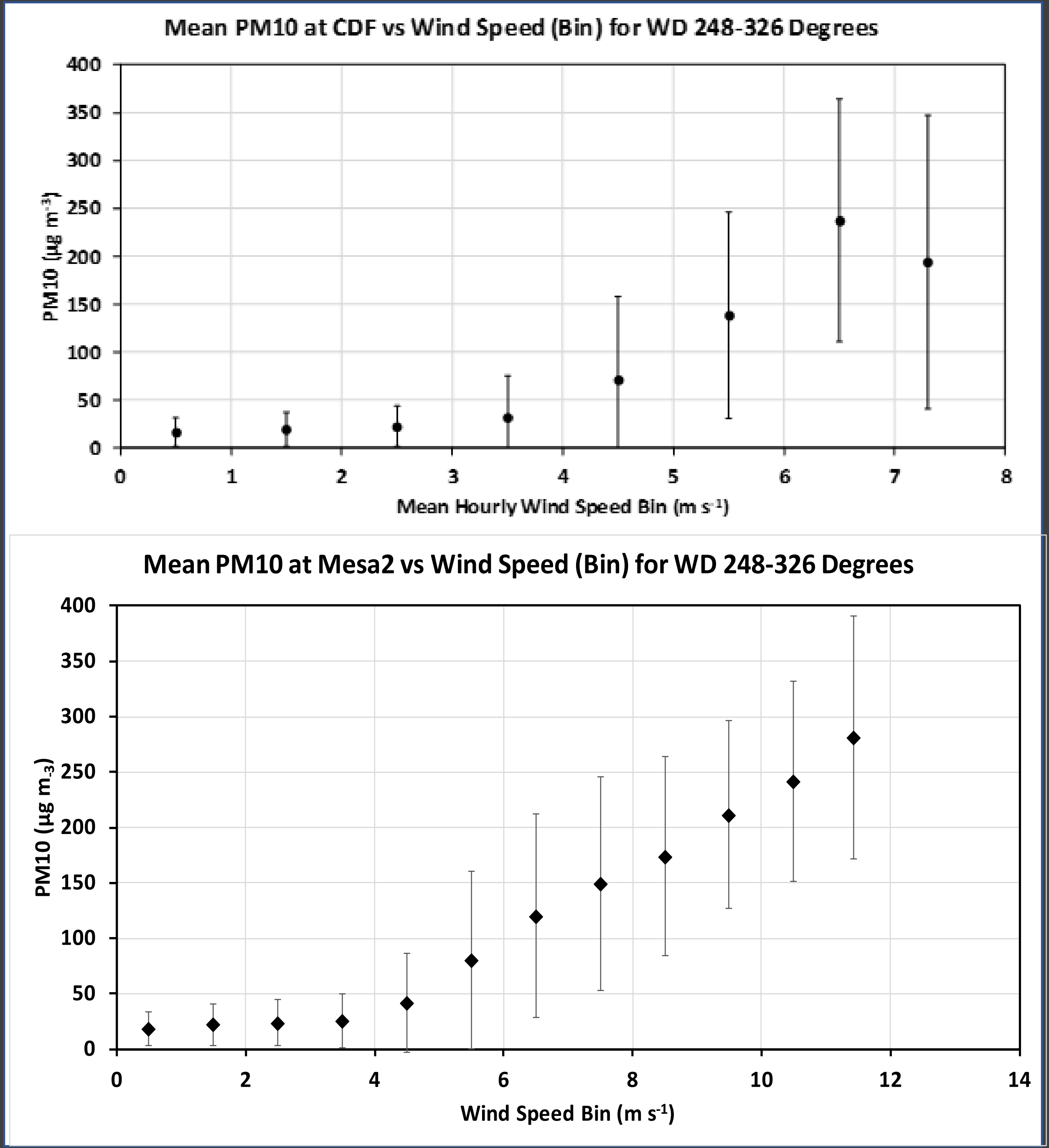
Methods

- **Assumptions:**
- **1) Winds from 248° to 326 ° are used to ensure, conservatively, that the air flow that reaches CDF and Mesa2 has most likely travelled from the ODSVRA**



Methods

- **Assumptions:**
- **2) A wind speed filter is applied based on screening for the conditions where it is most likely that the PM_{10} reaching CDF and Mesa2 is due to the generation of dust by the saltation process within the ODSVRA.**
- **CDF and Mesa2: ≥4.5 m/s; S1 ≥8 m/s**



Methods

- Assumptions:
- 3) Eliminate hourly wind speed and the corresponding PM_{10} data for that hour if there has been a precipitation event from one to three days prior to the measurement

Analysis

- Calculate Wind Power Density (WPD) for each (filtered) hour

WPD = air density (kg/m^3) x wind speed^3 (m/s)=Watts/m^2

Analysis

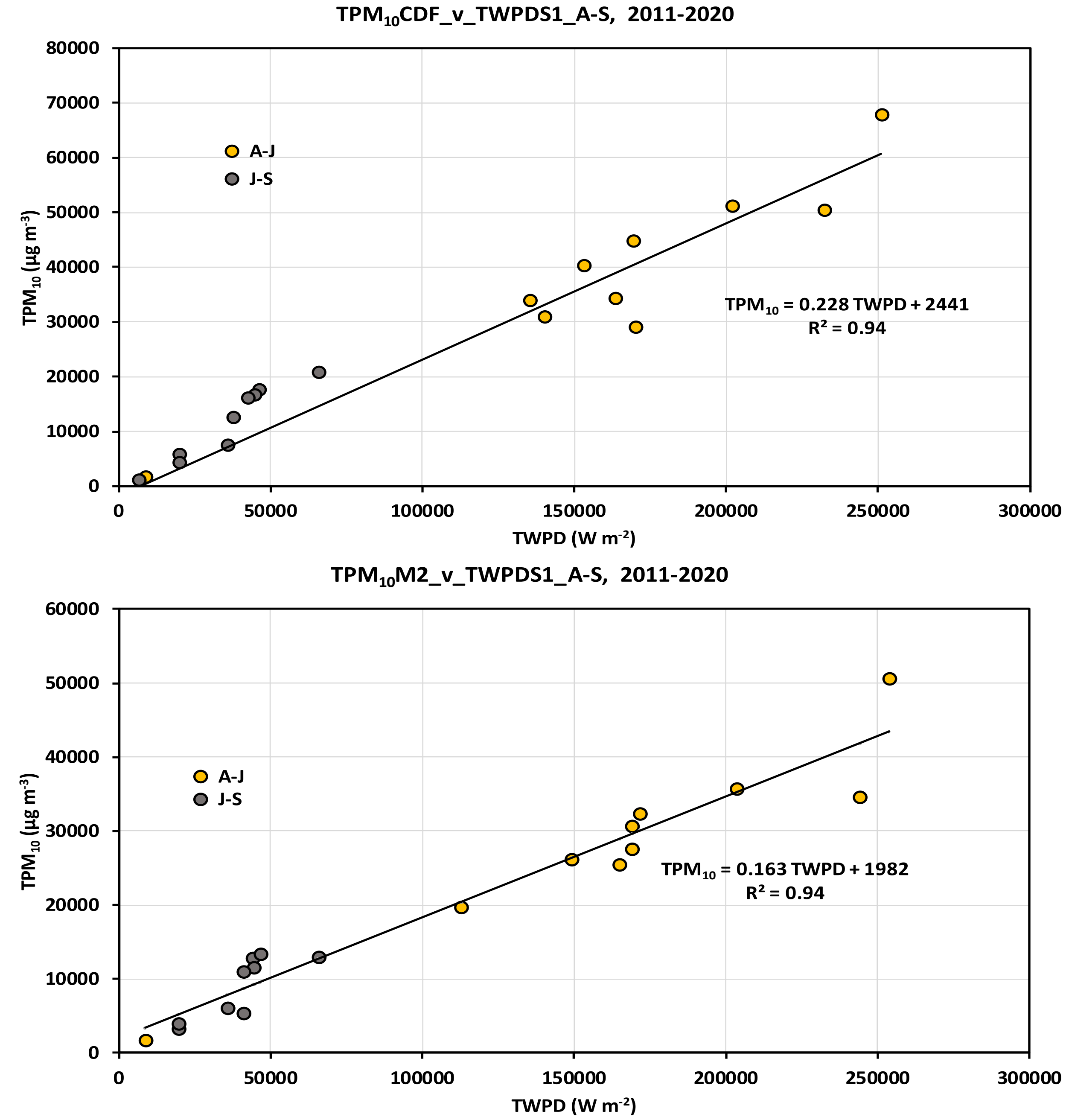
Calculate the sum of hourly WPD for the periods of interest (April-June and July-September [filters applied])

Calculate the sum of PM_{10} hourly concentration for the matching hours in the same periods of interest

$$Total\ WPD = \sum_{End\ Hour}^{Begin\ Hour} Hourly\ WPD$$

$$Total\ PM_{10} = \sum_{End\ Hour}^{Begin\ Hour} Hourly\ PM_{10}$$

Results



TPM10CDF_v_TWPDS1_A-S, 2011-2020
A-J
J-S
TPM10 = 0.228 TWPD + 2441
R² = 0.94
TPM10 (µg m-3)
TWPD (W m-2)
TPM10M2_v_TWPDS1_A-S, 2011-2020
A-J
J-S
TPM10 = 0.163 TWPD + 1982
R² = 0.94
TPM10 (µg m-3)
TWPD (W m-2)

Results

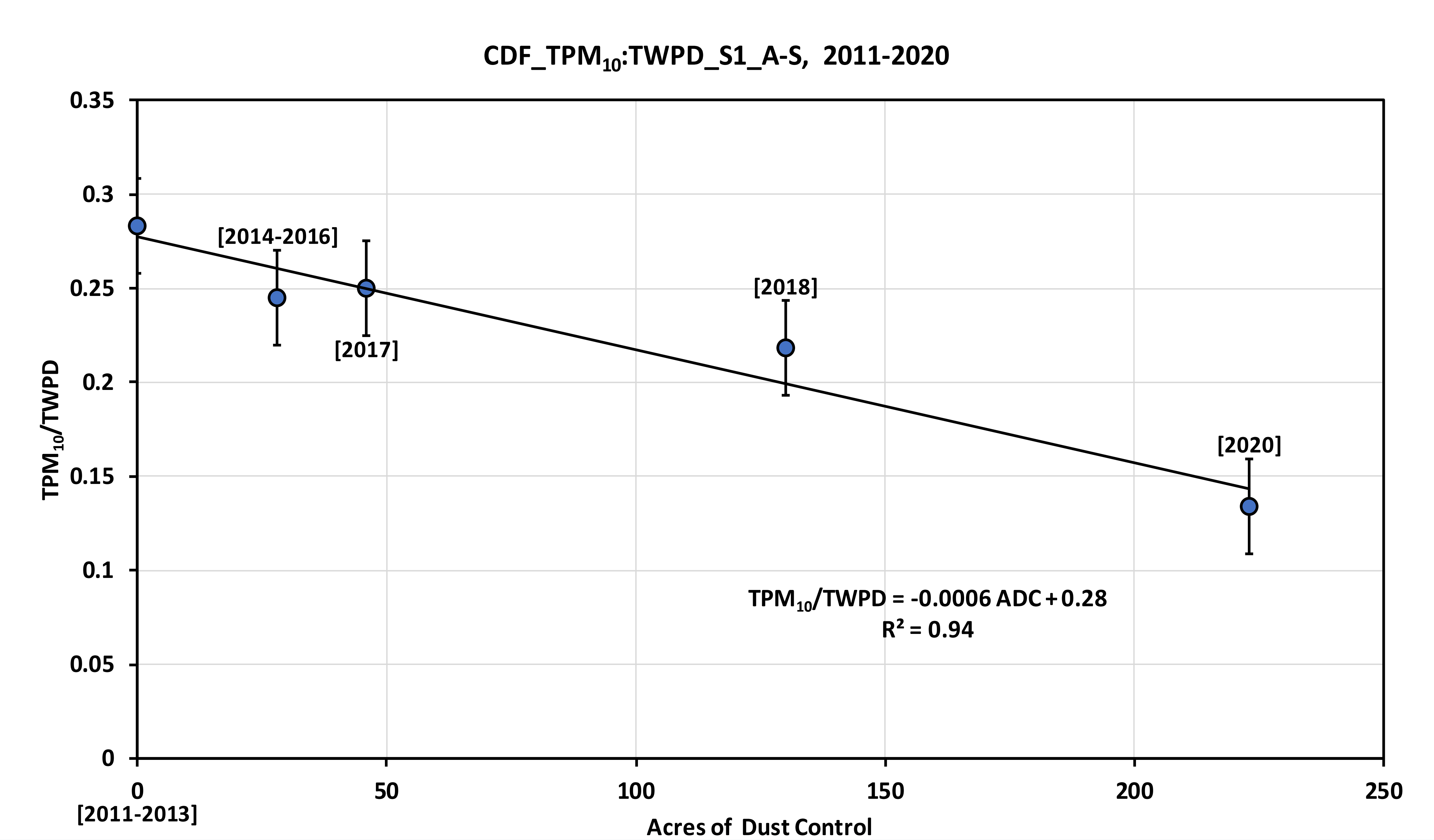
Because of the strength of the relation between TPM_{10} and TWPD, their ratio can serve as a metric to evaluate how the dust emission system is changed by landscape changes.

Constant ratio through time: no change in dust emission system

Changing ratio through time: change in dust emission system through time

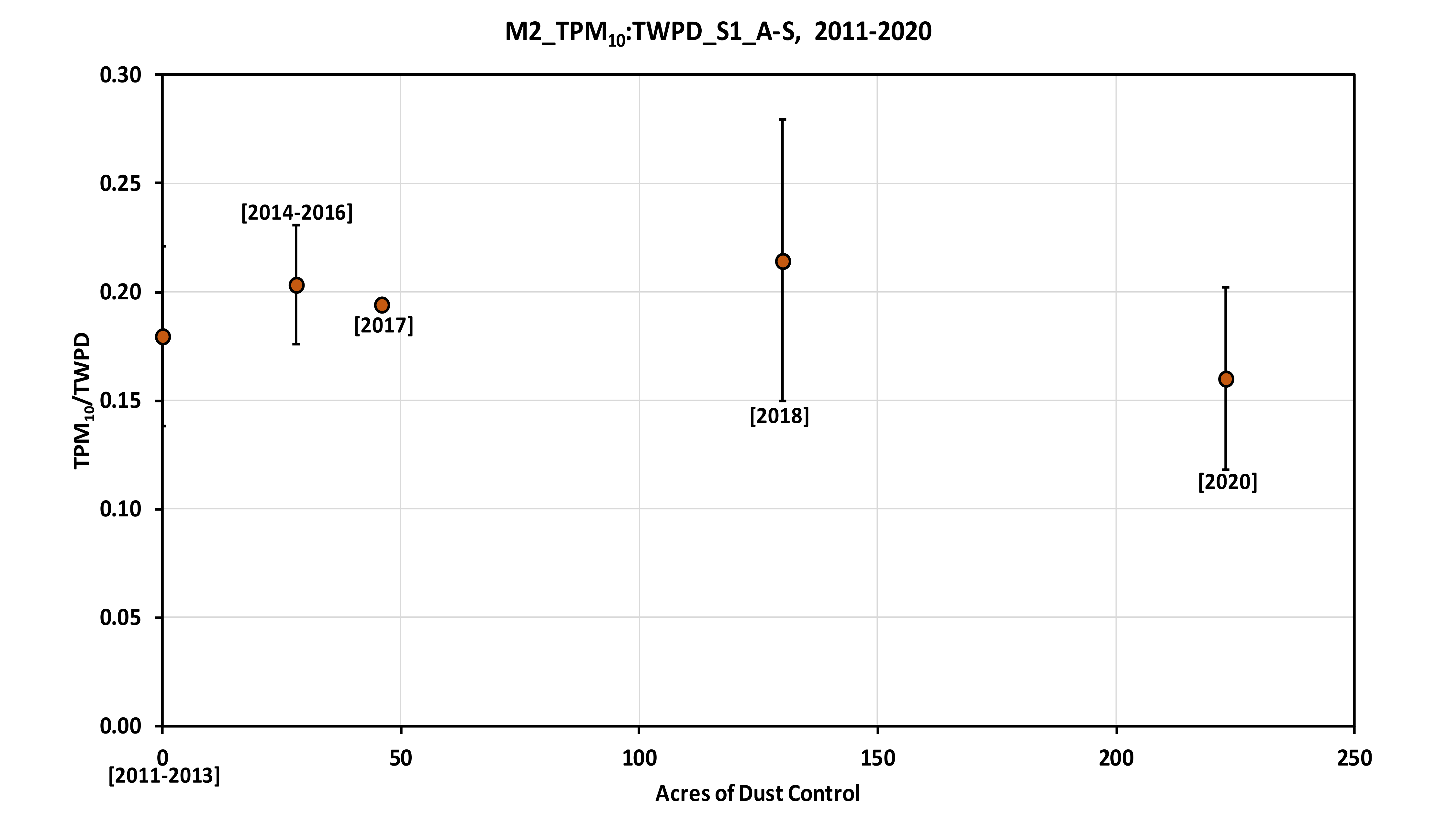
Why change?: 1) reduction in area emitting, or 2) change in surface emissivity

Results



CDF_TPM10:TWPD_S1_A-S, 2011-2020
TPM10/TWPD
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
[2014-2016]
[2017]
[2018]
[2020]
TPM10/TWPD = -0.0006 ADC + 0.28
R² = 0.94
0
[2011-2013]
50
100
150
200
250
Acres of Dust Control

Results


M2_TPM10:TWPD_S1_A-S, 2011-2020
TPM10/TWPD
0.30
0.25
0.20
0.15
0.10
0.05
0.00
[2014-2016]
[2017]
[2018]
[2020]
0
50
100
150
200
250
[2011-2013]
Acres of Dust Control

Summary

- DRI's emission/dispersion modeling suggests PM_{10} at CDF is reduced by 42% due to controls in place in 2020 (i.e., 223 acres)
- Sequential decline in TPM_{10}:TWPD ratio for CDF/S1 tower from 2011-2013 to 2020 indicate that with increased area of dust controls the production of PM_{10} has decreased through time
- Reduction in 2020 is 48% for equivalent WPD since 2011-2013 (no controls in place)
- (Possible) Decline in TPM_{10}:TWPD ratio for Mesa2/S1 tower between 2011-2013 and 2020 indicates dust controls have reduced the production of PM_{10} by 11% for equivalent WPD since 2011-2013 (no controls in place), model results suggest 7% decrease

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Wind and PM_{10} Relations Between May/June 2019 and May/June 2020

E. Furtak-Cole and J.A. Gillies, Division of Atmospheric Sciences, Desert Research Institute

Parks requested that DRI undertake an analysis of available hourly wind speed and PM_{10} data to provide a plausible explanation as to why there were more exceedances of the State 24-hour mean PM_{10} air quality standard of 50 μg m^{-3} in the months of May and June 2020, compared to the same two months in 2019. This increase in the number of exceedances in 2020 compared to 2019 is noted by different stakeholders as being unexpected because the ODSVRA was closed to off-highway vehicle (OHV) activities during this period, and the closure continues to be enforced. There appears to have been an expectation by certain stakeholders that the closure of the ODSVRA to OHV, and the establishment of dust controls (i.e., increased vegetation cover, straw surface covers, and temporary wind fences in the ODSVRA) should have resulted in a reduction in regional PM_{10} and the number of exceedances of the State 24-hour mean PM_{10} air quality standard.

The expectation that the Park closure should have resulted in a reduction of PM_{10} due to the cessation of riding alone, presupposes that active OHV riding actively creates a majority of the dust emissions. It has been stated elsewhere, for example by Parks, the Science Advisory Group (SAG), and the San Luis Obispo County Air Pollution District (SLOCAPCD), that the PM_{10} attributable to mineral dust emissions originating within the ODSVRA that causes exceedances of the State 24-hour mean PM_{10} standard is due principally to dust emitted by the sand surface due to windblown saltation processes. The role of OHV is inferred to be that it augments the emission process as emissions from undisturbed dunes (e.g., Oso Flaco and the northern dune preserve) are lower than those from heavily trafficked areas within the riding area of the ODSVRA. The physical mechanisms that augment the emissivity due to OHV activity have not yet been fully explained and remains an on-going area of scientific inquiry.

Two key environmental factors strongly affect the saltation-driven dust emission process. Chief among these are wind energy and moisture conditions. Environmental conditions that change the moisture conditions in the sand are: precipitation, relative humidity, fog frequency and magnitude, and drying potential. These variables exert considerable control of the moisture content of the sand surface and hence the threshold for saltation (e.g., Bauer et al., 2009; Nield and Wiggs, 2011) and the strength of the emissions (e.g., Ishizuka et al., 2008; Munkhtsetseg et al., 2016). In addition, the view that cessation of OHV riding would have an immediate and measurable effect on dust emissions and downwind PM_{10} presupposes that the dust emission system changes rapidly from an impacted to a non-impacted or pre-disturbance state. There are no data yet available that can confirm this contention, nor define how the system changes as a function of time as it adjusts to the cessation of OHV activity.

This report provides relevant information to clarify why the number of exceedances of PM_{10} increased for the period May and June between the years 2019 and 2020. We frame this analyses through the question: Were the environmental conditions (principally wind speed, wind direction, moisture) in May and June 2020, sufficiently different from May and June, 2019 to plausibly explain the higher number of 24 hour mean PM_{10} values measured at the San Luis Obispo County Air Pollution Control District's (SLOCAPCD) CDF air quality monitoring station that exceeded the State (50 μg m^{-3}) air quality standard for 24-hour mean PM_{10} concentration in 2020?

The primary sources of wind and PM_{10} data used for these analyses were the data record of PM_{10} hourly concentration and the accompanying mean hourly wind speed and wind direction data measured at 10 m above ground level (AGL) acquired from the SLOCAPCD for the CDF monitoring site and mean hourly wind speed and wind direction data measured at 10 m AGL for the ODSVRA S1 tower acquired from California State Parks. To place 2019 and 2020 in context with the longer-term record of winds and PM_{10}, we use the available May and June monthly data from 2011 to 2020 for the CDF site and the S1 tower.

1 Analytical Approach

The emission of dust from an erodible surface such as the dune sands of the ODSVRA is principally a function of the wind shear generated on that surface as expressed by the “law of the wall” (e.g., Stull 1988) and the flux of sand once the threshold shear stress has been exceeded. From dimensional analysis (e.g., Gillette and Stockton, 1986; Martin and Kok, 2017) it can be argued that since the horizontal mass flux of the saltating particles and the kinetic energy flux to the surface carried by the saltating particles are both proportional to the shear stress, they should be roughly proportional to each other. Shao (2001) used this assumption to develop a model of dust emissions that is based on defining the relation between dust emissions and the force associated with the kinetic energy of the saltating grains. Shao expresses the flux of dust (F µg m^{-2} s^{-1}) as a function of mass of saltating particles, acceleration due to gravity, binding energy among the particles, and the horizontal saltation flux (Q, g m^{-1} s^{-1}).

Wind shear drives the saltation system in the dunes, but values for wind shear are not available for the ODSVRA and once the plume of wind-generated dust travels beyond the eastern edges of the open sand and travels towards the CDF monitoring location, local wind shear (at CDF) is not strongly connected to the wind shear that created the emissions. Hence another variable that quantifies the wind and relates to the strength of the dust emissions at both the S1 tower and the CDF site is needed. We suggest that wind power density (WPD, W m^{-2}) is an effective variable for evaluating the relation between the energy in the wind and the response of the dust emission system of the ODSVRA to evaluate temporal changes in the response of the PM_{10} emission system between different months and years at the CDF monitoring site or any other nearby monitoring station.

Wind power density (WPD) is defined as (e.g., Kalmikov, 2017):

$WPD=0.5\ \rho_a\ u^3$ (1)

where ρ_a is air density (kg m^{-3}), and u (m s^{-1}) is wind speed (at a known height). The International System of Units defines WPD in Watts per square meter (W m^{-2}).

WPD is a quantitative measure of wind energy available at a location and is used to evaluate siting wind turbines. It is also fundamentally related to sediment transport by wind (Bagnold, 1941; Chepil, 1945; Skidmore, 1998) and is used to parameterize erosive wind power in the United States Department of Agriculture’s, Wind Erosion Prediction System (Hagen et al., 1999).

To quantify WPD at the CDF and S1 tower sites the hourly WPD is summed for the two locations for the two month duration after applying three filtering criteria. For CDF and S1 hourly WPD are filtered for wind direction from 248° to 326° to insure conservatively that the air flow that reaches CDF has most likely travelled from the ODSVRA. A wind speed filter applied is based on screening for the conditions where it is most likely that the PM_{10} reaching CDF is due to the generation of dust by the saltation process within the ODSVRA.

S1 tower wind data below a mean hourly value of 8 m s^{-1} at 10 m AGL are removed. This is based on available data from the nearby and recently installed monitoring stations at the foredune restoration site that indicate that saltation threshold wind speed measured at 3 m is ≈6 m s^{-1} determined from Sensit saltation instruments using the method of Barchyn and Hugenholtz (2011). To estimate the threshold wind speed at 10 m AGL we apply the “law of the wall” (Stull, 1988) and use the aerodynamic roughness length (z_0=0.0026 m) for the S1 tower as described in Mejia et al. (2019). For CDF we filter the wind speed and PM_{10} data removing all hourly wind speeds <4.5 m s^{-1}. We observe that hourly mean wind speeds ≥4.5 m s^{-1} shows a good correlation with the BAM-measured hourly PM_{10} at CDF, indicating that the PM_{10} concentration is responding to the emissions of dust originating from within the ODSVRA (Figure 1) after filtering for wind direction.

We apply one additional filter to try and account for an important source of moisture that will affect the threshold wind shear for saltation and the strength of the dust emissions (Bauer et al., 2009; Nield and Wiggs, 2011; Ishizuka et al., 2008; Munkhtsetseg et al., 2016). We eliminate hourly wind speed and the corresponding PM_{10} data for that hour if there has been a precipitation event from one to three days prior to the measurement (precipitation data from San Luis Obispo airport and a nearby National Weather Service station).

For the analysis we have opted to use totals instead of means to produce mechanistically meaningful correlations. Means are typically used to make inference when only a small sample of a population can be measured. In the case of this meteorological dataset, the population can be considered completely measured. Moreover, means are easily biased, and it can be shown that May and June for any given year have different non-Gaussian distributions for wind speed and PM_{10}. Mechanistically, in the context of air quality, we seek predictors for time-integrated quantities, such as the number of hours over a PM_{10} threshold or the total PM_{10} measured. Because the mean averages out time, it contains no information related to duration of an event in a time series, only the distribution of severity. By contrast, the sum of WPD correlates with the sum of PM_{10} concentration, because both the severity and duration of wind events are accounted for. An important physical mechanism underlies this correlation: the concentration of PM_{10} is proportional to the wind power (i.e., WPD) that generated the dust via the emission process and transfers it into the atmosphere.

As theory shows (Bagnold, 1941; Chepil, 1945; Skidmore, 1998) particulate matter emissions from the surface should scale with the wind energy acting across the surface. Thus, a linear relationship should exist between WPD and PM_{10} for any given hour, provided that the system is in an emissive state (e.g., not saturated with soil moisture or completely crusted over). This relationship is preserved by summing over the hours of each quantity, allowing for assessment for an arbitrary time period. Similarly, the number of hours of that wind is above the threshold for saltation, WPD is expected to correlate with some exceedance of PM_{10} measured at a monitoring location. Here, we choose ≥50 µg m^{-3} to match the State 24-hour mean standard. By using these two measures, both the severity and duration of dust events are accounted for. It is important to note that any measure can be biased, which is why multiple measures are needed to define the underlying mechanisms that are characterized within the data. For example, a short wind event of very high velocity may only exceed threshold for a short period of time, but a high WPD will explain large observed PM_{10} totals. Conversely, a long period of moderate winds just above threshold may register as a State air quality violation, while producing only moderate WPD and PM_{10} totals.

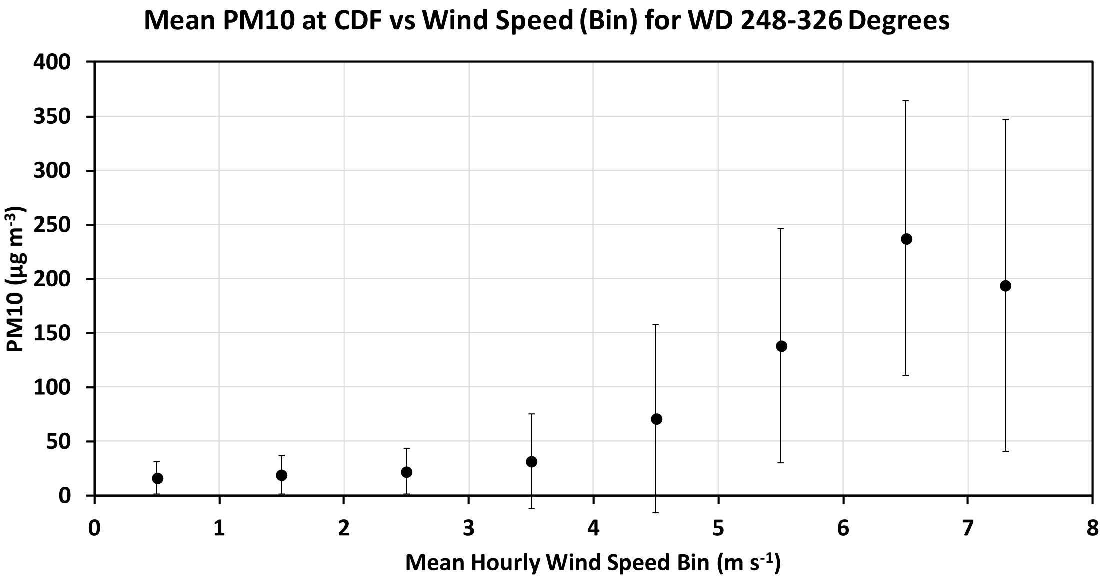

Figure 1. The relation between hourly mean PM_{10} and hourly mean wind speed measured at 10 m AGL for winds from 248°-326° observed at the CDF monitoring station in 2019 (Jan-Dec). PM_{10} increases as a function of wind speed bin for bins ≥4.5 m s^{-1}.

Results

Hours Above Threshold Wind Speed, May-June 2019 and 2020, CDF

The likelihood of exceeding the State 24-hour PM_{10} standard of ≥50 µg m^{-3} at the CDF monitoring station due to emissions of mineral dust from the ODSVRA requires that the wind speed equals or exceeds the threshold conditions for saltation within the ODSVRA (i.e., 8 m s^{-1}) and that the wind speed at CDF has reached or exceeded 4.5 m s^{-1} (Fig. 1). Figure 2 shows the total number of hours that meet these threshold values at CDF and S1, respectively. It is immediately apparent in Fig. 2 that in the May-June period 2019, the number of hours with wind below these threshold values was very different than for all other years of record.

The number of hours above (or conversely below) these threshold wind speeds impacts the number of hours when hourly PM_{10} values can rise to levels that have the potential over 24 hours to exceed the State standard. The more hours in a day with PM_{10} ≥50 µg m^{-3}, the greater the probability that an exceedance can occur. The relation between hours with PM_{10} ≥50 µg m^{-3} and wind speed at or over the CDF threshold value of 4.5 m s^{-1} is shown in Fig. 3 and for winds at or over the S1 threshold value of 8.0 m s^{-1} is shown in Fig. 4.

Total Wind Power Density, May-June 2011 through 2020, CDF and S1 Tower

WPD is a fundamental unit of wind energy defined from first principles and has been demonstrated to correlate with sediment transport by wind. The total WPD calculated for CDF and S1 tower for May and June (combined) from 2011 through to 2020 is shown in Fig. 5. This figure shows that the total WPD as calculated for the S1 tower, is dramatically lower in 2019 than any other year in the data record.

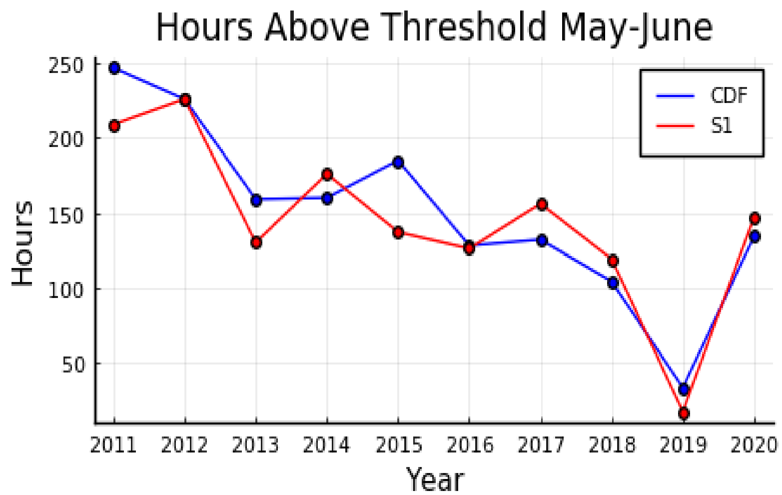

Figure 2. Total hours that wind speed is above the threshold of response for increasing PM_{10} at CDF (i.e. ≥4.5 m s^{-1}, 10 m AGL) and total hours wind speed is above the threshold of saltation at S1 (i.e., ≥8.0 m s^{-1}, 10 m AGL).

Figure 5 indicates that in 2019 the available wind energy within the ODSVRA for transporting sand via saltation and the accompanying dust emissions is less than all other years in the record. Figures 6 and 7 show the PM_{10} response at CDF to total WPD is highly correlated, more so for the relation between CDF PM_{10} and S1 total WPD than CDF PM_{10} and CDF total WPD. This clearly illustrates the connection between the wind-driven saltation and dust emissions within the ODSVRA and the downwind concentration of PM_{10} dust. Figure 7 also shows that in 2019, the number of exceedances of the State Standard would be expected be low, principally due to the low total WPD in those months for that year.

The question remains, what could have been the effect of the cessation of riding and the presence of the dust controls in place in 2019 and 2020? The combined effect of this is discernable for 2020. For May and June, 2020 the total WPD at the S1 tower was $\approx 1.132\times10^5$ W m^{-2} and the corresponding total PM_{10} at CDF was 1.888×10^4 µg m^{-3}. The years 2014 and 2017 had similar total WPD values (at S1), $\approx 1.13\times10^5$ W m^{-2} and $\approx 1.07\times10^5$ W m^{-2} respectively, while the total PM_{10} values at CDF for those years are 2.82×10^4 µg m^{-3} and 2.65×10^4 µg m^{-3}, respectively. This suggests that for years with approximately equivalent total WPD for May and June (for the available data record 2011-2020), the saltation/dust emission system within the ODSVRA in those months in 2020 produced approximately 31% less PM_{10} than 2014 and 2017, when there were considerably less dust controls in place and OHV was active. A more conservative estimate is the difference between the calculated 2020 Total PM_{10} and the Total PM_{10} determined from the least squares regression line (2.60×10^4, green arrow in Fig. 7) fit to the data record, which shows total PM_{10} in 2020 was 7.09×10^3 µg m^{-3} less than the regression-derived value, a change of 27%. We cannot, however, determine how much of this change can be attributed to the cessation of riding and the dust control areas as they are confounding effects. In addition, the moisture effect filter used in this analysis is simple and does not account for potentially important moisture effects related to RH, fog, and drying, which vary from year-to-year.

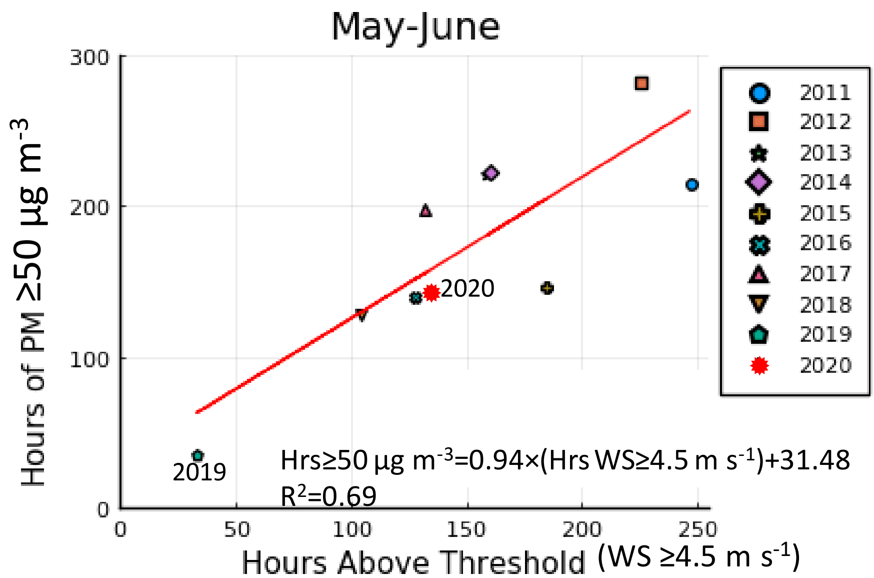

Figure 3. Total hours of PM_{10} ≥50 µg m^{-3} and total hours above wind speed ≥4.5 m s^{-1} at CDF for the months May and June, 2011-2020.

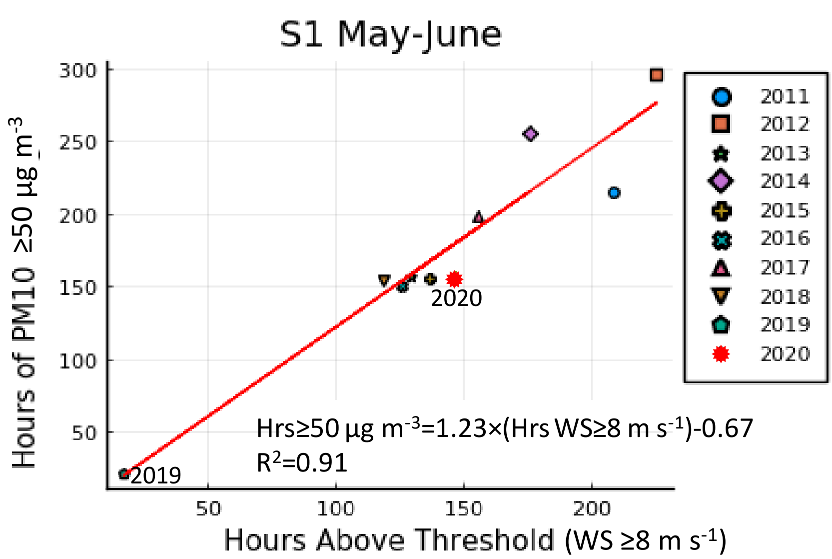

Figure 4. Total hours of PM_{10} ≥50 µg m^{-3} at CDF and total hours above wind speed ≥8.0 m s^{-1} at S1 for the months May and June, 2011-2020.

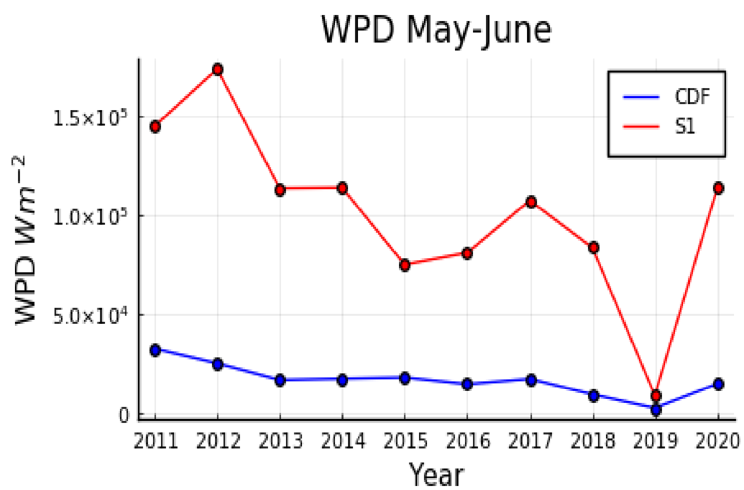

Figure 5. Total WPD (W m^{-2}) for CDF and S1 tower (above threshold wind speed conditions), May and June, 2011-2020.

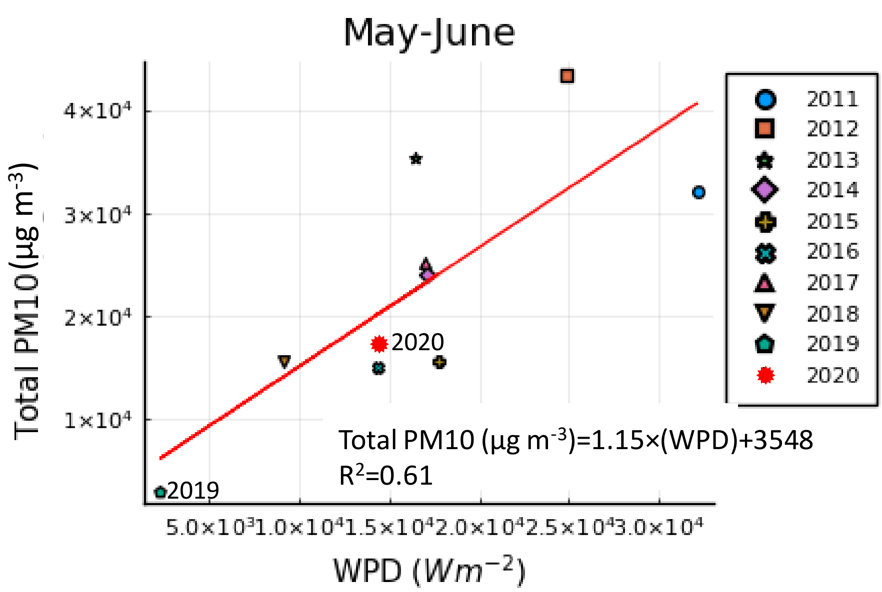

Figure 6. Total PM_{10} (µg m^{-3}) and total WPD at CDF for the months May and June, 2011-2020.

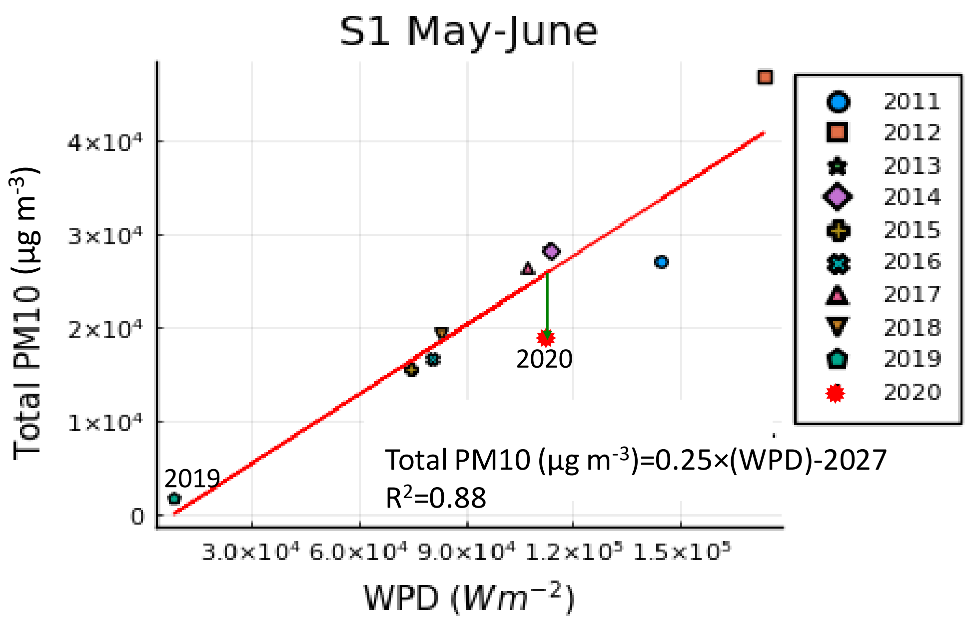

Figure 7. Total PM_{10} (µg m^{-3}) at CDF and total WPD at S1 for the months May and June, 2011-2020.

Conclusions

Our analyses of the wind and PM_{10} data from 2011-2020 clearly show that to explain how PM_{10} scales as a function of wind, total WPD is an appropriate metric. PM_{10} emissions scale non-linearly (i.e., as a power function) of wind energy, so any metric of wind speed that does not account for this, such as mean hourly wind speed, cannot be used for comparison of wind and PM_{10} changes across space or through time. The data presented show that for May and June 2019 the total WPD and associated total PM are much lower than 2020 (by a factor ≈0.44), indicating the potential for producing PM_{10} via saltation was very much reduced, as was the number of hours when the hourly average of PM_{10} was ≥50 µg m^{-3}, which is needed to create a 24-hour mean PM_{10} value ≥50 µg m^{-3}. It is encouraging to note that the analyses presented here indicates that in May and June 2020, the total PM_{10} was between 27%-31% less than the two previous years with similar total WPD (2014 and 2017), indicating that the dust emission system has been altered since those years. The reduction in total PM_{10} in 2020 cannot, however, be apportioned to what is attributable to the presence of the dust controls that were in place or due to the cessation of riding. Additional data will be needed to answer this question.

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State of California • The Natural Resources Agency
Gavin Newsom, *Governor*

DEPARTMENT OF PARKS AND RECREATION
Off-Highway Motor Vehicle Recreation Division
1725 23rd Street, Suite 200
Sacramento, California 95816
Telephone: (916) 324-5801 • Fax: (916) 324-0271

Lisa Ann L. Mangat, *Director*

Memorandum

An Analysis: May and June Wind Strength Year to Year and State PM10 Exceedances with and without OHV Recreation, Oceano Dunes SVRA.

August 5, 2020

From:
Will Harris
Senior Engineering Geologist
California Geological Survey

Background
Since March 28, 2020, due to coronavirus concerns, off-highway vehicle (OHV) recreation has been prohibited at the Oceano Dunes State Vehicular Recreation Area (Oceano Dunes) in south San Luis Obispo (SLO) County California. Oceano Dunes remains closed to OHV recreation due to concerns related to endangered and threatened shorebirds.

The SLO County Air Pollution Control District (APCD) has suggested that OHV recreation causes the dune saltation process to be enhanced in some way, leading to more dust that blows downwind—an additional amount of dust beyond what is emitted naturally from the dune saltation process. As yet, the OHV-enhanced saltation value and related added dust amount has not been determined by the APCD nor by the Scientific Advisory Group (SAG), a collection of advisors and scientists formed as a result of the May 2018 Stipulated Order of Abatement (SOA) issued to DPR by the APCD.

A commonly expressed idea to determine if OHV recreation truly does increase saltation-generated dust downwind of Oceano Dunes is to prohibit OHV use for a period of time to see what happens. The coronavirus shut down of Oceano Dunes has created that opportunity.

The closure to vehicles has allowed for an examination of changes in the emission of saltation-generated dust from the dunes that may be due to the absence of OHV recreation. It is for this reason that the Desert Research Institute (DRI), consultant to the California Department of Parks and Recreation (DPR), has been conducting weekly testing of dune surface dust-emissive potential within Oceano Dunes. Thus far, DRI has not provided any preliminary findings from the testing.

But in the context of the SOA, which requires that violations of the state PM10 standard recorded downwind of Oceano Dunes be reduced, comparing the number of PM10 violations by specific month in any given year offers a simple metric.

A local news publication did such a comparison for the month of May and found that in May 2020, when there was no OHV recreation, there were more violations of the state's PM10 standard than for the same month in the previous six years (https://calcoastnews.com/2020/05/coronavirus-shutdown-shows-dust-on-the-nipomo-mesa-science-is-flawed/).

The violations were recorded at the APCD's CDF and Mesa 2 air monitoring sites located on Nipomo Mesa (Mesa), approximately two miles downwind (easterly) of Oceano Dunes.

In an attempt to explain this unanticipated finding, the APCD posted a Frequently Asked Questions (FAQ) document to its website (https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/June2020FAQ-42.pdf). The second question in the document reads, "Why have there been more exceedances [of the state's PM10 standard] in 2020 than by this point last year?" In answer the APCD states, "In simple terms, it was a very windy spring. 2020 is by far the windiest of the last 6 years, while 2019 was the least windy."

This claim is based on wind data recorded at the CDF site on the Mesa. For individual years from 2015 through 2020, data from January through June were combined to represent spring wind speeds for a respective year.

However, that comparison is not germane to specific months when, in 2020, there was no OHV recreation at Oceano Dunes. Also, the comparison does not represent "a very windy spring" since the comparison uses data from January, February, and the first half of March. In other words, the first half of 2020 may indeed be the windiest half-year of the last six years, but that does not necessarily mean May 2020 has been the windiest May of the last six years.

Examining wind speed in May, and to a lesser extent, June, is more relevant because these are the months, in any given year, when the most violations of the state PM10 standard have been recorded. It is for this reason the SAG, in conducting SOA-required computer modeling of dust emission, uses wind and PM10 data recorded from May and June 2013 to inform their computer model.

Analysis
To that end, here is an examination of the APCD's CDF wind speed data from May and June for the years 2013 through 2020. The purpose of this data analysis is to determine which year had the windiest May and the windiest June, and if those windiest months in a particular year recorded the most violations of the state's PM10 standard.

The CDF site records hourly resultant wind speed in miles per hour (mph) and wind direction (the direction the wind is coming from). Days on the Mesa when elevated concentrations of PM10 are recorded coincide with strong prevailing winds from the northwest. The winds occur seasonally, predominantly in the late spring. The winds build in strength daily, beginning in the late morning, peaking in mid to late afternoon, and calming by early evening. Accordingly, to make this examination relevant to high PM10 recorded on the Mesa, the wind data were culled based on wind speed, wind direction, and time of day: Only data for winds above 5 mph, coming from the northwest quadrant, recorded between the hours of 11:00AM and 7:00PM were used for the analysis.

Hourly wind speed for each day from those segregated data were then added up and averaged. Those daily averages were then used to calculate the monthly wind speed average for each May and June from 2013 to 2020. Additionally, the recorded state PM10 violations for

May and June of each year were tallied to determine if wind speed and lack of OHV recreation in 2020 correlated with the number of PM10 violations.

Results and Discussion

The results are summarized in the table below.

Wind Speed and State PM10 Exceedances Recorded at CDF for May and June, 2013 to 2020					
May			**June**		
Year*	**Averaged Wind Speed (mph)***	**Exceedances of State PM10 Standard**	**Year***	**Averaged Wind Speed (mph)***	**Exceedances of State PM10 Standard**
2013	10.529	20	2017	9.012	9
2014	10.036	19	2018	8.787	9
2015	9.842	5	2015	8.715	5
2019	9.391	6	2014	8.627	6
2016	9.376	4	2020*	8.615	7
2020*	9.375	12	2016	8.602	10
2018	9.351	9	2013	8.464	7
2017	9.123	10	2019	7.834	2

*No OHV recreation occurring within Oceano Dunes SVRA.

**Wind speed averages determined using data for winds above 5 mph, coming from the northwest quadrant, recorded between the hours of 11:00AM and 7:00PM.

***Ordered from most to least windy years.

Most broadly, the CDF data show northwest winds are stronger in May than June, an expected result.

Regarding May, averaged northwest wind speeds year to year show variability within 1.4 mph. May 2013 had the highest average wind speed (10.05 mph), and May 2017 had the lowest wind speed (9.12 mph). May 2020 wind speed (9.38 mph) was the third least windy May of the eight years examined. Additionally, May 2020, when no OHV recreation occurred in the dunes, had the most violations of the state's PM10 standard (12) since 2014.

For June, averaged northwest wind speeds year to year show variability within 1.2 mph. June 2017 had the highest average wind speed (9.01 mph), and June 2019 had the lowest (7.83 mph). June 2020 wind speed (8.61 mph) was the fourth least windy June of the eight years examined. In comparing violations of the state's PM10 standard year to year, June 2020, with no OHV recreation in the dunes, recorded 7 violations. The most violations were recorded in June 2016 (10), which was the third least windy June (8.60 mph) for the eight years examined.

It should be noted that since 2017, DPR has installed approximately 230 acres of saltation-reducing treatments in the dunes. Most of these treatments consist of planted dune vegetation, and most have been in the OHV riding area of Oceano Dunes. Despite this effort, despite that May and June 2020 were less windy than most other years going back to 2013, and despite that there was no OHV recreation occurring at Oceano Dunes, the number of violations of the state's PM10 standard, particularly in May 2020, appears exceptionally high. It appears the geologic processes of the dunes system, in the broader context of the dust concentrations measured on the Mesa, are far from understood. Accordingly, attempts to accurately assign those recorded dust concentrations to a specific recreational activity within a specific area of the dunes are premature at best and may even be unachievable.

Conclusions

The review of the data shows that northwest wind speeds in May 2020 and June 2020 were not exceptionally elevated. In fact, May 2020 and June 2020, respectively, had lighter winds than most of the correlating months and years examined. From these data, the months of May and June in 2020 were not very windy.

Additionally, the comparatively lower wind speeds of May 2020 and June 2020 do not correlate to the high number of state PM10 violations concurrently recorded during these months in 2020, when OHV recreation was not present. This finding is at odds with the referenced APCD FAQ document that stated, "more exceedances [of the state PM10 standard] are expected in a windier year than in a less windy year." This may be because the APCD analysis to determine the strength of spring winds year to year as a means to explain PM10 exceedances in 2020 incorporates data from months that are not in spring (January, February, the first half of March), and does not consider the specific months in 2020 when there was no OHV recreation occurring in the dunes.

September 11, 2020

Jon O'Brien
Environmental Program Manager
California State Parks
Off-Highway Motor Vehicle Recreation Division
1725 23rd Street, Suite 200
Sacramento, CA 95816

Dear Mr. O'Brien:

The following is my response to the Scientific Advisory Group's (SAG) August 20, 2020 critique of the August 5, 2020 memorandum I prepared for the California Department of Parks and Recreation (DPR) Off Highway Motor Vehicle Recreation (OHMVR) Commission. The title of my memorandum is "An Analysis: May and June Wind Strength Year to Year and State PM10 Exceedances with and without OHV Recreation, Oceano Dunes SVRA."

My memorandum was prompted by three concerns.

1. The May 2018 Stipulated Order of Abatement (SOA) issued to DPR by the Hearing Board of the San Luis Obispo County Air Pollution Control District (APCD) mandates that violations of the state's 24-hour averaged PM10 standard, as measured on Nipomo Mesa (Mesa), be reduced. The SOA implies, and the SAG has stated (SAG, 2020), that the PM10 violations result from off-highway-vehicle-created alterations in the dust-emissive potential of dune surfaces at the Oceano Dunes State Vehicular Recreation Area (SVRA), which is two miles west (upwind) from the Mesa. The SAG has not yet quantified a change in dust emissive potential at Oceano Dunes related to off-highway vehicle (OHV) activity (SAG 2020).
2. In spring 2020, OHV recreation was prohibited at Oceano Dunes due to coronavirus concerns. Yet despite the OHV closure, and despite SAG-directed vegetation planting efforts to date that have covered the dunes with more dust-reducing vegetation than has existed naturally (CGS, 2017; CGS, 2019; DPR, 2020), the number of state PM10 violations—the metric of the SOA—in May and June 2020 has increased.
3. In a "frequently asked questions" document posted to its website on June 30, 2020, the APCD stated the increase in PM10 violations was because, when compared to other years, spring 2020 was "very windy," as measured at its CDF monitoring station on the Mesa. To make that characterization, the APCD combined CDF data from January through June to represent "spring" wind speeds for a respective year.

In my memorandum, I demonstrate in a simple way that May and June 2020 are not "the windiest of the last 6 years," as claimed by the APCD. This is an easy conclusion to make once the data have been segregated as I described in my memo. In their critique, the SAG does not refute this conclusion. Their argument centers on what they perceive as a more appropriate and complex way of performing statistical analysis. But whether determined by my analysis or something more exhaustive specific to the months examined, the conclusion will be the same: May and June 2020 are not exceptionally windy. The SAG did not apply their recommended analysis to the issue, and so does not offer any refutation or evidence to prove this otherwise. To better serve in its advisory role, the SAG may wish to evaluate the APCD's use of data from non-spring months to characterize spring 2020 winds.

This leaves the question that should be of greater concern to the SAG: Why are there so many exceedances of the state's PM10 standard as recorded on the Mesa when there has been no OHV recreation at Oceano Dunes since March 28, 2020, and when the dunes have been covered with so much vegetation?

These exceedances highlight the complexity of the dune system, particularly within the broader geographic context of dust concentrations measured two miles downwind on the Mesa. As I stated in my memo, attempts to accurately assign those recorded dust concentrations to a specific recreational activity within a specific area of the dunes are premature at best.

Respectfully submitted,

Will J. Harris, PG 5679, CEG 2222, CHg 750
Senior Engineering Geologist
California Geological Survey

cc: Professor William Nickling, lead, Scientific Advisory Group.

References cited:

CGS 2017. Acreage Analysis Related to Saltation Potential, Oceano Dunes State Vehicular Recreation Area, San Luis Obispo County, California. Memorandum prepared for the DPR OHMVR Division by Will Harris, California Geological Survey, January 5, 2017.

CGS 2019. Dune Vegetation Comparison, Oceano Dunes State Vehicular Recreation Area, San Luis Obispo County, California. Memorandum prepared for the DPR OHMVR Division by Will Harris, California Geological Survey, January 3, 2019.

DPR, 2020. Staff Report: Oceano Dunes SVRA – Dust Control Program. Prepared for the August 6, 2020 DPR OHMVR Commission Meeting by Jon O'Brien, DPR OHMVR Division, and Ronnie Glick, DPR Oceano Dunes District.

SAG, 2020. Response to Memo to D. Canfield from W. Harris, 09-10-2019. Prepared by the Scientific Advisory Group, February 24, 2020.

Oceano Dunes State Vehicular Recreation Area Dust Control Program

DRAFT 2021 Annual Report and Work Plan

ATTACHMENT 05

Sediment Trackout Prevention Measures

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100% SUBMITTAL

CALIFORNIA DEPARTMENT OF PARKS AND RECREATION
FACILITIES AND DEVELOPMENT DIVISION
OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

SFM PERMIT APPLICATION NUMBER: 20-S-1574-CP-NW

SCOPE OF WORK

THIS PROJECT INCLUDES THE CONSTRUCTION OF TWO CONCRETE V-GROOVED SEDIMENT TRAP TO PREVENT SEDIMENT TRACK-OUT AT TWO ENTRANCES TO OCEANO DUNES STATE VEHICULAR RECREATION AREA (PARK). THE PROJECT SITES ARE LOCATED AT THE ENTRANCES TO THE PARK AT GRAND AVENUE AND PIER AVENUE IN THE CITY OF OCEANO. THIS PROJECT ALSO INCLUDES MINOR ACCESSIBILITY WORK IN THE PARKING LOT OF PIER AVENUE.

GENERAL NOTES

1. ALL MATERIALS SHOWN OR NOTED ON THE PLANS ARE NEW UNLESS CALLED OUT OTHERWISE.
2. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY ALL EXISTING CONDITIONS SHOWN OR DIMENSIONED HERE. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE STATE'S REPRESENTATIVE FOR RESOLUTION BEFORE PROCEEDING WITH THAT PORTION OF THE WORK.
3. ALL WORK SHALL COMPLY WITH THE CURRENT EDITION OF THE FOLLOWING LISTED CODES, AND ALL OTHERS HAVING JURISDICTION OVER THE WORK.

   TITLE 19, CCR, PUBLIC SAFETY, SFM REGULATIONS.
   2019 CA ADMINISTRATIVE CODE TITLE 24, PT 1.
   2019 CA BUILDING CODE (CBC) TITLE 24, PT 2.
   2019 CA ELECTRICAL CODE (CEC) TITLE 24, PT 3.
   2019 CA MECHANICAL CODE (CMC) TITLE 24, PT 4
   2019 CA PLUMBING CODE (CPC) TITLE 24, PT 5.
   2019 CA ENERGY CODE CCR TITLE 24, PT 6.
   2019 CA GREEN BUILDING STANDARDS TITLE 24, PT 11.
   2019 CA REFERENCED STANDARDS TITLE 24, PT 12.
   2010 ADA STANDARD FOR ACCESSIBLE DESIGN.
   THE SECRETARY OF THE INTERIOR'S STANDARDS FOR THE TREATMENT OF HISTORIC PROPERTIES.

4. CONDUCT ALL WORK IN ACCORDANCE WITH THE LATEST SAFETY RULES AND REGULATIONS OF ALL AUTHORITIES AND AGENCIES HAVING JURISDICTION OVER THE WORK.
5. ALL WORK SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION DOCUMENTS. WHERE DETAILED INFORMATION OR CLARIFICATION IS REQUIRED, THE MATTER SHALL BE REFERRED TO THE STATE'S REPRESENTATIVE FOR WRITTEN RESOLUTION.
6. THE CONTRACTOR SHALL NOT SCALE THE DRAWINGS, BUT SHALL RELY ONLY ON THE WRITTEN DIMENSIONS GIVEN. IF A DISCREPANCY OCCURS OR NO DIMENSION IS GIVEN, THE CONTRACTOR SHALL NOTIFY THE STATE'S REPRESENTATIVE FOR WRITTEN CLARIFICATION BEFORE PROCEEDING WITH THAT PORTION OF THE WORK.

SURVEY NOTES

THIS SURVEY IS BASED ON NAD83 (CSRC) EPOCH 2011 STATE PLANE COORDINATE SYSTEM ZONE 05, AND NAVD88 (GEOID12A) VERTICAL DATUM. USING GPS REAL-TIME NETWORK (CSDS RTN). THE FOLLOWING STATION gb1f HELD FIXED:

STATION Gb1f
N: 2239594.403
E: 5779296.013
EL: 89.804

UNITS ARE US SURVEY FEET, GRID DISTANCES. TO OBTAIN GROUND DISTANCES, DIVIDE DISTANCES BY THE PROJECT AVERAGE COMBINED SCALE FACTOR OF 0.99994575

THE UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD OBSERVATIONS ONLY. NO GUARANTEE THAT THE UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. NO WARRANT IS MADE THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED AS THEY WERE NOT PHYSICALLY LOCATED.

ABBREVIATIONS

AB	AGGREGATE BASE
AC	ASPHALT CONCRETE
CLR	CLEAR
DIA.	DIAMETER
(E)	EXISTING
ISA	INTERNATIONAL SYMBOL OF ACCESS
MAX	MAXIMUM
MIN	MINIMUM
NAD	NORTH AMERICAN DATUM
NAVD	NORTH AMERICAN VERTICAL DATUM
NTS	NOT TO SCALE
O.C.	ON CENTER
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
(P)	PROPOSED
SF	SQUARE FEET
TYP.	TYPICAL

SYMBOLS LEGEND

A / A-1 — SECTION NUMBER / SHEET NUMBER

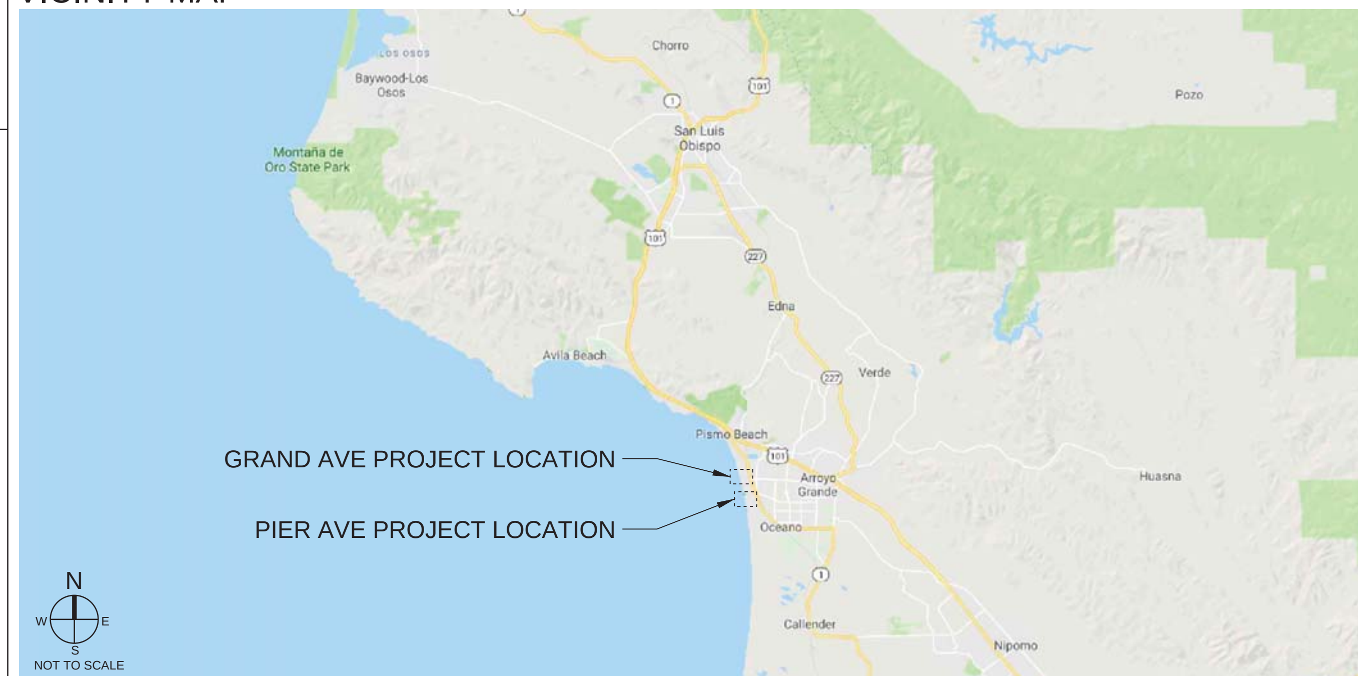
1 / A-1 — DETAIL NUMBER / SHEET NUMBER

1 — REVISION NUMBER

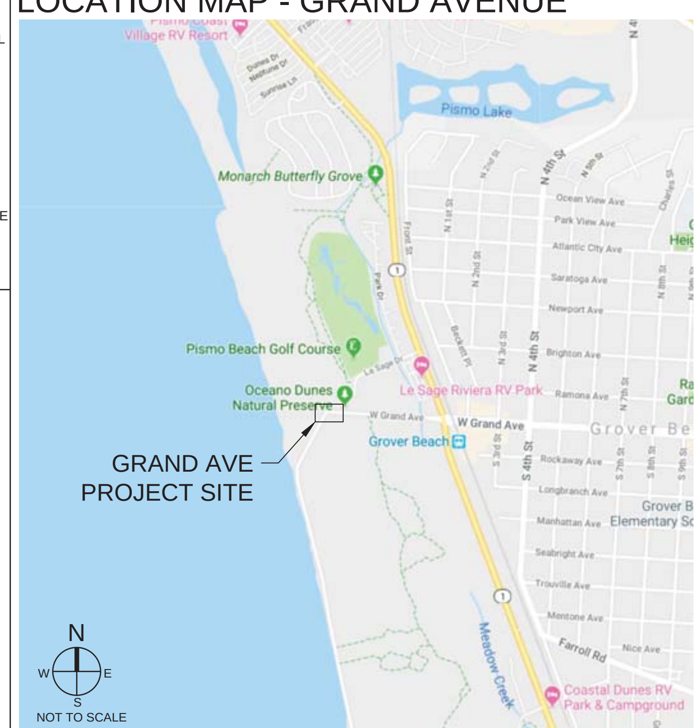
X' — DIMENSION LINE CENTER LINE

X' — DIMENSION LINE FACE OF MATERIAL

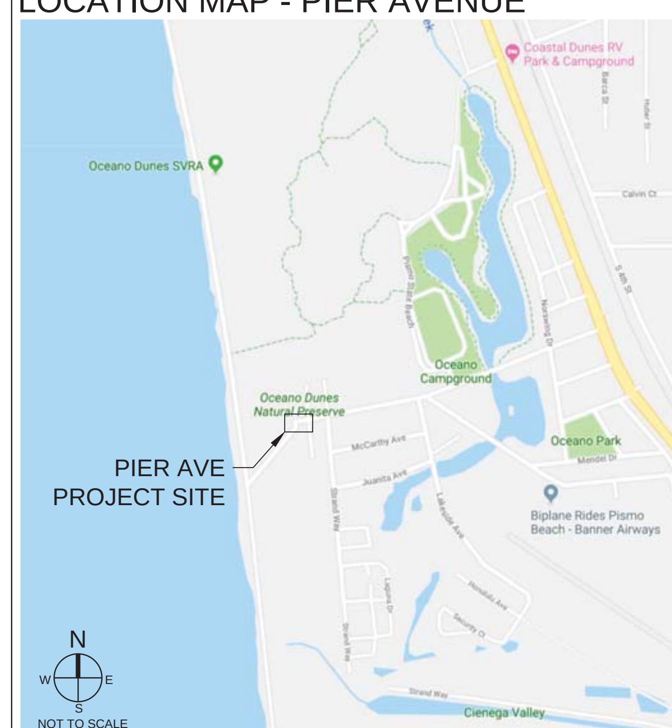
VICINITY MAP



LOCATION MAP - GRAND AVENUE



LOCATION MAP - PIER AVENUE



SHEET INDEX

UNDERGROUND SERVICE ALERT

USA North

811
CALL BEFORE YOU DIG

SHEET SIZE: 22X34

CALIFORNIA STATE PARKS SINCE 1864

FACILITIES & DEVELOPMENT
One Capitol Mall
Sacramento, CA 95814

REGISTERED PROFESSIONAL ENGINEER
VINH LE
No. 84125
SIGNED: 05/28/20
CIVIL
STATE OF CALIFORNIA

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY

Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

Reviewed by Date

DPR ACCESS COMPLIANCE REVIEW
ACCESSIBILITY SECTION

Certification #

Reviewed by Date

ACCESSIBILITY COMPLIANCE AND STATE FIRE MARSHAL SIGNED ORIGINALS ARE ON FILE AT THE DEPARTMENT OF PARKS AND RECREATION, NORTHERN SERVICE CENTER

DESIGNED:	VL
DRAWN:	VL
CHECKED:	KR
DATE:	05-28-2020

REVISIONS	
△	DATE

OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

TITLE SHEET

DRAWING NO.
04535P.1

SHEET NO.
G-1
1 OF 8

File: C:\Users\vinh.le\Desktop\Corna Virus\Oceano Dunes Trackout\05_Drawings\Sheet Set\G-1 TITLE SHEET.dwg Layout: G-1 TITLE SHEET Date: May 28 2020 - 1:42 pm User: Vinh.Le

100% SUBMITTAL

GENERAL NOTES:

1. CONTRACTOR SHALL, AT ALL TIMES, KEEP THE PREMISES FREE FROM ACCUMULATION OF WASTE MATERIALS OR RUBBISH CAUSED BY HIS WORK. AT THE COMPLETION OF THE WORK REMOVE ALL RUBBISH, TOOLS, AND SURPLUS MATERIALS, AND LEAVE THE JOB IN A BROOM CLEAN CONDITION.
2. SELECTIVE DEMOLITION SHALL BE DONE IN ACCORDANCE WITH THE CONSTRUCTION DOCUMENTS. REPAIR ANY DEMOLITION PERFORMED IN EXCESS OF THAT REQUIRED. RETURN STRUCTURES AND SURFACES TO THE CONDITION PRIOR TO COMMENCEMENT OF SELECTIVE DEMOLITION. REPAIR ADJACENT CONSTRUCTION OR SURFACES, SOILED OR DAMAGED, BY SELECTIVE DEMOLITION WORK.
3. A LOCATION FOR THE CONTRACTOR'S CORPORATION YARD WILL BE DESIGNATED WITHIN THE SITE BY THE STATE'S REPRESENTATIVE. CONTRACTOR IS PERMITTED TO FENCE THIS AREA TO PROTECT OFFICES, STORED MATERIAL AND EQUIPMENT. CONTRACTOR IS RESPONSIBLE FOR SECURING HIS/HER EQUIPMENT FROM THEFT OR VANDALISM.
4. THESE DRAWINGS DO NOT CONTAIN THE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. WORKER AND PEDESTRIAN PROTECTION SHALL BE PROVIDED AND MAINTAINED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLIANCE WITH ALL CURRENTLY APPLICABLE SAFETY LAWS OF ANY JURISDICTIONAL BODY, INCLUDING BUT NOT LIMITED TO OSHA REQUIREMENTS.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE EXACT LOCATION OF ALL EXISTING UTILITIES AND FOR THE PROTECTION AND REPAIR OF DAMAGE TO THEM. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING ALL UTILITIES AS TO THE LOCATION OF ALL UNDERGROUND FACILITIES CALL "UNDERGROUND SERVICE ALERT" 811, 48 HOURS BEFORE DIGGING. ALSO CALL THE NOTIFY THE STATE'S REPRESENTATIVE 48 HOURS PRIOR TO DIGGING.
6. THE CONTRACTOR IS RESPONSIBLE FOR SITE CONDITIONS CONTINUALLY DURING WORKING HOURS, INCLUDING PUBLIC SAFETY, DUST CONTROL, AND EROSION AND SEDIMENT CONTROL.
7. THE CONTRACTOR IS FINANCIALLY RESPONSIBLE FOR THE MAINTENANCE OR REPAIR OF OFFSITE STREET SURFACES WHERE DAMAGE HAS BEEN SUSTAINED BECAUSE OF THE CONSTRUCTION TRAFFIC.
8. CONSTRUCTION NOISE SHALL BE IN COMPLIANCE WITH CONSTRUCTION DOCUMENTS FOR SPECIFIC RESTRICTIONS AND HOURS OF OPERATION.
9. THE CONTRACTOR SHALL MAINTAIN AN ACCURATE RECORD OF ALL APPROVED DEVIATIONS FROM THE PLANS BEFORE AND DURING CONSTRUCTION. UPON COMPLETION OF WORK, ONE SET OF RED-LINED AS-BUILT PLANS SHALL BE SUBMITTED TO THE STATE'S REPRESENTATIVE FOR REVIEW AND ACCEPTANCE.
10. REFER TO GEOCON'S GEOTECHNICAL INVESTIGATION REPORT TITLED "OCEANO DUNES SRVA" PROJECT NUMBER S9030-05-72 FOR SUBSURFACE CONDITIONS. THE CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE GEOTECHNICAL INVESTIGATION REPORT PRIOR TO BIDDING.
11. THE TYPES, LOCATIONS, SIZES, AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE IMPROVEMENT PLANS WERE OBTAINED FROM SOURCES OF VARYING RELIABILITY. THE CONTRACTOR IS CAUTIONED THAT ONLY ACTUAL EXCAVATION WILL REVEAL THE TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. A REASONABLE EFFORT HAS BEEN MADE TO LOCATE AND DELINEATE ALL KNOWN UNDER-GROUND UTILITIES. HOWEVER THE STATE CAN ASSUME NO RESPONSIBILITY FOR THE COMPLETENESS OR ACCURACY OF ITS DELINEATION OF SUCH UNDERGROUND UTILITIES NOR FOR THE EXISTENCE OF OTHER BURIED OBJECTS OR UTILITIES WHICH MAY BE ENCOUNTERED BUT WHICH ARE NOT SHOWN ON THESE DRAWINGS.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING THE STATE'S REPRESENTATIVE 48-HOURS PRIOR TO COMMENCING WORK AND 24-HOURS PRIOR TO RESUMPTION AFTER INTERRUPTION. REQUESTS FOR INSPECTION SHALL BE GIVEN 72-HOURS IN ADVANCE, AND BE PERFORMED BY THE STATE'S AUTHORIZED REPRESENTATIVE.
13. IT IS POSSIBLE THAT PREVIOUS ACTIVITIES HAVE OBSCURED SURFACE EVIDENCE OF CULTURAL RESOURCES OR THAT PREVIOUSLY UNDISCOVERED CULTURAL RESOURCES ARE LOCATED ON THE SITE. IF PREVIOUSLY UNIDENTIFIED CULTURAL RESOURCES ARE ENCOUNTERED DURING EARTH-MOVING ACTIVITIES, ALL CONSTRUCTION ACTIVITY WITHIN 100 FEET OF THE RESOURCES SHALL BE HALTED IMMEDIATELY, AND THE APPROPRIATE AUTHORITIES NOTIFIED. IF SUSPECTED HUMAN REMAINS ARE ENCOUNTERED, THE COUNTY CORONER AND THE DEPARTMENT PARKS AND RECREATION SHOULD BE NOTIFIED IMMEDIATELY. IF PREHISTORIC OR HISTORIC-ERA RESOURCES ARE ENCOUNTERED, THE DEPARTMENT PARKS AND RECREATION AND A QUALIFIED ARCHAEOLOGIST SHOULD BE NOTIFIED IMMEDIATELY.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPORTING ALL CONFLICTS, ERRORS, OMISSIONS, ETC. TO THE STATE'S REPRESENTATIVE IMMEDIATELY UPON DISCOVERY. IF SO DIRECTED BY THE STATE'S REPRESENTATIVE, THE CONTRACTOR SHALL STOP WORK UNTIL MITIGATION CAN BE MADE. AND COSTS INCURRED RESULTING FROM THE CONTRACTOR'S FAILURE TO STOP WORK AS DIRECTED SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
15. APPROVAL OF THESE PLANS DOES NOT AUTHORIZE OR APPROVE ANY OMISSION OR DEVIATION FROM APPLICABLE REGULATIONS. FINAL APPROVAL IS SUBJECT TO FIELD INSPECTION. ONE SET OF APPROVED PLANS AND SPECIFICATIONS SHALL BE AVAILABLE ON THE PROJECT SITE AT ALL TIMES.

V-GROOVE NOTES:

1. PRIOR TO BEGINNING CONCRETE WORK ON THE ACTUAL SEDIMENT TRAP, THE CONTRACTOR SHOULD BE REQUIRED TO MAKE 4' x 8' x 4" V-GROOVE CONCRETE TEST PANELS ON FLAT GROUND AT THE CONSTRUCTION SITE. UPON APPROVAL OF A TEST PANEL BY THE STATE'S REPRESENTATIVE, THE PANEL WILL DEMONSTRATE THE CONTRACTOR'S ABILITY TO FORM SATISFACTORY V-GROOVES AND WILL SERVE AS AN OBJECTIVE STANDARD ON THE SITE FOR JUDGING THE ACCEPTABILITY OF THE V-GROOVES FORMED ON THE ACTUAL SEDIMENT TRAP.
2. USE A CONCRETE CREW OF NOT LESS THAN 5 WORKERS INCLUDING AT LEAST 2 FINISHERS.
3. ALL TOOLS, SUPPLIES, EQUIPMENT AND MATERIALS ARE TO BE ON SITE BEFORE BEGINNING PLACEMENT OF CONCRETE.
4. FOR MULTIPLY LANE, PLACE CONCRETE AND FINISH ONE LANE AT A TIME.
5. START EARLY IN THE DAY WITH ATTENTION TO:

   5.1. TIME OF YEAR
   5.2. ALTITUDE
   5.3. HAUL DISTANCE
   5.4. TEMPERATURE
   5.5. WIND
   5.6. DESIGN MIX
   5.7. WEATHER FORECAST
   5.8. CLIMATE
   5.9. SIZE OF CREW

6. LIMIT PLACEMENT OF CONCRETE TO THE FOLLOWING MAXIMUM RATES PER HOUR:

   8-10 CY/HOUR FOR 6" THICK SECTIONS
   11-13 CY/HOUR FOR 8" THICK SECTIONS

   THIS WILL RESULT IN A PRODUCTION RATE OF ABOUT 30-35 LINEAR FEET OF 15' WIDE LANE PER HOUR, OR AN AREA OF ABOUT 450-525 SQUARE FEET.

7. ADEQUATELY VIBRATE THE CONCRETE EVERY 12" ON CENTER WITH INTERNAL VIBRATORS TO ELIMINATE AIR POCKETS, AND TO INSURE FULL CONTACT WITH THE REBAR AND CONSTRUCTION FORMS. DO NOT OVER-VIBRATE AS THE AGGREGATE WILL SETTLE TO THE BOTTOM AND WEAKEN THE CONCRETE SLAB.
8. IF NECESSARY, SCREED THE WET CONCRETE TO THE TOP OF THE FORMS USING A VIBRATORY POWER SCREED, WORKING UPHILL VIA HAND OR GASOLINE POWERED WINCHES.
9. WOOD FLOAT THE CONCRETE AS NECESSARY TO TOUCH UP AND REPAIR THE SCREEDED SURFACE.
10. BEGINNING AT THE APPROPRIATE LOWER CORNER, BEGIN FORMING V-GROOVES AT AN SPECIFIED ANGLE (SEE PLAN) FROM THE LONGITUDINAL AXIS OF THE SEDIMENT. INITIALLY, THERE WILL BE A TRIANGULAR AREA AT THE VERY BOTTOM OF THE SEDIMENT TRAP WITHIN WHICH IT WILL BE AWKWARD TO USE THE V-GROOVE TOOL HOWEVER, AFTER PROGRESSING UP THE SEDIMENT TRAP TO THE POINT WHERE THE V-GROOVE TOOL CAN BE USED OVER THE FULL WIDTH OF THE LAUNCHING LANE, THE GROOVING OPERATION WILL BE MUCH EASIER. CARE MUST BE TAKEN TO INSURE THAT THE ANGLES ON THE FRONT AND REAR OF THE V-GROOVE TOOL FIT SNUGLY AGAINST THE FORMS ON EACH PASS OF THE TOOL ACROSS THE WET CONCRETE. IT IS OFTEN HELPFUL TO FABRICATE A COUPLE OF SMALLER V-GROOVE HAND TOOLS TO USE IN THE TIGHT CORNERS ARE THE TOP AND BOTTOM FOR THE RAMP. FOR A 15' WIDE LANE, THE USE OF A STRAIGHT 20' LENGTH OF 2" x 6" LUMBER WILL BE OF GREAT ASSISTANCE IN MAINTAINING THE CORRECT ALIGNMENT AND PROVIDES A GUIDE FOR RUNNING THE V-GROOVE TOOL ACROSS THE WET CONCRETE. WHEN DONE PROPERLY, CRISP V-GROOVES CAN BE FORMED WITH ONLY ONE OR TWO PASSES OF THE TOOL. VIBRATE, SCREED AND V-GROOVE ONE HOURLY PLACEMENT OF CONCRETE BEFORE ALLOWING THE NEXT PLACEMENT. IF UNEXPECTED DELAYS OCCUR BETWEEN HOURLY PLACEMENTS DUE TO EQUIPMENT PROBLEMS, TRAFFIC, ETC., LEAVE THE ROUGH EDGE ALONG THE UPPER SIDE FOR THE LAST PLACEMENT GENERALLY ALONG THE SAME ANGLE ALIGNMENT OF THE V-GROOVES. THIS WILL ELIMINATE MOST OF THE PROBLEMS OF TRYING TO FINISH BOTH "OLD" AND "NEW" CONCRETE ON THE SAME PASS OF THE FINISH TOOL. TO ASSIST CONTRACTORS AND OTHERS IN THE CONSTRUCTION OF V-GROOVE SURFACES, THE DIVISION OF BOATING AND WATERWAYS HAS PRODUCED AN EIGHT MINUTE VIDEO WHICH ILLUSTRATES THE INFORMATION PRESENTED ABOVE. THE VIDEO CAN BE ORDERED BY CONTACTING THE STATE'S REPRESENTATIVE AS PER THE INFORMATION AT THE END OF THE INTRODUCTION TO THE LAYOUT, DESIGN AND CONSTRUCTION HANDBOOK BY THE DEPARTMENT OF BOATING AND WATERWAYS.

TESTING REQUIREMENTS:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL EARTHWORK COMPACTION TESTING. THE STATE'S REPRESENTATIVE SHALL BE NOTIFIED AT LEAST 72-HOURS IN ADVANCE OF ANY SCHEDULED COMPACTION TESTING BEING PERFORMED ON THE SITE. ALL COMPACTION TESTING SHALL BE PERFORMED BY A REGISTERED SOIL ENGINEER IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND SHALL BE PAID FOR BY THE CONTRACTOR. RESULTS OF THESE TESTS SHALL BECOME THE PROPERTY OF THE STATE. ANY RE-TESTING DEEMED NECESSARY BY THE STATE'S REPRESENTATIVE SHALL BE PAID FOR BY THE CONTRACTOR.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL AGGREGATE BASE COMPACTION TESTING. THE STATE'S REPRESENTATIVE SHALL BE NOTIFIED AT LEAST 72-HOURS IN ADVANCE OF ANY SCHEDULED COMPACTION TESTING BEING PERFORMED ON THE SITE. ALL COMPACTION TESTING SHALL BE PERFORMED BY A REGISTERED SOIL ENGINEER IN ACCORDANCE WITH THE WITH THE PROJECT SPECIFICATIONS AND SHALL BE PAID FOR BY THE CONTRACTOR. RESULTS OF THESE TESTS SHALL BECOME THE PROPERTY OF THE STATE. ANY RE-TESTING DEEMED NECESSARY BY THE STATE'S REPRESENTATIVE SHALL BE PAID FOR BY THE CONTRACTOR
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY AGGREGATE CONCRETE TESTING IF DEEMED NECESSARY BY THE STATE'S REPRESENTATIVE. THE STATE'S REPRESENTATIVE SHALL BE NOTIFIED AT LEAST 72-HOURS IN ADVANCE OF ANY SCHEDULED PAVING OPERATION BEING PERFORMED ON THE SITE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EMPLOYING A TESTING AGENCY TO PERFORM CONCRETE TESTING AT THEIR EXPENSE. ALL RESULTS OF THE CONCRETE TESTING SHALL BECOME PROPERTY OF THE STATE. THE CONTRACTOR SHALL SUPPLY ONE (1) SET OF FOUR (4) STANDARD CYLINDERS FOR EVERY 20 CUBIC YARDS OF CONCRETE PLACED, OR FOR EACH MAJOR PLACEMENT DURING THE DAY. ONE SPECIMEN SHALL BE TESTED AT SEVEN (7) DAYS, TWO (2) SPECIMENS TESTED AT 28 DAYS, AND ONE (1) SPECIMEN RETAINED IN RESERVE FOR LATER TESTING IF REQUIRED. COMPRESSIVE STRENGTH TESTS SHALL BE PERFORMED AS PER REQUIREMENTS SET FORTH IN THE PROJECT SPECIFICATIONS. THE STATE'S REPRESENTATIVE SHALL BE NOTIFIED AT LEAST 72-HOURS IN ADVANCE OF ANY SCHEDULED CONCRETE POURING BEING PERFORMED ON THE SITE. PRIOR TO ANY CONCRETE PLACEMENT, FORMWORK AND REBAR PLACEMENT MUST BE INSPECTED AND APPROVED BY THE STATE'S REPRESENTATIVE. FAILURE RECEIVE APPROVAL BY THE STATE'S REPRESENTATIVE ON FORMWORK AND REBAR PLACEMENT PRIOR TO POURING CONCRETE MAY RESULT IN THE CONTRACTOR DEMOLISHING IMPROVEMENTS AT THEIR EXPENSE.

ACCESSIBILITY NOTES:

1. ALL FLATWORK AND CURBS SHALL BE CONSTRUCTED TO COMPLY WITH CURRENT TITLE 24 ADA ACCESSIBILITY LAWS. THIS REQUIRES "EXTRA EFFORT" IN ACHIEVING THE ACCURACY OF THE GRADES AND SLOPES REQUIRED (FINISHED GRADES OF CONCRETE IN TITLE 24 AREAS SHALL BE WITHIN A TOLERANCE OF ±1/8" OF PROPOSED GRADES). PRIOR TO POURING ANY CURB OR FLATWORK AROUND THE PERIMETER OF ANY BUILDING, THE CONCRETE CONTRACTOR SHALL VERIFY THAT THE GRADE OF THE FINISHED FLOOR AND THE FLATWORK/CURB FORMS ARE IN THE PROPER GRADE DIFFERENTIAL PRIOR TO POURING CONCRETE ON ANY TITLE 24 ROUTE OF ACCESS. IF ANY DIFFERENCES ARE FOUND, NOTIFY THE STATE'S REPRESENTATIVE IMMEDIATELY PRIOR TO PROCEEDING.
2. PARKING
   2.1. SURFACE SLOPES FOR PARKING SPACES AND ACCESS AISLES SERVING THEM SHALL NOT EXCEED 2% IN ANY DIRECTION.

SHEET SIZE: 22X34

CALIFORNIA STATE PARKS SINCE 1864 ®

FACILITIES & DEVELOPMENT
One Capitol Mall
Sacramento, CA 95814

REGISTERED PROFESSIONAL ENGINEER
VINH LE
No. 84125
SIGNED: 05/28/20
CIVIL
STATE OF CALIFORNIA

OFFICE OF THE STATE FIRE MARSHAL
APPROVED FIRE AND PANIC ONLY
Approval of this plan does not authorize or approve any omission or deviation from applicable regulations. Final approval is subject to field inspection. One set of approved plans shall be available on the project site at all times.

Reviewed by Date

DPR ACCESS COMPLIANCE REVIEW
ACCESSIBILITY SECTION
Certification #

Reviewed by Date

ACCESSIBILITY COMPLIANCE AND STATE FIRE MARSHAL SIGNED ORIGINALS ARE ON FILE AT THE DEPARTMENT OF PARKS AND RECREATION, NORTHERN SERVICE CENTER

DESIGNED:	VL
DRAWN:	VL
CHECKED:	KR
DATE: 05-28-2020	

REVISIONS	
△	DATE

OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

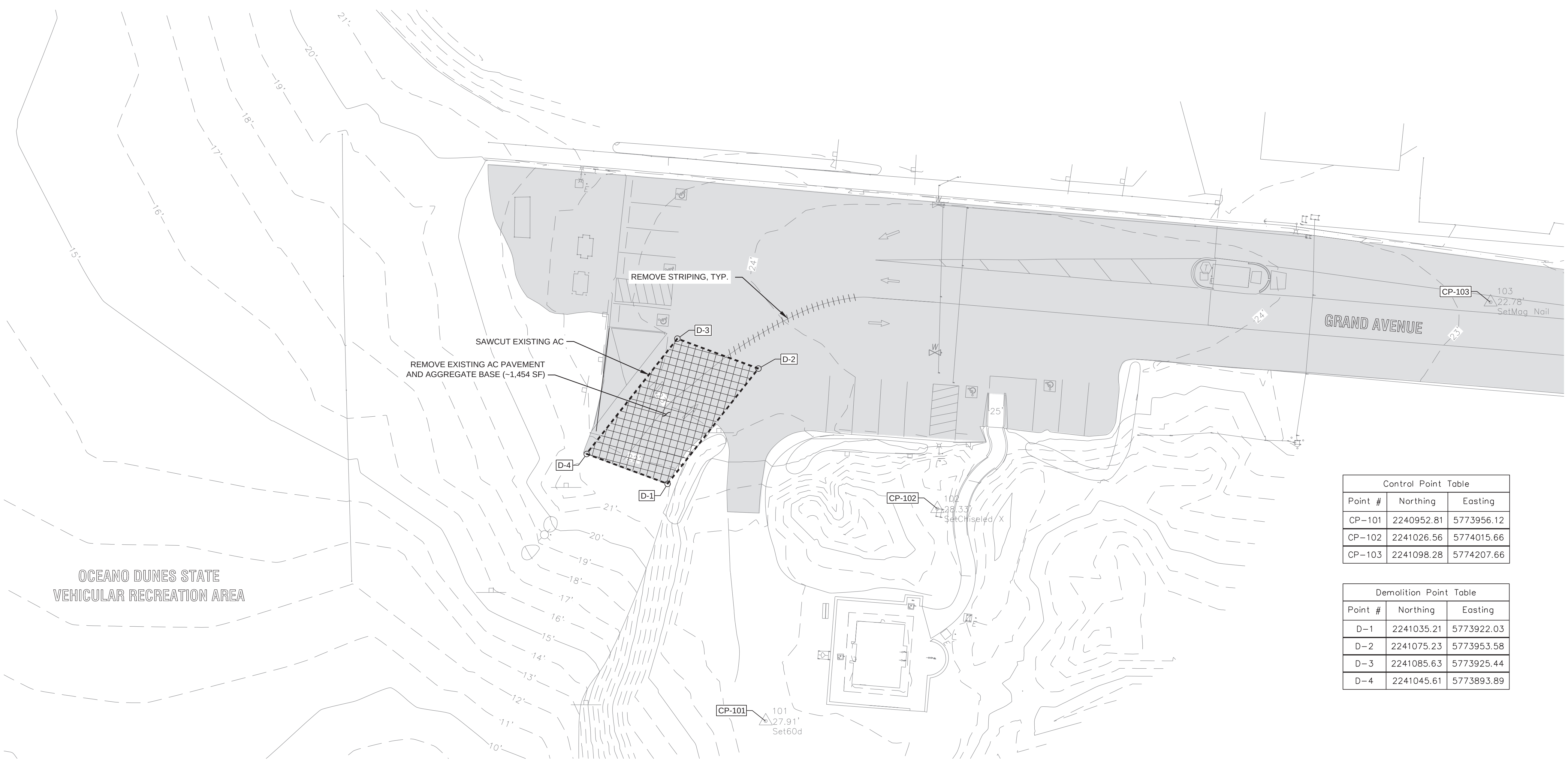
GENERAL NOTES

DRAWING NO.
04535P.2

SHEET NO.
G-2

100% SUBMITTAL

File: C:\Users\vinh.le\Desktop\Corna Virus\Oceano Dunes Trackout\05_Drawings\Engineering\C-1 EXISTING SITE AND DEMOLITION PLAN - GRAND AVENUE.dwg Layout: C-1 EXISTING SITE AND DEMOLITION PLAN - GRAND AVENUE Date: May 28 2020 - 1:44 pm U $(++)



Control Point Table		
Point #	Northing	Easting
CP-101	2240952.81	5773956.12
CP-102	2241026.56	5774015.66
CP-103	2241098.28	5774207.66

Demolition Point Table		
Point #	Northing	Easting
D-1	2241035.21	5773922.03
D-2	2241075.23	5773953.58
D-3	2241085.63	5773925.44
D-4	2241045.61	5773893.89

EXISTING SITE AND DEMOLITION PLAN - GRAND AVENUE

SCALE: 1" - 20'

LEGEND

- EXISTING AC TO BE DEMOLISHED AND REMOVED (~1,454 SF)
- EXISTING AC ROADWAY TO REMAIN UNDISTURBED
- SAWCUT LINE
- REMOVE STRIPING

DEMOLITION NOTES

1. CONSTRUCTION SITE SHALL BE KEPT CLEAR FROM THE DEBRIS AND CONSTRUCTION MATERIAL.
2. CONTRACTOR SHALL LEGALLY DISPOSE OF CONSTRUCTION DEBRIS OFFSITE.
3. CONTRACTOR SHALL WORK ON ONE LOCATION AT A TIME TO ENSURE THAT VEHICULAR ACCESS TO THE BEACH IS AVAILABLE.

N W E S

1"=20'

0 10 20 40

SHEET SIZE: 22X34

CALIFORNIA STATE PARKS SINCE 1864

FACILITIES & DEVELOPMENT
One Capitol Mall
Sacramento, CA 95814

REGISTERED PROFESSIONAL ENGINEER VINH LE No. 84125 SIGNED: 05/28/20 CIVIL STATE OF CALIFORNIA

OFFICE OF THE STATE FIRE MARSHAL APPROVED FIRE AND PANIC ONLY

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SEDIMENT TRACK-OUT PREVENTION MEASURES

EXISTING SITE AND DEMOLITION PLAN - GRAND AVENUE

DRAWING NO. 04535P.3

SHEET NO. C-1

3 OF 8

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File: C:\Users\vinh.le\Desktop\Corna Virus\Oceano Dunes Trackout\05_Drawings\Engineering\C-2 EXISTING SITE AND DEMOLITION PLAN - PIER AVENUE.dwg Layout: C-2 EXISTING SITE AND DEMOLITION PLAN - PIER AVENUE Date: May 28 2020 - 1:45 pm Use $(++)

EXISTING SITE AND DEMOLITION PLAN - PIER AVENUE

SCALE: 1" - 20'

Control Point Table		
Point #	Northing	Easting
CP-101	2235048.32	5775134.55
CP-102	2234788.17	5775151.13
CP-103	2234986.22	5775015.77
CP-104	2235051.30	5774928.89
CP-105	2235061.78	5775016.38
CP-106	2235210.12	5774918.51

Demolition Point Table		
Point #	Northing	Easting
D-1	2234962.4681	5774941.13
D-2	2234980.2073	5774950.31
D-3	2234994.9965	5774947.81
D-4	2234993.2313	5774937.49
D-5	2235019.9554	5774916.01
D-6	2234979.4819	5774899.48

LEGEND

- EXISTING AC TO BE DEMOLISHED AND REMOVED (~1,897 SF)
- EXISTING AC ROADWAY TO REMAIN UNDISTURBED
- SAWCUT LINE
- REMOVE STRIPING

DEMOLITION NOTES

1. CONSTRUCTION SITE SHALL BE KEPT CLEAR FROM THE DEBRIS AND CONSTRUCTION MATERIAL.
2. CONTRACTOR SHALL LEGALLY DISPOSE OF CONSTRUCTION DEBRIS OFFSITE.
3. CONTRACTOR SHALL WORK ON ONE LOCATION AT A TIME TO ENSURE THAT VEHICULAR ACCESS TO THE BEACH IS AVAILABLE.

N W E S

1"=20'

0 10 20 40

SHEET SIZE: 22X34

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OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

EXISTING SITE AND DEMOLITION PLAN - PIER AVENUE

DRAWING NO.
04535P.4

SHEET NO.
C-2

4 OF 8

100% SUBMITTAL

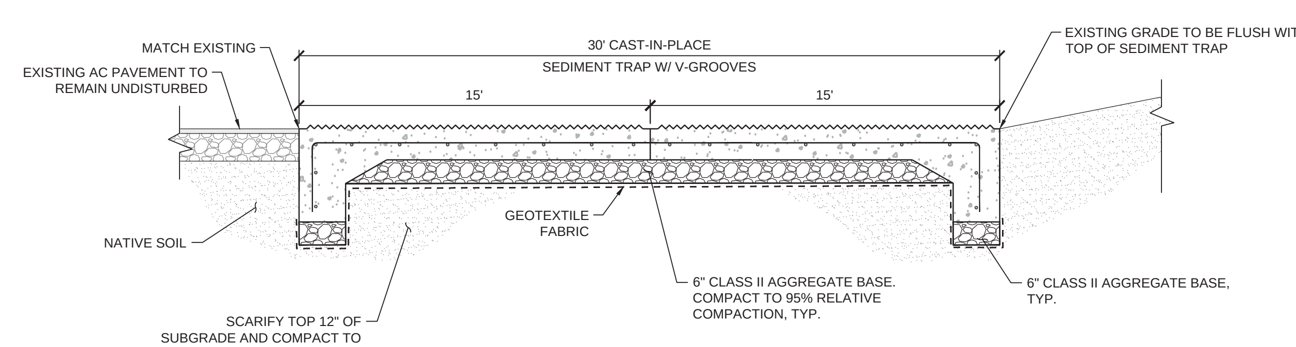
File: C:\Users\vinh.le\Desktop\Corna Virus\Oceano Dunes Trackout\05_Drawings\Engineering\C-3 SITE IMPROVEMENT PLAN - GRAND AVENUE.dwg Layout: C-3 SITE IMPROVEMENT PLAN - GRAND AVENUE Date: May 28 2020 - 2:10 pm User: Vinh.Le

SITE IMPROVEMENT PLAN - GRAND AVENUE

SCALE: 1" - 20'

LEGEND

PROPOSED CONCRETE SEDIMENT TRAP WITH V-GROOVES	PROPOSED GEOTEXTILE FABRIC
PROPOSED CONCRETE	PROPOSED CENTERLINE STRIPING
PROPOSED CLASS II AGGREGATE BASE	
EXISTING AC ROADWAY TO REMAIN UNDISTURBED	
EXISTING AGGREGATE BASE	
NATIVE SOIL	



SECTION A

NOT TO SCALE

N W E S

1"=20'

0 10 20 40

SHEET SIZE: 22X34

CALIFORNIA STATE PARKS SINCE 1864

FACILITIES & DEVELOPMENT
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SEDIMENT TRACK-OUT PREVENTION MEASURES

SITE IMPROVEMENT PLAN - GRAND AVENUE

DRAWING NO.
04535P.5

SHEET NO.
C-3

5 OF 8

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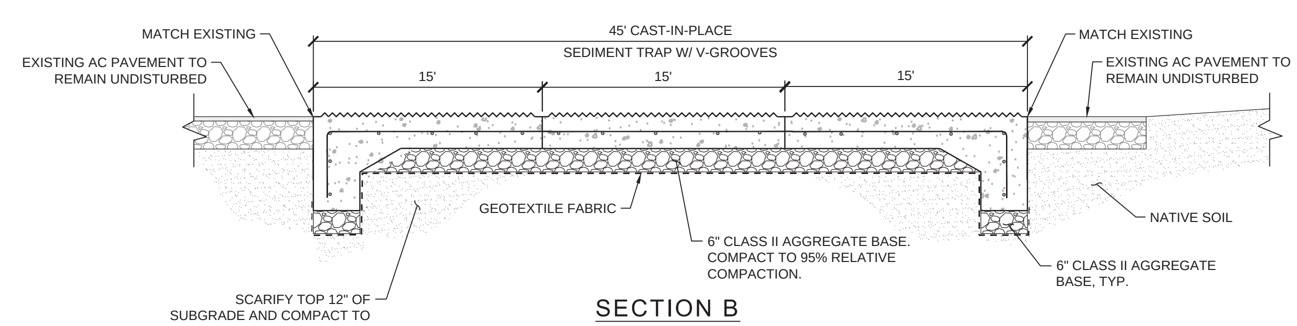
SITE IMPROVEMENT PLAN - PIER AVENUE

SCALE: 1" - 20'

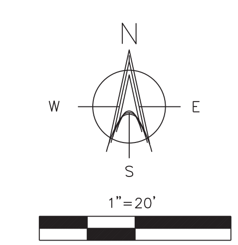
LEGEND

- PROPOSED CONCRETE SEDIMENT TRAP WITH V-GROOVES
- PROPOSED CONCRETE
- PROPOSED CLASS II AGGREGATE BASE
- EXISTING AC ROADWAY TO REMAIN UNDISTURBED
- EXISTING AGGREGATE BASE
- NATIVE SOIL
- PROPOSED GEOTEXTILE FABRIC



SECTION B

NOT TO SCALE



SHEET SIZE: 22X34

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OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

SITE IMPROVEMENT PLAN - PIER AVENUE

DRAWING NO.
04535P.6

SHEET NO.
C-4

6 OF 8

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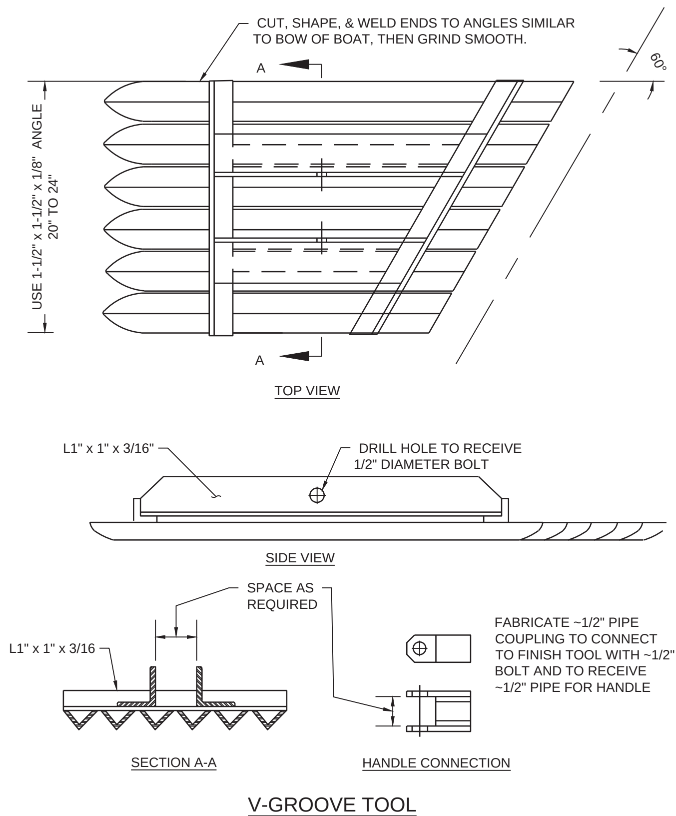
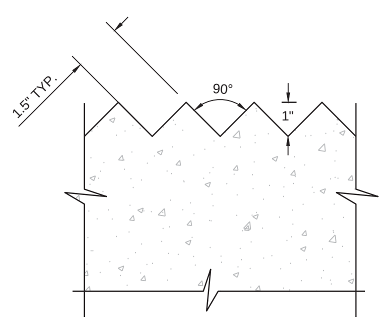
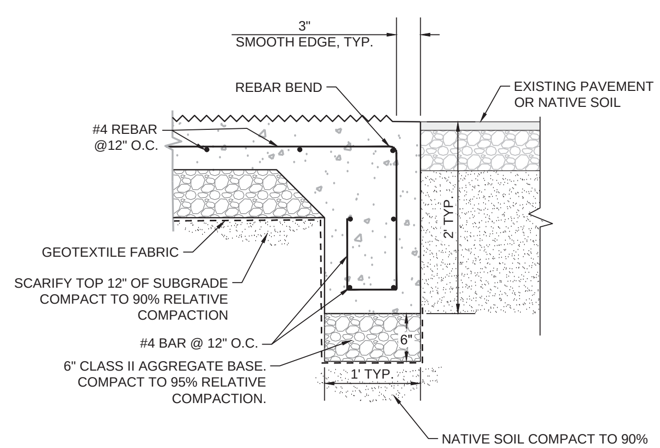


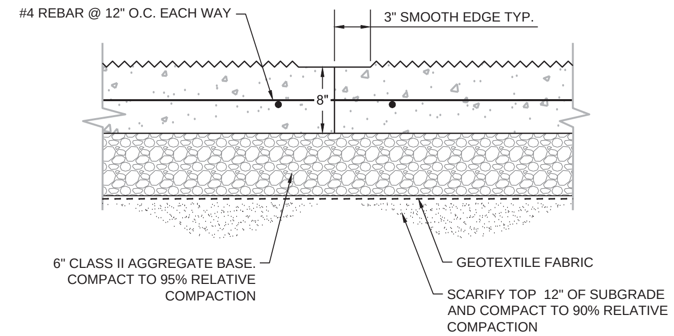
1 V-GROOVE LAYOUT & TOOL
NTS



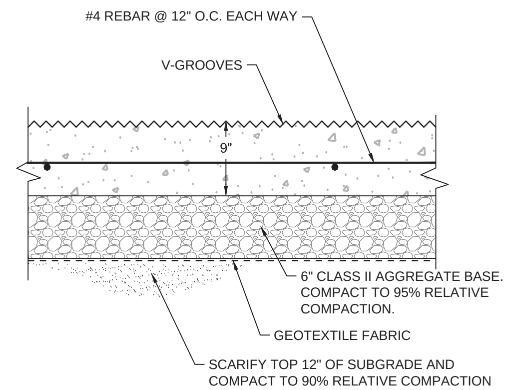
2 V-GROOVES
NTS



3 TURNDOWN FOOTING
NTS



4 CONTROL JOINT
NTS



5 CONCRETE SEDIMENT TRAP
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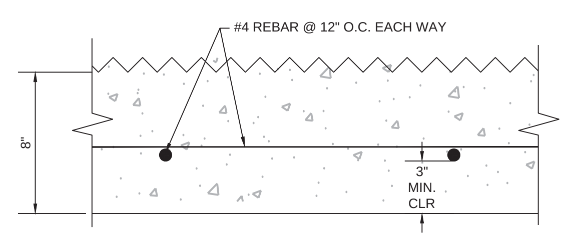

6 REBAR CLEARANCE
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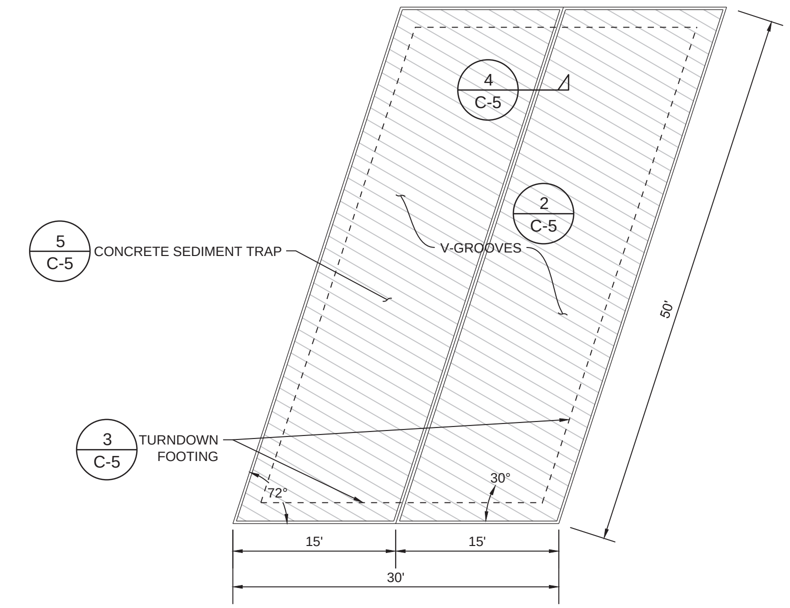
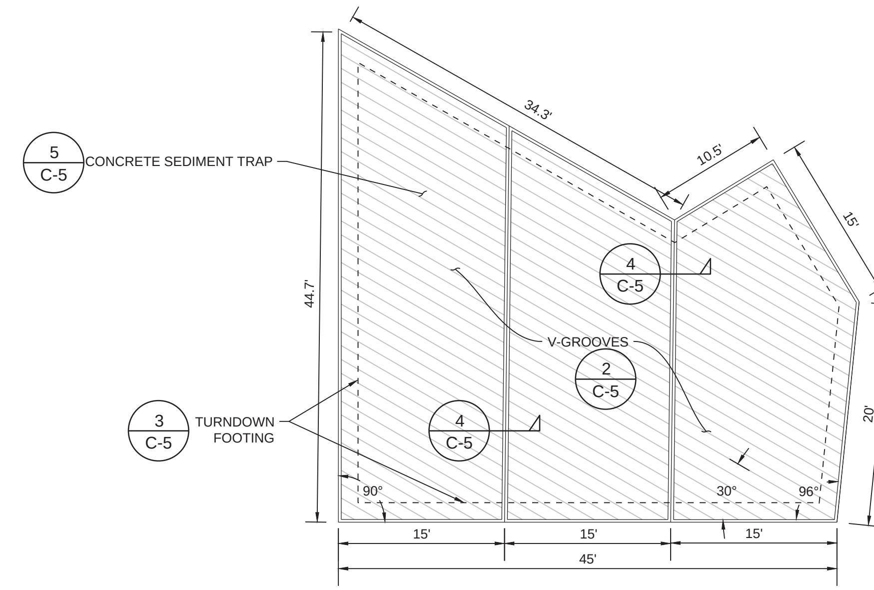


7 SEDIMENT TRAP LAYOUT - GRAND AVENUE
NTS



8 SEDIMENT TRAP LAYOUT - PIER AVENUE
NTS

SHEET SIZE: 22X34

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CALIFORNIA STATE PARKS SINCE 1864

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No. 84125
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Reviewed by Date

DPR ACCESS COMPLIANCE REVIEW
ACCESSIBILITY SECTION
Certification #

Reviewed by Date

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DESIGNED:	VL
DRAWN:	VL
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DATE: 05-28-2020	

REVISIONS

△	DATE

OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES
CONSTRUCTION DETAILS

DRAWING NO.
04535P.7

SHEET NO.
C-5
7 OF 8

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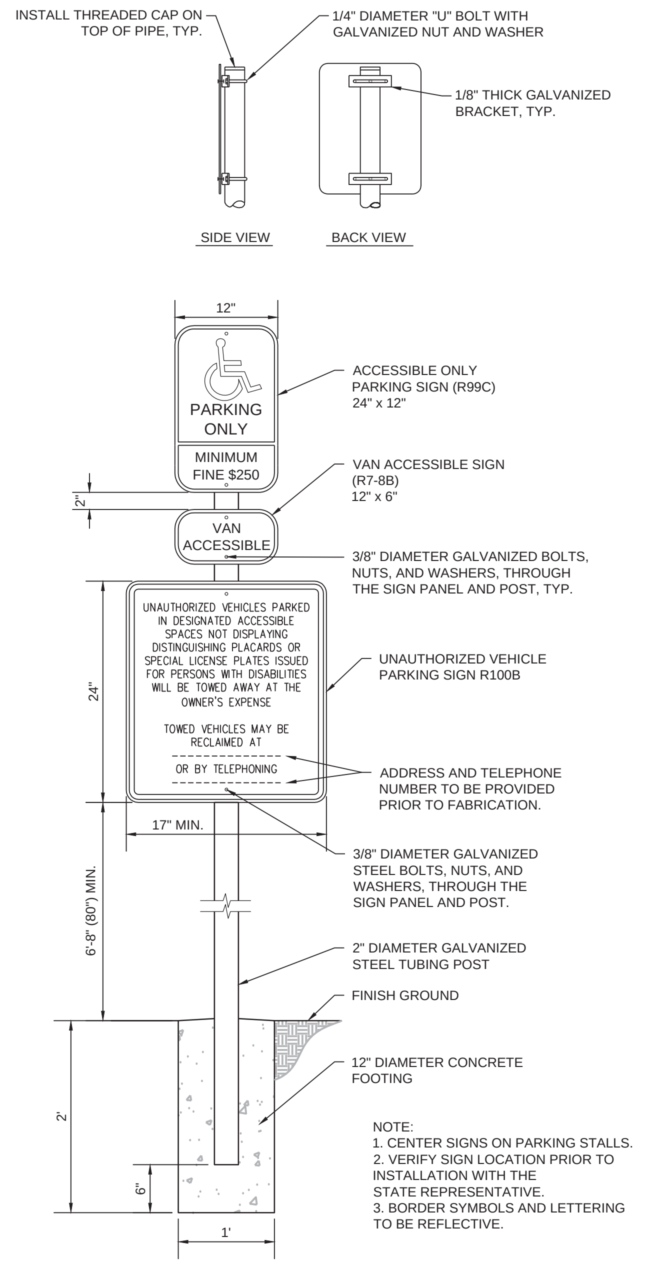

1 ACCESSIBLE PARKING SIGN & POST
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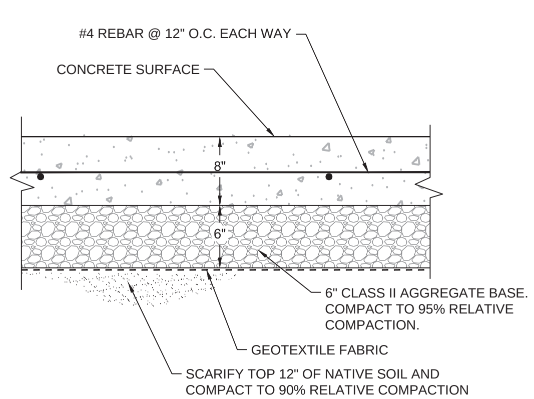

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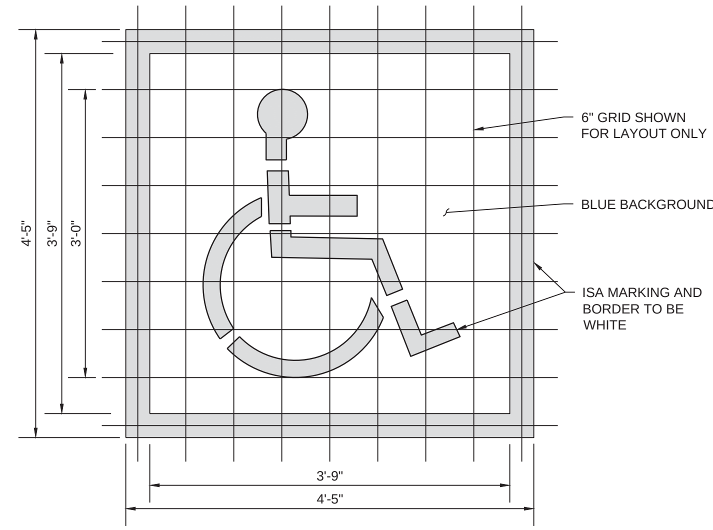

3 INTERNATIONAL SYMBOL OF ACCESS MARKING
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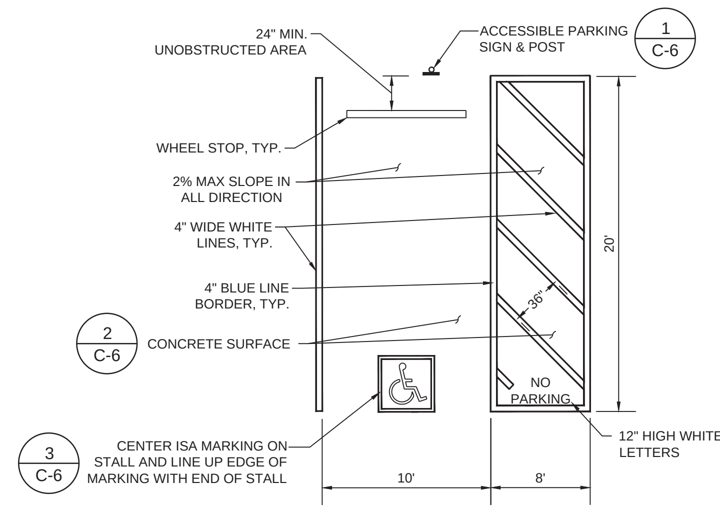

4 VAN ACCESSIBLE PARKING STALL
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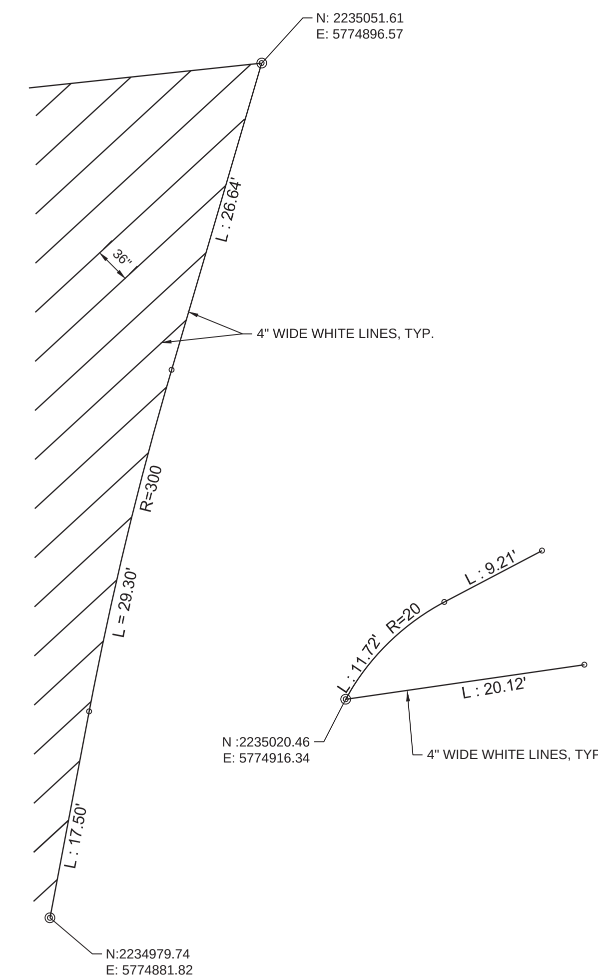

5 STRIPING - PIER AVENUE
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OCEANO DUNES SVRA
SEDIMENT TRACK-OUT PREVENTION MEASURES

ACCESSIBILITY AND STRIPING DETAILS

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C-6
8 OF 8

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 06

DRI MetOne 212-2/BAM Calibration Procedures

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2020 Pre and Post Deployment Calibrations of MetOne 212-2 Instruments with a BAM

In order to achieve a measure of PM_{10} from the MetOne 212-2 instrument that can be compared between stations and to the PM_{10} measured by an EPA Federal Equivalent Method a calibration procedure was developed to convert the particle count data to an equivalent mass based PM_{10} concentration. Cross-calibration of each 212-2 instrument with a Beta Attenuation Monitor (BAM-1022, MetOne Instruments, Grants Pass, OR) was achieved by collocating them in an environmentally controlled chamber and establishing a unit-specific calibration relation. The instruments are rack-mounted in the chamber beside the BAM and a filter-based sampler (cyclone-style sampler). Under controlled temperature and humidity conditions dust is created by simulated saltation of Oceano

Dune sand and mixed thoroughly within the chamber exposing all instruments to the same PM10 concentrations. The data stream (particle counts in each bin size per unit time) from the 212-2 units and the BAM (μg m^{-3}) are recorded by a datalogger.

Each 212-2 outputs a data string corresponding to the counts of particles that are greater than a given diameter in a given volume. In order to translate this into a mass-equivalent concentration: 1) the number of particles in a size bin is calculated by subtracting the number of counts associated with all larger size bins, 2) a diameter representing all the particles within a size bin is estimated (taken to be the geometric mean of the minimum and maximum of the size bin), 3) the volume of an individual particle of the characteristic diameter of the size bin is calculated assuming particles are spheres, 4) the total volume of particles in a volume of air is calculated by multiplying the volume of a single particle by the number of particles in the size bin in the known volume of air, and 5) a particle density of 2600 kg m^{-3} is used to estimate the mass concentration of particles in the size bin. The cumulative mass concentration of particles through size bin 6 is denoted as PMbin6. A calibration relationship between the BAM and the PMbin6 value is defined through the paired values of BAM-measured PM_{10} and calculated PMbin6 for each 212-2 instrument.

An example of this relation is shown in Figure A. The consistency of the calibration relations among the 212-2 units prior to deployment in 2020 was good. The mean slope value for all units combined was 0.238 (±0.063) and mean intercept was 4.704 (±0.869). The mean correlation coefficient was 0.950 (±0.013).

In addition to the chamber testing, an in-Park calibration station was established in 2020. This station consisted of a BAM, mounting hardware for two 212-2 units, wind speed, wind direction and RH instruments, and datalogging with modem telemetry. The purpose of the in-Park calibration was to determine the performance of the 212-2 and BAM instruments under ambient conditions at the ODSVRA. Of concern was their ability to perform under high wind

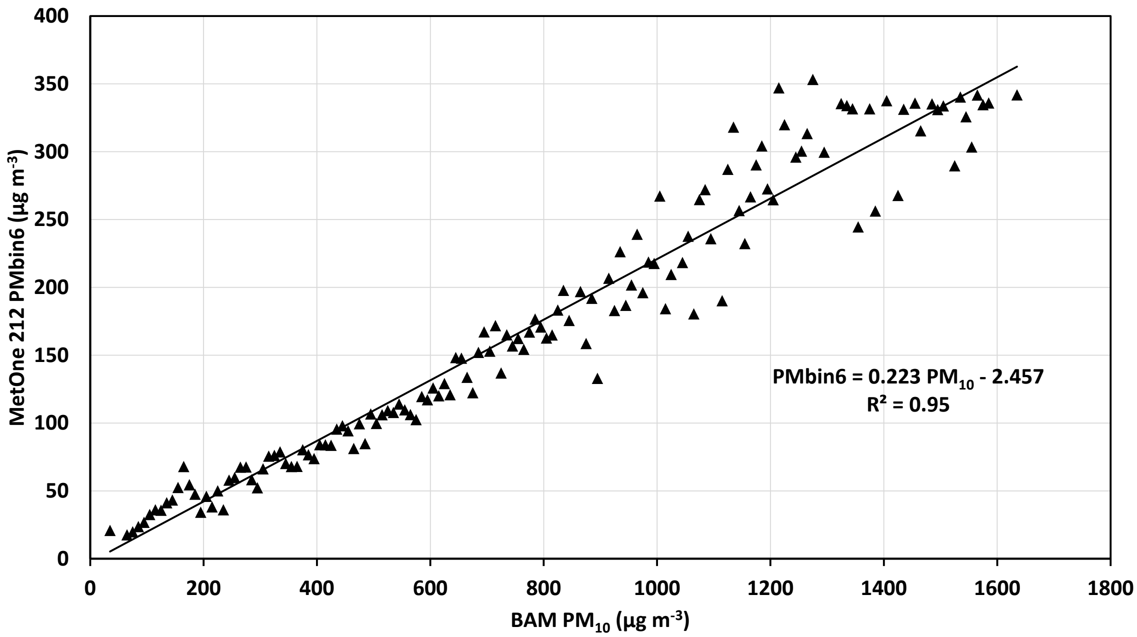

Figure A. An example of the calibration relationship between BAM and PMbin6 from chamber testing for the MetOne 212 instrument deployed at the BBQ site (Fig. 4).

conditions and whether this resulted in a bias in the measurement compared to the BAM. In 2020, 10 of the 212-2 units were collocated with the in-Park BAM.

The available data from the in-Park calibration testing indicated that the 212-2 units were not adversely affected by wind speeds that exceeded 5 m s-1 compared to the chamber conditions (i.e., no wind). The mean slope value and intercept values were 0.224 (±0.042) and 5.096 (±3.437), respectively. The mean correlation coefficient was 0.917 (±0.119). The differences in slope, intercept, and correlation coefficient are due to the dynamic nature of the field environment, but the degree of change indicates that under these conditions the correlation between the two instruments remained high and provides confidence that the 212-

An example of the post-deployment calibration (January 2021) relation is shown in Figure B. The consistency of the calibration relations among the 212-2 units post-deployment was good. The

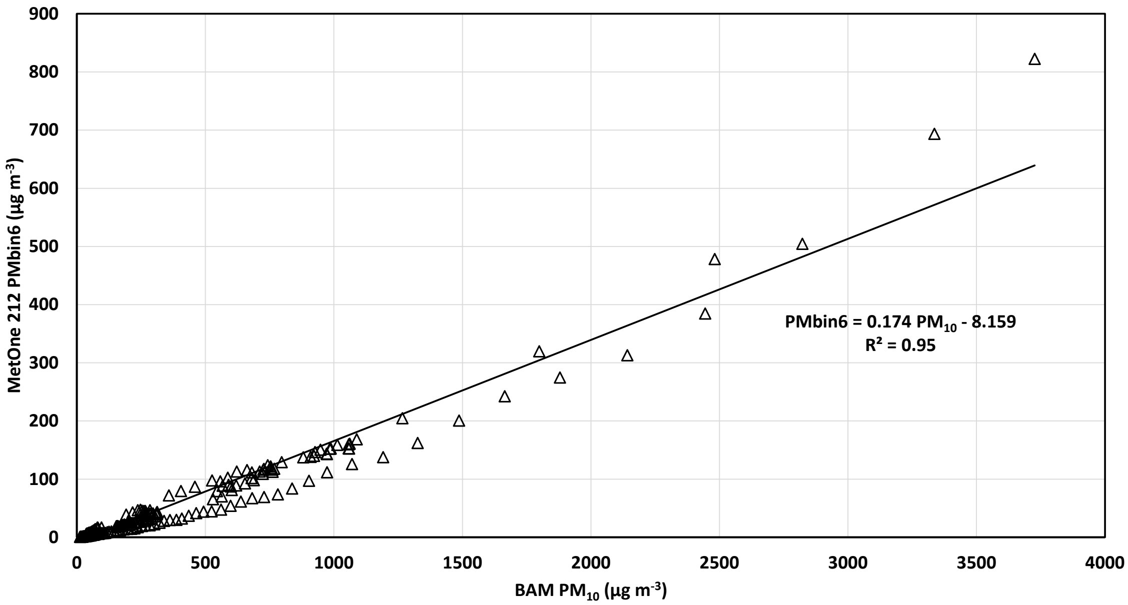

Figure B. An example of the calibration relationship between BAM and PMbin6 from chamber testing for the MetOne 212 instrument deployed at the BBQ site (Fig. 4) following removal from the field.

mean slope value for all units combined was 0.238 (±0.082) and mean intercept was -8.254 (±3.018). The mean correlation coefficient was 0.966 (±0.011). The post-deployment calibrations compare very favorably with the pre-deployment calibrations in terms of the slopes of the relation between the MetOne 212 (dependent variable) and the BAM (independent variable). The change in the mean intercept from 0.238 to -8.254 suggests a systematic change did occur, but overall the effect on the calculated PM_{10} values is less than 10 µg m^{-3}.

The data acquired from these stations are used to evaluate the state of the dust emission system within the ODSVRA across space and through time. The developing database is used to compare various metrics (e.g., monthly total Wind Power Density [W m^{-2}], Total PM_{10} [µg m^{-3}]) between months and between years. Examples of the continuous data collected for the in-Park Station Moymell and the out-of-Park Station CDF for May 2020 are shown in Figure C.

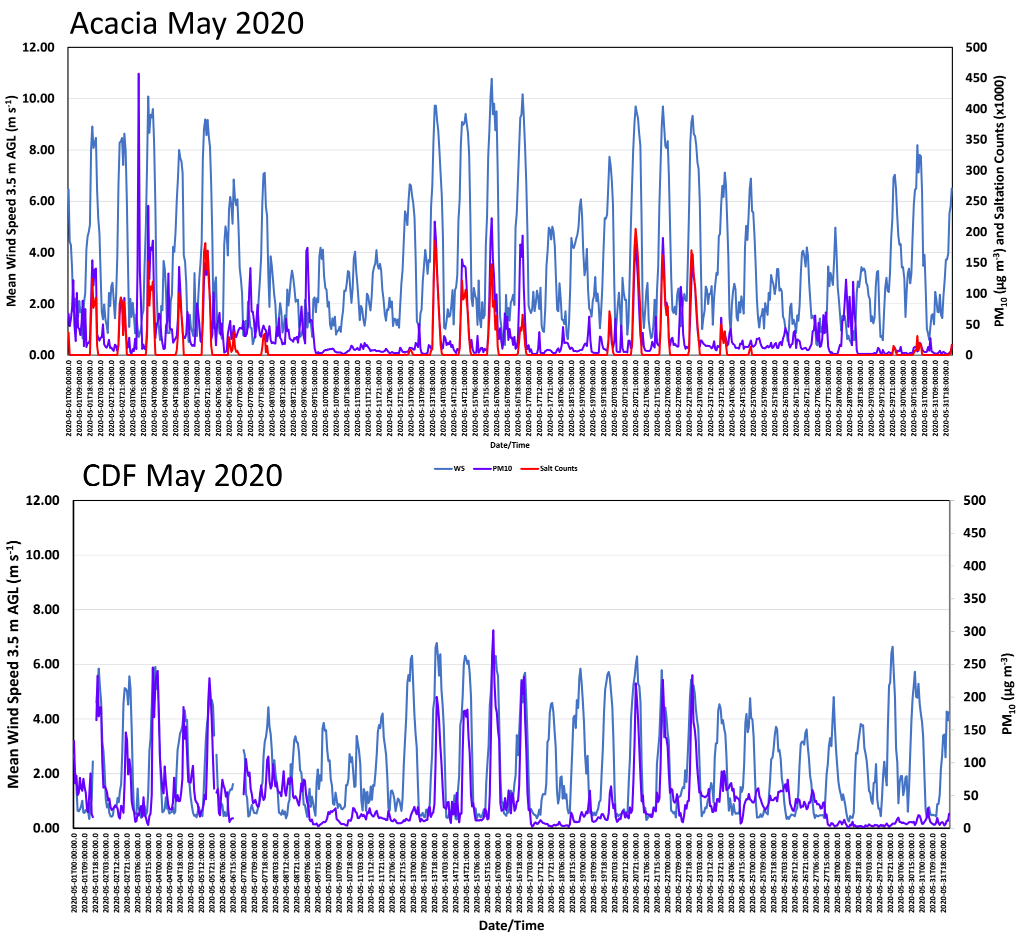

Figure C. Examples of mean hourly wind speed, PM_{10}, and Sensit particle counts from the network stations Acacia and CDF (see 2021 ARWP Figure 2-6 for locations). Note the Acacia station has a Sensit whereas CDF does not.

2021 Pre Deployment Calibrations of MetOne 212-2 Instruments with a BAM

The MetOnes deployed in spring 2021 were calibrated against a BAM in the DRI environmental chamber in Las Vegas in April 2021. An example of the relation between PMbin6 and Bam-measured PM_{10} is shown in Figure D. for unit #8. For the instruments calibrated in April 2021, relation between the MetOnes and the BAM had a mean correlation coefficient (R^2) of 0.982 (±0.005) between the calculated PMbin6 values and the BAM-measured PM_{10} values. The mean slope value for all units combined was 0.490 (±0.132) and mean intercept was -4.060 (±0.989). The values of the slope and intercept have changed each year for each instrument, which is likely due to the reconditioning each unit goes through at the annual factory maintenance. The in-chamber and in-Park calibrations are necessary to ensure that each instrument has a specific calibration to provide the best estimate of PM_{10} during deployment at the ODSVRA.

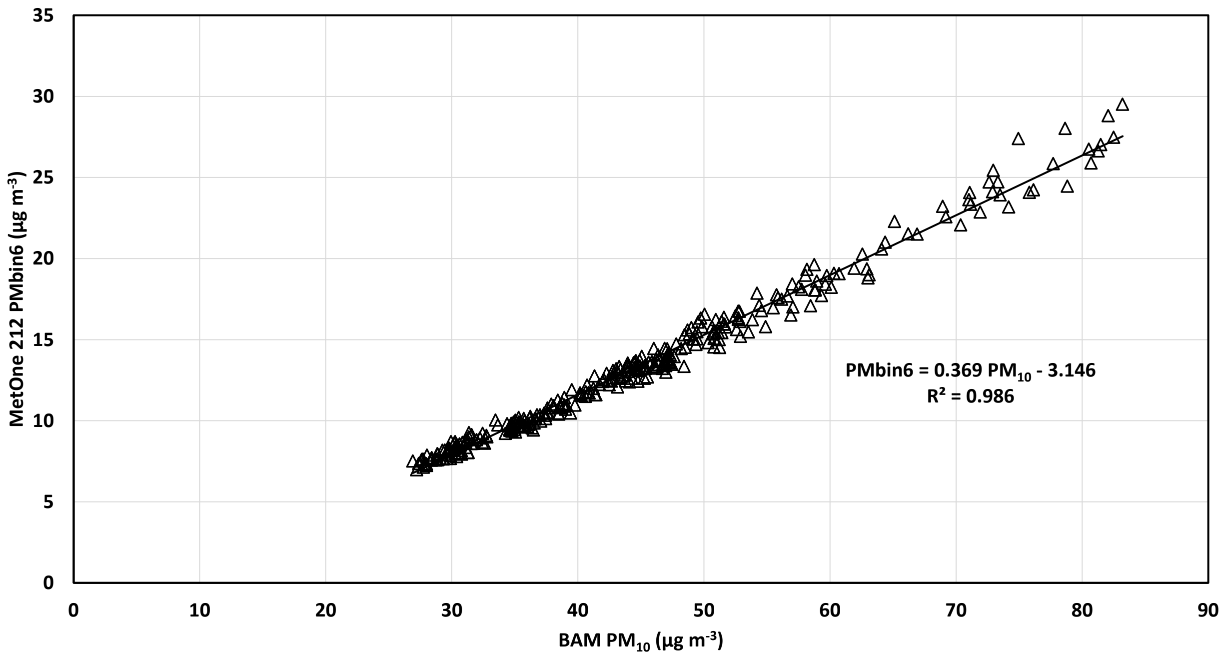

Figure D. The relation between PMbin6 and PM_{10} for unit #8, April 2021 in-chamber calibration prior to deployment.

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 07

DRI and UCSB 20 – 21 Sand Flux Report

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Saltation flux measurements –

Temporary Sand Fences Arrays and Foredune Restoration Areas

The operation of the BSNE sampling network that quantifies sand flux in dust control and foredune restoration areas was carried out by personnel from the Coastal San Luis Resource Conservation District following training received from DRI personnel. The sampling strategy is to have the traps installed, the opening set at 15 cm above the surface, prior to a sand transport event. Following an event (typically the next morning), each BSNE is visited and the collected sand is put into Ziploc bags with the date of collection and the unique identifier for the BSNE. The empty BSNE is returned to its holder and the height set to 15 centimeters (cm) making it ready for the next collection. The sample bags are returned to the RCD office for latter weighing on an electronic balance to a precision of 0.01 grams (g).

Temporary Sand Fence Arrays

Saltation flux measurements were made in the two temporary sand fence arrays established in spring 2020. In 2020, 12 traps were placed in each array area and 20 in the re-vegetation area. In 2020, 12 traps were placed in each of the fence arrays and the BSNE traps were placed between consecutive sand fences at a distance of 6 fence heights from the upwind (western) fence based on the positioning shown in Table 1.

Table 1. The positions of BSNE sand traps within the two temporary sand fence arrays, 2020

Row #	Distance (m)	D/H	BSNE* (Area 1, 43 rows)	BSNE (Area 2, 36 rows)
0	0	0	X X	X X
2-3	16	13	X X	X X
3-4	24	20		X
4-5	33	27	X X	X X
8-9	67	55	X	X
12-13	101	90	X	X
18-19	144	118	X X	X X
30-31	255	209	X	X
38-39	323	272	X	

*X X indicates 2 BSNEs spaced 2 m apart, N-S

Control effectiveness of the array to reduce sand flux is defined by the Normalized Sand Flux (NSF):

NSF=sand flux internal to the array/sand flux upwind of the array

The overall control effectiveness is based on the change of NSF as a function of downwind distance through a dust control area (sand fence array or vegetation).

In the temporary sand fence array Area 1 in 2020, the NSF decreased rapidly between the first four sets of traps (upwind to between rows 12 and 23) to ND=33 (40.3 m) (Figure A). The NSF then stabilized to a relatively constant value to the end of the array (323 m), except at ND=91.2 where a high degree of variability in the flux was observed. This is due to its elevated position where maximum wind speeds are likely to occur. This has been observed at elevated positions in other fence arrays in previous years. The mean NSF between ND=33 and ND=188.6 in Area 1, excluding the measurement at ND=91.2 was 0.28 (±0.11), indicating that the effectiveness of this sand fence array was not as high as has been observed in the past.

In the temporary sand fence array Area 2 in 2020, the NSF decreased rapidly between the first four sets of traps (upwind to between rows 8 and 9) to ND=44.8 (54.7 m) (Figure B). The NSF then stabilized to a relatively constant value to the end of the measurements (255 m). A high degree of variability in the flux was observed at all the measurement positions ND≥67.7. The mean NSF between ND=44.8 and ND=171.2 in Area 2, was 0.21 (±0.08), similar to Area 1.

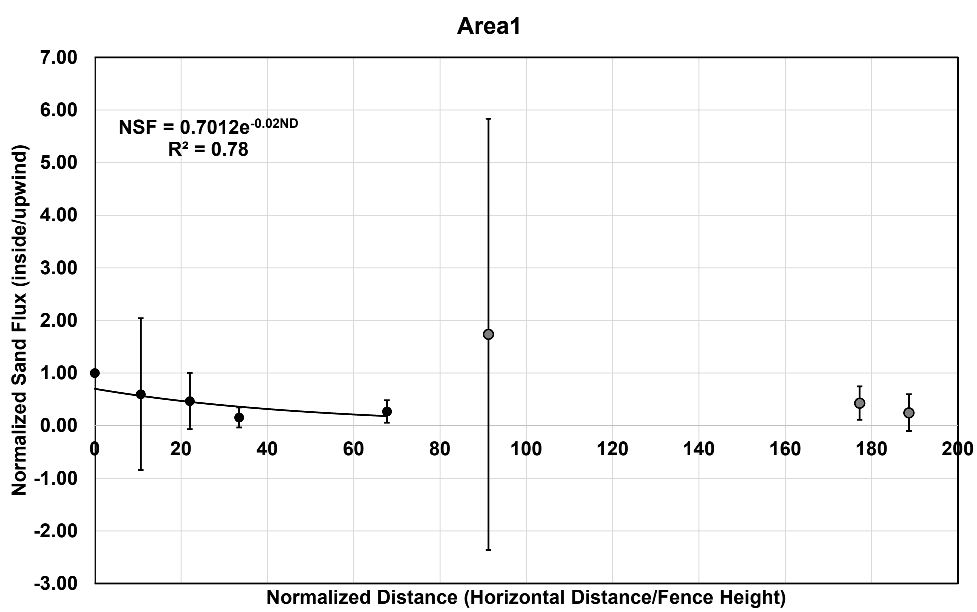


Figure A. Mean normalized sand flux as a function of normalized distance for the fence array Area 1 in 2020. The regression represents the change in NSF as a function of ND between ND 0 to 66.7 (black circles).

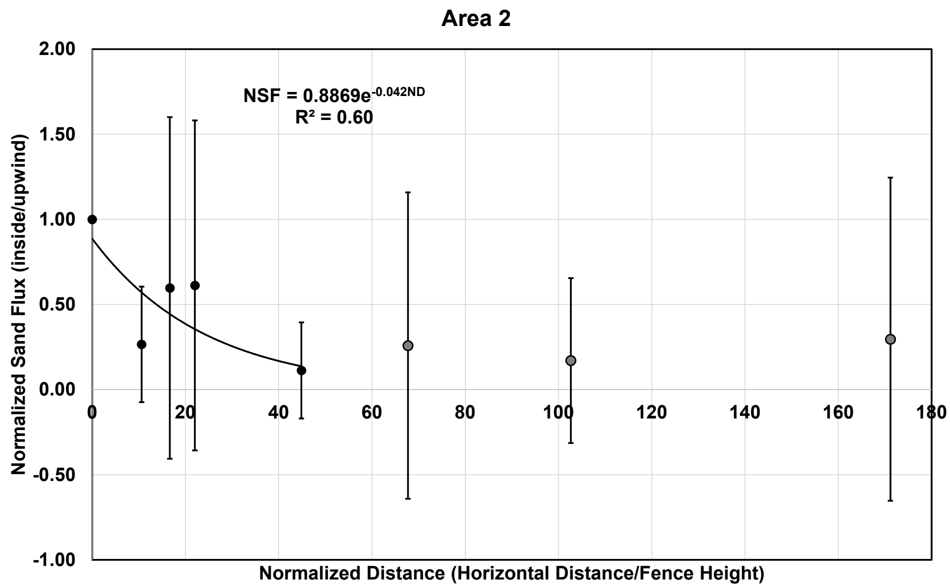


Figure B. Mean normalized sand flux as a function of normalized distance for the fence array Area 2 in 2020. The regression represents the change in NSF as a function of ND between ND 0 to 44.9 (black circles).

Foredune Restoration Areas

To characterize the changes in wind and to monitor saltation activity and changes in vegetation cover and dune morphology through time, a suite of instruments on a 3 m tripod on a platform was deployed near the eastern edge of each treatment plot, approximately 10 m west of the eastern fence line and halfway along the north-south length of the treatment area. These monitoring stations have almost the same configuration as those deployed across and exterior to the Oceano Dunes SVRA to measure temperature, RH, wind speed, wind direction, and pressure (ClimaVue500). The restoration area stations, however, do not have PM measurements.

Sensit saltation sensors are located at each station to provide data on threshold wind speed for sand transport. A remote camera system is also deployed at each station to provide additional information on the frequency and relative magnitude of sand transport events providing a wider field of view than the point-measurement of the Sensit. The camera systems also provide qualitative data on weather conditions, sea state, changes in plant cover, and changes in dune form and development. Three tipping bucket rain gauges are deployed across the restoration area (north, middle, south) to provide data on precipitation across the foredune restoration zone.

Sand flux in the 6 foredune restoration treatment areas is measured using BSNE-style sand traps. A linear transect consisting of 5 BSNEs oriented with the major sand transporting wind direction, i.e., 292° at the north-south midpoint of each defined test area was established in April 2020. A BSNE is placed on the western side of a treatment area approximately 2 m from the security fence to receive the incoming sand flux. The next 4 traps in a treatment area are positioned at 4 m (12 feet), 13 m (42 feet), 45 m (148 feet), and 160 m (525 feet) along the 292° transect line. A map of the BSNE locations in the foredune restoration area is shown in Figure D.

The temporal trends for each of the BSNE transects in foredune restoration areas 1 to 3 and 4 to 6 are shown in Figure E and Figure F, respectively, for the time interval April to November 2020. For the foredune restoration areas normalized sand flux is defined as:

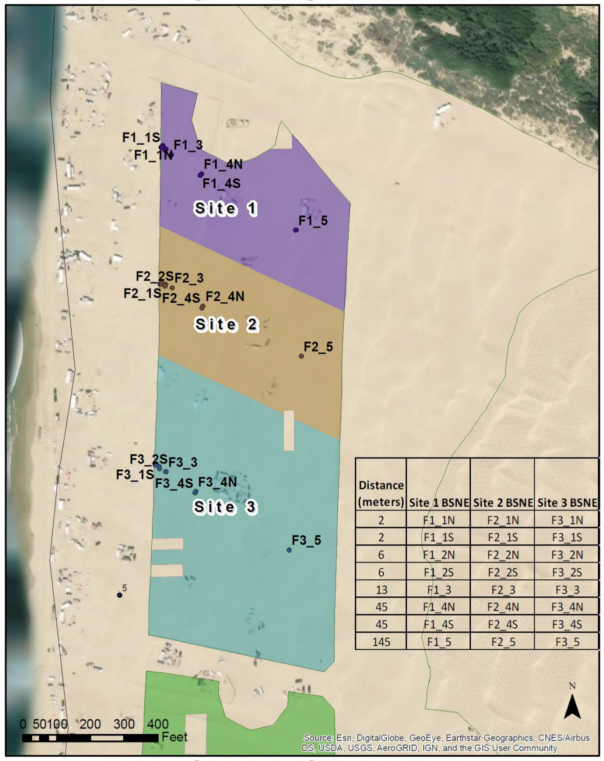
$$NSF=((BSNE_n \text{ trap } 1 + BSNE_n \text{ trap } 2)/2)/((BSNE_1 \text{ trap } 1 + BSNE_1 \text{ trap } 2)/2)$$

where subscript *n* indicates trap position along the transect through the restoration area. $BSNE_1$ indicates the traps on the upwind leading edge of the area. BSNE traps are paired at each position, 1-5, and NSF is based on the mean value of the 2 traps at each position.

For areas 1 through 3 the normalized sand flux (NSF) remains in a relatively stable range of values through this time interval except for area 2, which shows a considerable increase in NSF at the four interior measurement locations in November 2020. For areas 4 through 6, stable ranges of NSF are observed at the interior monitoring positions through this time interval except for area 6, which shows a considerable increase in NSF at the four interior measurement locations in November 2020. This is likely due to the straw surface becoming inundated with sand across the width of this test plot.

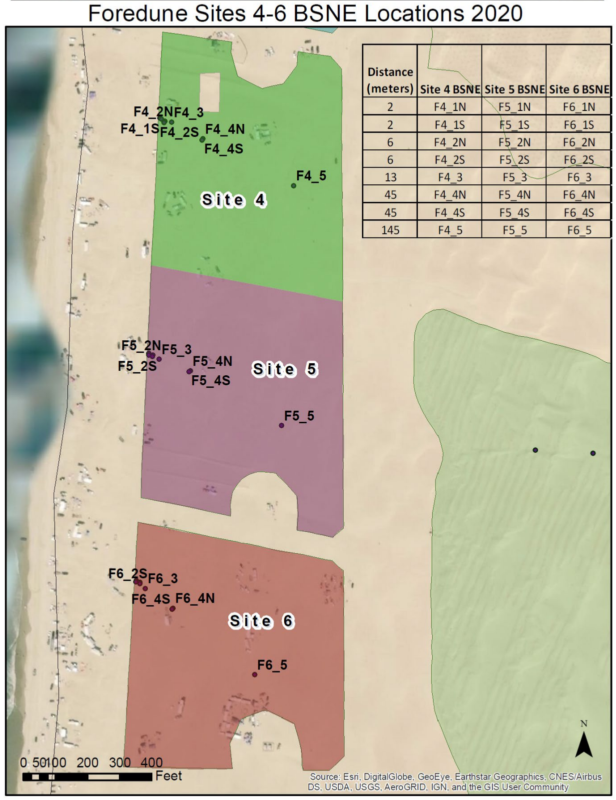
The relations between mean NSF and normalized distance (ND=Horizontal Distance to measurement position/Total distance across restoration area) are shown for foredune restoration areas 1 to 3 and 4 to 6 are shown in Figure G and Figure H, respectively, for the time interval .

Foredune Sites 1-3 BSNE Locations 2020



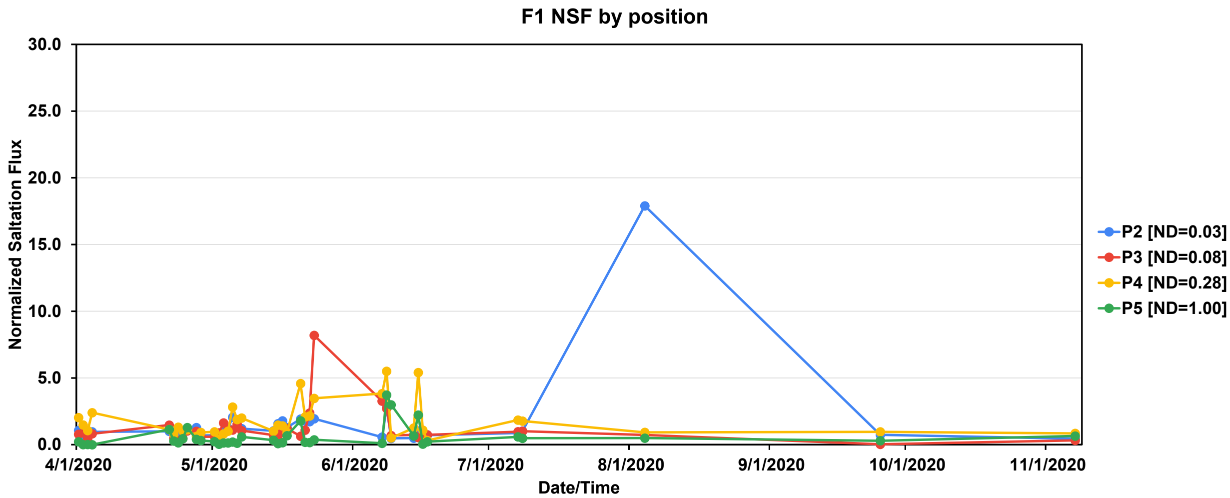
Distance (meters)	Site 1 BSNE	Site 2 BSNE	Site 3 BSNE
2	F1_1N	F2_1N	F3_1N
2	F1_1S	F2_1S	F3_1S
6	F1_2N	F2_2N	F3_2N
6	F1_2S	F2_2S	F3_2S
13	F1_3	F2_3	F3_3
45	F1_4N	F2_4N	F3_4N
45	F1_4S	F2_4S	F3_4S
145	F1_5	F2_5	F3_5

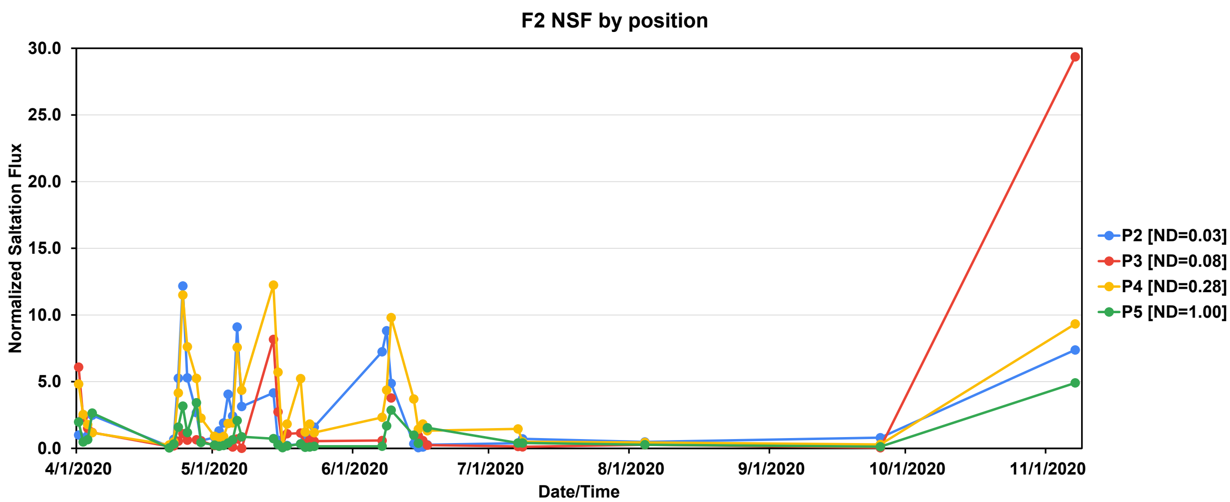
Foredune Sites 4-6 BSNE Locations 2020



Distance (meters)	Site 4 BSNE	Site 5 BSNE	Site 6 BSNE
2	F4_1N	F5_1N	F6_1N
2	F4_1S	F5_1S	F6_1S
6	F4_2N	F5_2N	F6_2N
6	F4_2S	F5_2S	F6_2S
13	F4_3	F5_3	F6_3
45	F4_4N	F5_4N	F6_4N
45	F4_4S	F5_4S	F6_4S
145	F4_5	F5_5	F6_5

Figure D. Locations of the BSNE samplers in the foredune restoration areas.





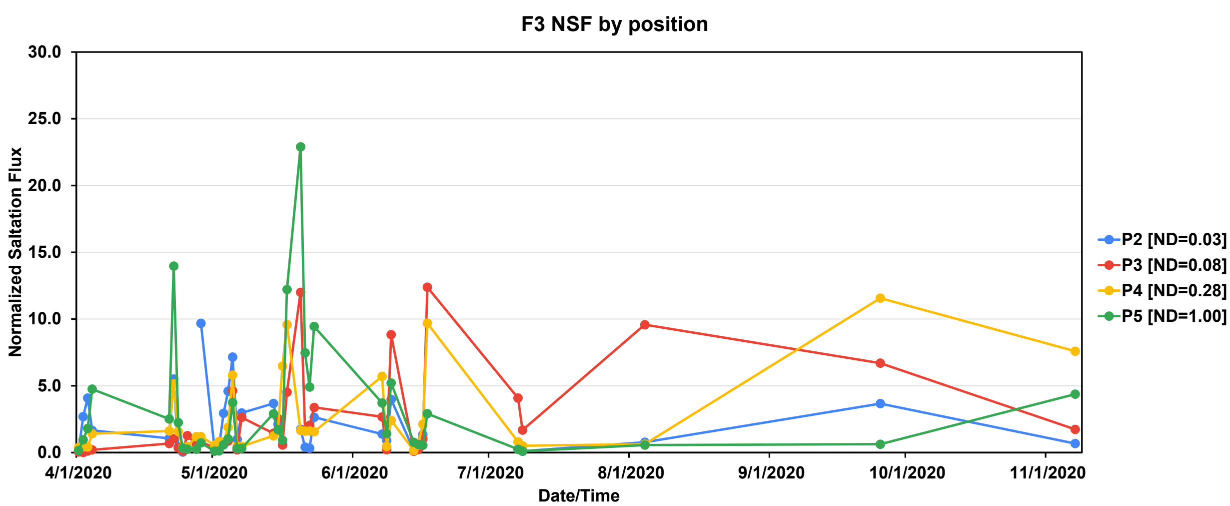


Figure E. The change in NSF at the interior measurement positions restoration areas 1 through 3 for the time interval April to November 2020.

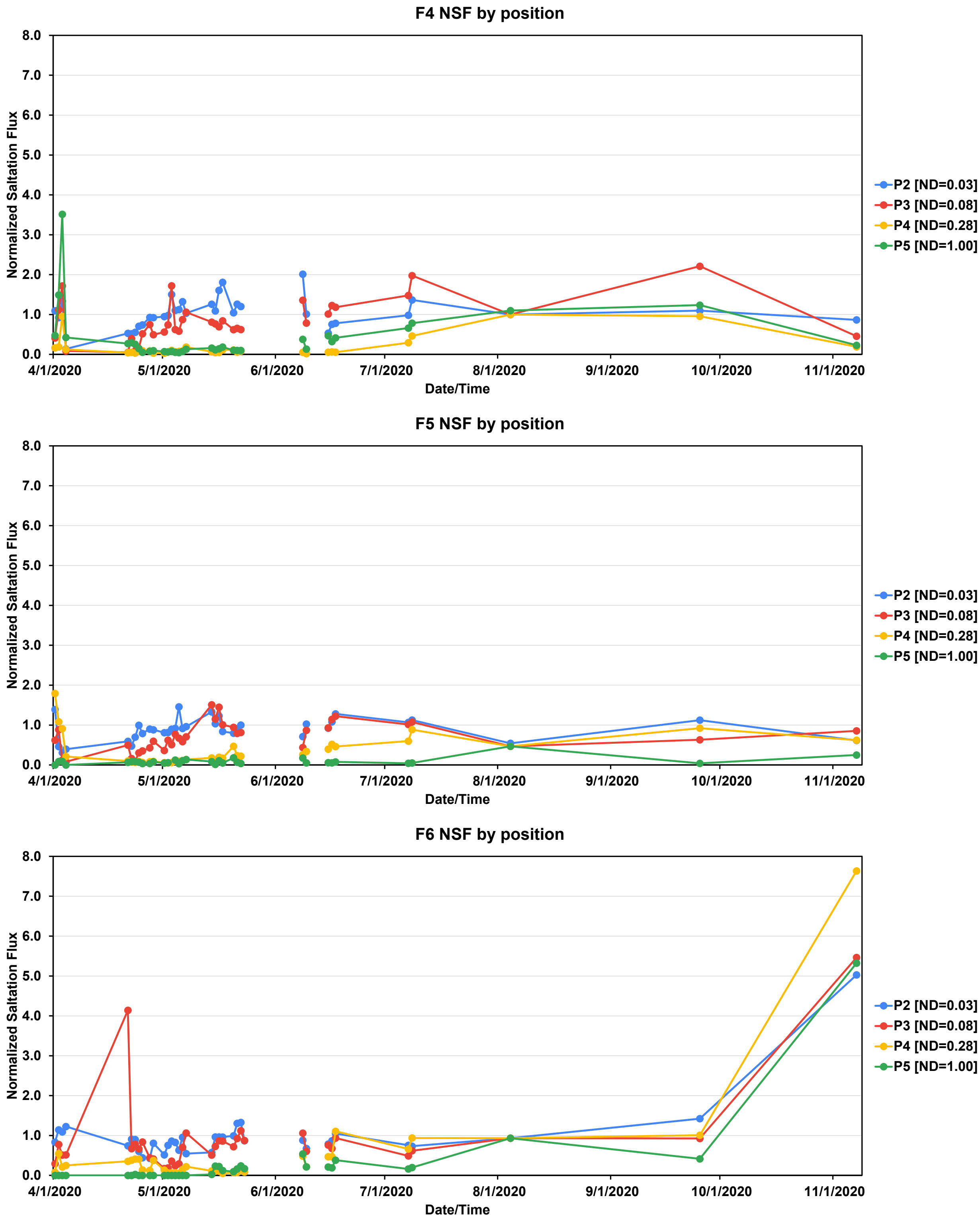


Figure F. The change in NSF at the interior measurement positions restoration areas 4 through 6 for the time interval April to November 2020.

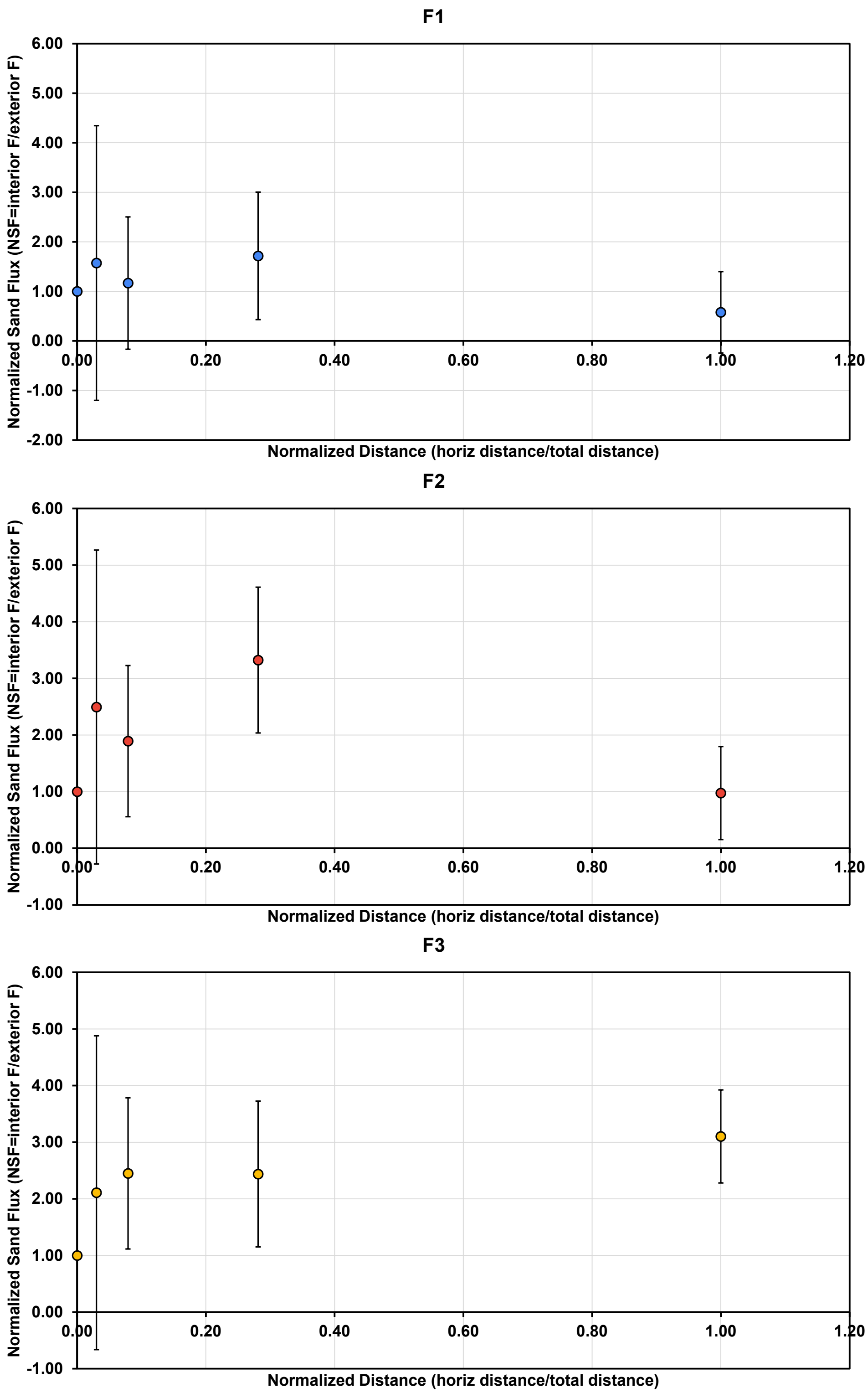


Figure G. The change in NSF as a function of ND for restoration areas 1 through 3 for the time interval April to November 2020.

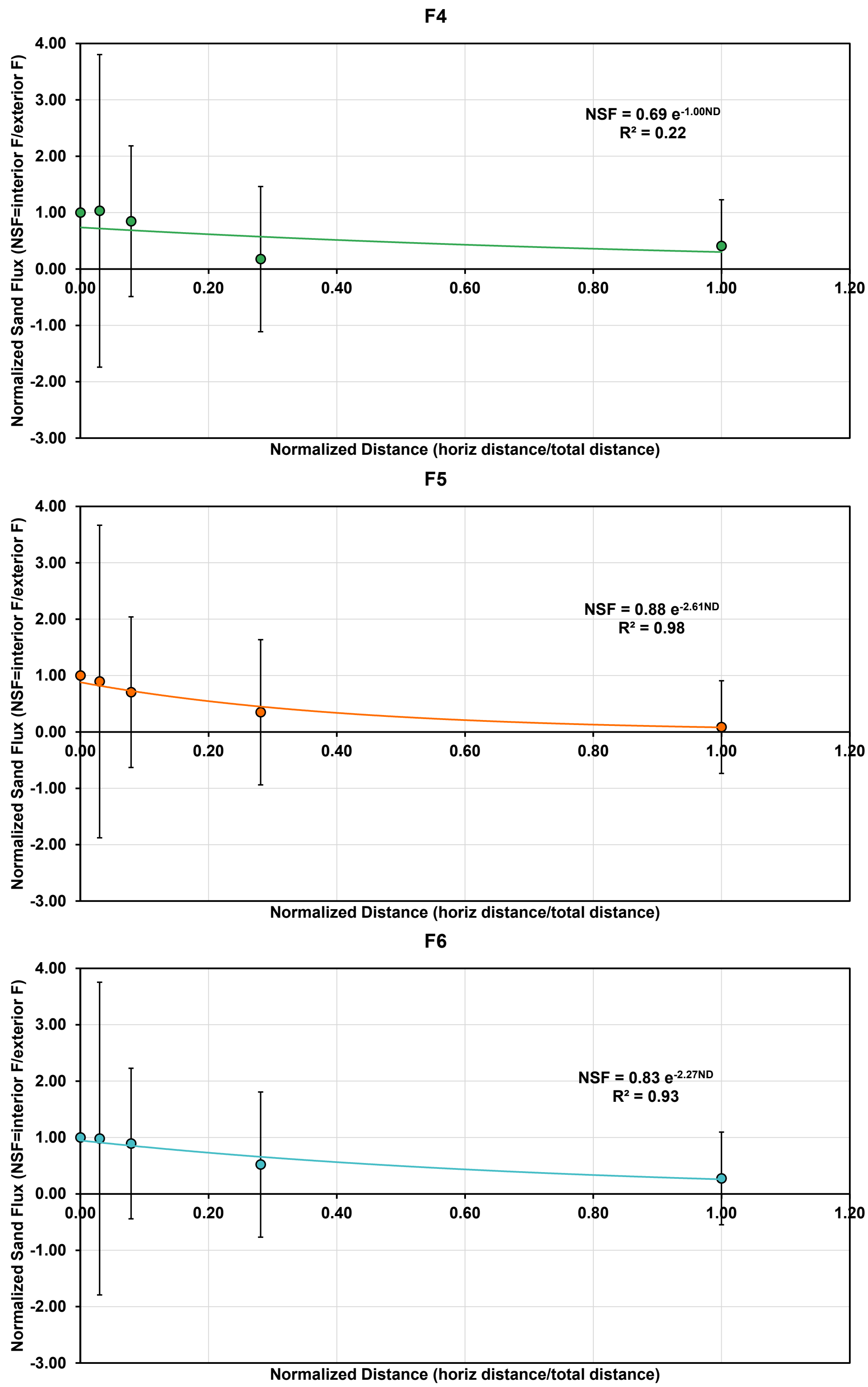


Figure H. The change in NSF as a function of ND for restoration areas 3 through 6 for the time interval April to November 2020.

April to November 2020. For areas 1 through 3 the normalized sand flux (NSF) as a function of ND shows a relatively limited range of variability across the measurement transect. For areas 4 through 6, NSF was systematically reduced as a function of ND for this time interval. This is observed most clearly in areas 5 and 6, although there is high degree of variability in NSF at each measurement position. The reduction in NSF as a function of ND is preserved at these restoration areas even as the magnitude of the overall flux increased in November 2020.

April to November 2020. For areas 1 through 3 the normalized sand flux (NSF) as a function of ND shows a relatively limited range of variability across the measurement transect. For areas 4 through 6, NSF was systematically reduced as a function of ND for this time interval. This is observed most clearly in areas 5 and 6, although there is high degree of variability in NSF at each measurement position. The reduction in NSF as a function of ND is preserved at these restoration areas even as the magnitude of the overall flux increased in November 2020.

Change in NSF through time in the restoration areas, suggest that saltation flux was increasing towards the eastern side of treatment areas 4, 5, and 6 as time progressed from the initial installation through to November 2020. This suggests that the effectiveness to control sand flux was diminishing through time, likely because of the increasing burial of the straw through time and the limited plant and nebkha development. For treatment areas 1, 2, and 3, NSF remained variable at all locations through time indicating that the control efficiency did not change appreciably through the April to November time interval.

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 08

UCSB-ASU 2020-2021 ODSVRA Foredune Restoration UAS Survey Report

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UCSB-ASU 2020-2021 ODSVRA Foredune Restoration UAS Survey Report

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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<u>ATTACHMENT 09</u>

DRI 2020/2021 Computational Fluid Dynamics (CFD) Report

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2020/2021 Computation Fluid Dynamics (CFD) Report

Computational fluid dynamics (CFD) is the science of producing simulations of fluid flow using large computational resources. For applications at the Oceano Dunes, and in particular the Oso Flaco foredune, the incompressible Navier-Stokes equations will be solved as the model governing fluid flow. This is a set of partial differential equations, which will be solved using a computational method called the Finite Volume Method (FVM). The FVM method decomposes the domain of interest, in our case a zone of air flow above the foredune, into discrete computational cells (finite volumes) which are used to compute a solution. This solution arrives in the form of a massive set of linear equations, which can be solved by a computer. The shape and number of computational cells has a direct effect on the quality of the solution, and the amount of computing power that is required. DRI is using a software implementation of the FVM called openFOAM (open field operations and manipulation), which has been installed on the University of California, Santa Barbara computing cluster. DRI expects that the simulations will be done on the UCSB computing cluster through the support of Dr. I.J. Walker.

The domain of the simulations can be visualized as a rectangular box placed over the dune surface (see the left pane of Figure A for an example). The governing equations and FVM method together produce a solution inside the box, however boundary conditions for air velocity, pressure, and turbulence quantities must be specified on the boundaries of the box. DRI will use a k-epsilon turbulence model in openFOAM to produce steady-state simulations of the flow field over a portion of the Oso Flaco foredune. This helps to mitigate the very large computational resources needed to produce simulations over a large three-dimensional space. Steady state solutions also provide a time-averaged view of the flow, which is appropriate for the time scales of large wind events. The solution of the flow will produce detailed fields of velocity and pressure throughout the study area, including downwind of foredune, as well as quantification of turbulence production and decay caused by the interaction of the flow with the dune topography. From the velocity and pressure fields quantities such as the surface shear stress on the dune surface, flow path lines, and turbulence intensity can be resolved. Surface shear stress in particular is very important to characterize as it is a primary driver of emissions of dust via the shear-driven saltation process. An example of velocity magnitude patterns inside a domain along a transect across a dune is shown in the right pane of Figure A.

Sonic anemometer data from the spring 2021 field campaign will be indispensable in the setup and validation of the simulations. As mentioned earlier, the flow on the interior of the domain is dictated by the boundary conditions, which need to be specified. It is particularly important the character of the velocity entering the inlet boundary is as realistic as possible. Here, the sonic anemometry data from the towers placed near the high tide mark will be used to set the inlet boundary flow conditions. These data will be time averaged to provide inlet profiles of the wind velocity. Turbulent fluctuations will also be calculated from the dataset, providing inlet turbulence boundary conditions. Towers with sonic anemometers placed along transects within the Oso Flaco foredune and within the restoration areas to characterize the local flow conditions will serve as important validation points for the output of the flow model.

The coding of the simulation in openFOAM has been drafted and is operational for generating shear stress on the foredune topography. A preliminary image of the shear stress developed on a portion of the Oso Flaco dune surface is shown in Figure B. The next phases of development are to obtain the digital elevation data that corresponds with the measurement transect made in May and that extends downwind of the easternmost location of the measurements. The sonic anemometry data are being QA-QCed to ensure that they do not contain any irregularities (e.g., lowest anemometers returned bad data due to dust on the transducers). Following this the sonic data will be used to provide the input boundary flow conditions as well as estimates of shear stress on the surface at the leading edge and at the measurement positions along the transect.

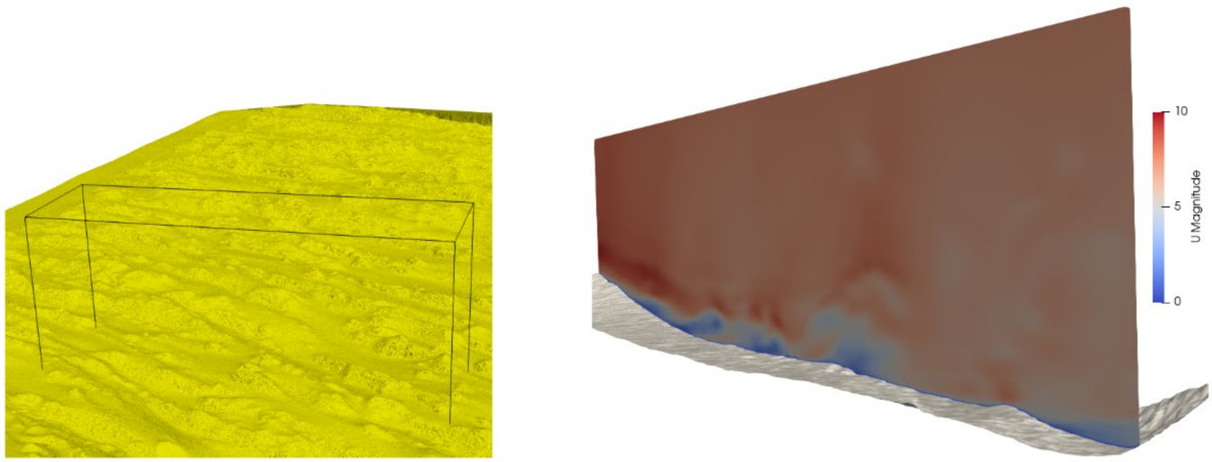

Figure A. **Left**: An example of a small computational domain placed over the Oso Flaco topography. **Right**: An example of velocity magnitude pattern across a portion of the dune from a preliminary simulation inside the domain.

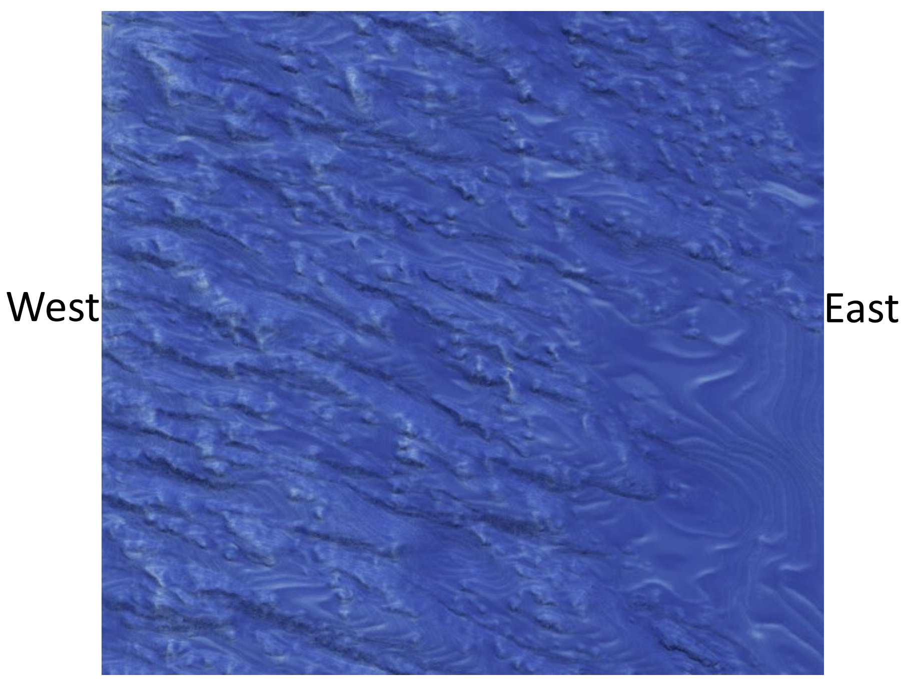

Figure B Preliminary simulation of shear stress distribution across an area of the Oso Flaco foredune. The lighter the color the greater the surface shear stress.

The simulation data will be interrogated to examine the pattern of shear stress distribution through and in the lee of the Oso Flaco foredune. The expectation is that a zone of shear stress reduction behind the foredune is defined with shear stress increasing with increasing distance from the foredune. The defined gradient will be used to modify the shear stress calculated by the CALMET wind field model in the DRI emission and dispersion model using this scaling relation. CALMET cannot resolve the fine scale effects of the complex foredune topography so the scaling relation can be applied after CALMET resolves shear stress, or friction velocity (u_*) in the grid cells representing a foredune area and in the lee of the foredune.

Flow Dynamics over Foredune and Oso Flaco

In May 2021, DRI and UCSB undertook a measurement campaign to characterize the flow over the foredune treatment areas. This was accomplished using 3 m towers instrumented with three 3-D sonic anemometers to measure the three components of wind speed horizontal (*u*), spanwise (*v*), and vertical (*w*) at 10 Hz at three positions on the tower: 0.25 m, 1.6 m, and 3.1 m. These data are used to estimate flow quantities such as the surface Reynolds stress (RS, which is a similar stress quantity as the shear velocity, u_*, e.g., Klipp, 2018), RS component stresses, such as u'^2 (e.g., Baddock et al., 2011; Weaver and Wiggs, 2011) and turbulence intensity (TI, e.g., Li and McKenna Neuman, 2012; Gillies et al., 2021). As the incoming wind from the ocean passes up the beach and across the foredune restoration areas these quantities are modulated by the surface roughness as it interacts with the flow.

The incoming flow to the restoration areas was determined by having one of the 3 m towers positioned upwind of restoration area 1 (northernmost treatment). This tower remained at this position for the duration of the measurements. The second tower was positioned at the downwind edge of five of the treatments (1 to 5) to measure the flow after it had passed over the treatments. No measurements were made on the downwind side of treatment 6 (Parks classic) due to the presence of two broods of Snowy plovers that required the restriction of access to the site.

The sonic anemometry measurements combined with measurements of surface roughness parameters obtained from the UAS-derived DEMS, on-ground photogrammetry, and terrestrial lidar scanning (TLS) data collected in May 2021, will be used to understand how the evolving surface structures, such as plants and nebkha, in the foredune areas are influencing the flow and the sediment transport potential across each treatment type.

Table1 provides an accounting of the measurement periods for the five treatment areas and the transect through the Oso Flaco dune. These data are currently being organized and quality assured/quality controlled. Following this analysis will be carried out to characterize the flow conditions and then link these data with the surface roughness measurements.

Table 1. The locations and observation periods of flow over the foredune restoration areas and a cross section through the Oso Flaco foredune.

Name	Longitude	Latitude	Day	Start**	End
Restoration Upwind*	-120.6291	35.073815	17-05-2021	15:16:51	17:41:21
Restoration Upwind	-120.6291	35.07383	21-05-2021	10:46:34	24:00:00
T1	-120.6274	35.0726004	17-05-2021	16:34:28	17:36:07
T2	-120.6273	35.0716462	18-05-2021	9:59:38	11:36:09
T3	-120.6272	35.0701377	18-05-2021	12:12:04	12:45:20
T4	-120.6272	35.0678638	19-05-2021	8:59:41	10:42:52
T5	-120.6272	35.0656751	21-05-2021	11:14:45	24:00:00
Oso Flaco Upwind	-120.6329	35.0378334	20-05-2021	8:45:00	24:00:00
Oso Flaco Transect P1	-120.6319	35.0380164	20-05-2021	9:40:46	10:51:25
Oso Flaco Transect P2	-120.6309	35.0374855	20-05-2021	11:18:00	11:49:20
Oso Flaco Transect P3	-120.6301	35.0372208	20-05-2021	12:09:29	12:41:16
Oso Flaco Transect P4	-120.6296	35.0367	20-05-2021	13:08:02	13:46:00
*Multiple collection periods at this location					
**times in UTC -8 with no adjustment for daylight savings					

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 10

Foredune Restoration Monitoring Report

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Summary of Vegetation Monitoring of Restoration Sites at ODSVRA

(Aug 2020-July 2021)

Line Intercept Transect Sampling

Methods

Line Intercept method (Line intercept: % cover =distance a+b+c+d+e+f/total transect length, where a, b, c, etc. are the intercept lengths of vegetation canopy) was used to estimate percent cover of species within each treatment area of the 48 acre Foredune Project and a reference site in the North Oso Flaco Foredune. A total of three transects of 30-meters each were sampled in each treatment area and a total of three 30-meter reference transects were sampled. Sampling occurred in September when access to Foredune areas were not limited by nesting bird activity.

Starting points for the transect lines will be randomly selected within each project area using GIS software. Transect directions were randomly selected from the eight cardinal and intermediate directions (i.e. N, NE, E, SE, S, SW, W, and NW).

A measuring tape was run along the transect and secured with wooden stakes. As the vegetation canopy intersected the line, the species was noted on the datasheet along with the beginning and ending measurements of the canopy under “Start” and “Stop”. When the canopies of two different species overlapped, each species was documented separately as two different canopies. A closed canopy for a given species was assumed until gaps in vegetation exceed the width of 5-centimeters. Dead vegetation was not included in the measurements unless it was clearly the result of seasonal dieback of a perennial plant that was still viable.

Once each 30-meter transect was surveyed, a walk around assessment within an area of 10-meters from the transect line was conducted and all addition species observed were noted.

Results

As expected in the first growing season, for year one of monitoring, none of the treatment areas met the vegetative cover of the reference site at 34.22% vegetative cover. However, three of the six treatment areas did meet the species diversity of the reference site with at least

9 species represented. The treatment area that saw the highest percent cover was Area 3 with 4.02% cover followed closely by Area 6 with 3.57% cover. Both Area 5 and Area 6 showed the highest level of species diversity with 10 species represented in both areas. Based on on-the-ground observations, it does not appear that total of three transects in each area were sufficient to determine the percent cover with certainty as it appeared that Area 4 had greater cover than Area 5 (0.76% compared to 0.40%) while Area 4 was planted with 61% of the density of Area 5. The monitoring methods are expected to become increasingly accurate as the vegetative cover continues to increase and substantial vegetative growth has already been observed in the second growing season. It does appear that the survey methods were sufficient to determine the species richness. Additional survey work will be needed to be sure.

Rapid growth of vegetation within much of the project area was observed during the winter and spring months following the September 2021 monitoring. It is anticipated that the 2021 monitoring with show a significant increase in vegetation cover within the project area.

Photo Point Monitoring

On-the-ground photo point monitoring was conducted for the 48 Acre Foredune project prior to project installation in February 2020 and following project installation in in May 2020 and October 2020. Photo point monitoring is scheduled to continue in October in subsequent years. Photo points are located on all four corners of each treatment area. For each photo point two photos are taken, each with one of the treatment area boundary lines on the outer edge of the photo with the interior of the treatment area centered in the photo. There is also one photo point overlooking the entire 48 Acre Foredune project from a distance.

In addition to on the ground monitoring, drone aerial imagery photo point monitoring was conducted in May 2020 and again in December 2020. Two photo points were take of each treatment area, including one from the east and one from the west for each area. Drone photo point monitoring is scheduled to continue on an annual basis.

Figure 1. Results from 48 Acre Foredune Project transect monitoring.

	North Oso Flaco Fordune Reference (3-30m transects)		2020 Foredune Project (3-30m transects per area)							
*Accounts for overlapping cover **Non-native species ***Includes species present within 10m of transect P=Present within 10m of transect	Percent Cover	Percent of Transects with species present***	Total Percent Cover	Percent of Transects with species present***	Area 1 Control	Area 2 Native Seed	Area 3 Native Seed & Grain Seed	Area 4 Low Density Nodes	Area 5 High Density Nodes	Area 6 Parks Classic
All species*	**34.22%**		**1.58%**		**0.00%**	**0.10%**	**4.02%**	**0.76%**	**0.40%**	**3.57%**
Abronia maritima	20.89%	100%	0.80%	83.3%		P	3.51%	0.18%	P	1.09%
Ambrosia chamissonis	11.03%	100%	0.61%	83.3%		0.10%	0.77%	0.50%	0.40%	1.90%
Camissoniopsis cheiranthifolia	0.86%	100%	0.10%	55.6%			P	0.43%	P	0.19%
Cakile maritima**	5.04%	100%	0.06%	44.4%			P	P	P	0.39%
Abronia latifolia		67%		66.7%		P	P	P	P	P
Eriophyllum staechadifolium				33.3%				P	P	P
Malicothrix incana		67%		33.3%				P	P	P
Atriplex leucophylla				22.2%				P	P	P
Achillea millefolium				16.7%				P	P	P
Abronia umbellata				5.6%			P			
Eriogonum parvifolium				5.6%						P
Monardella undulata crispa				5.6%					P	
Carpobrotus chilensis**	0.73%	100%								
Calystegia soldanella		33%								
Cuscuta subinclusa		33%								
Species Richness* **		**9**		**12**		**3**	**6**	**9**	**10**	**10**

Present only in reference	Present only in treatment	Present in both reference and treatment

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 11

2021 Updated Evaluation Metrics

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PMRP Evaluation Metrics – Annual Record 2020-21 (Preliminary)

The 2021 Annual Report and Work Plan (ARWP) includes an updated set of PMRP evaluation metrics developed in consultation with the Scientific Advisory Group (SAG). The intention of this update is to provide a more streamlined dashboard that makes it easier to track progress and to inform adaptative management. "Dust Mitigation Targets" refer to evaluation metrics with specific measurable endpoints. "Dust Mitigation Indicators" refer to values indicating progress but for which specific targets are not defined.

Dust Mitigation Targets

Dust mitigation treatments		**2013 (baseline)**	**2019**	**2020**	**2021**	**2022 (planned)**	**Current target[1]**
A. Cumulative area under treatment within ODSVRA, as of July 31 of current year, relative to 2013 baseline (acres)	A1. Total	0	138.0	230	323	413	N/A
	A2. Back dunes inside Riding Area	0	103.0	146	212	TBD	
	A3. Back dunes outside Riding Area	0	35	35	62	TBD	
	A4. Foredunes	0	0	49	49	49	
PM_{10} mass emissions		**2013 (baseline)**	**2019**	**2020**	**2021**	**2022 (planned)**	**Current target[2]**
B. Riding Area mean PM_{10} emissions for 10 baseline days - modeled[3]	B1. Mass emissions (metric tons / day)	182.2	160.0	155.3	145.2	TBD	91.1
	B2. Relative to 2013	100%	87.5%	85.0%	79.4%	TBD	50%
PM_{10} concentrations		**2013 (baseline)**	**2019**	**2020**	**2021**	**2022 (planned)**	**Current target[4]**
C. CDF mean PM_{10} concentration for 10 baseline days (µg/m^3) - modeled[3]		124.7	?	72.4	72.2	TBD	N/A
D. Mesa2 mean PM_{10} concentration for 10 baseline days (µg/m^3) - modeled[3]		97.5	?	91.2	73.8	TBD	

[1] The current dust mitigation treatment area target is defined in the Particulate Matter Reduction Plan (PMRP). This target may be revised in the future based on further modeling of dust mitigation effectiveness and monitoring of actual air quality improvements.

[2] The current PM_{10} mass emissions target is defined according to Stipulated Order of Abatement (SOA) provision 2c, which "…establish[es] an initial target of reducing the maximum 24-hour PM_{10} baseline emissions by fifty percent (50%), based on air quality modeling based on a modeling scenario for the period May 1 through August 31, 2013." The air quality modeling approach is described in the PMRP. The 10 baseline days for this scenario are defined in the 2020 Annual Report and Work Plan (ARWP), Attachment 6. Ongoing efforts to revisit the SOA target may result in changes to these values.

[3] The values reported here account only for "direct effects" resulting from changes in emissivity for areas directly under treatment. Future model refinements to account for downwind effects of treatments, such as through use of computational fluid dynamics (CFD) approaches, may result in changes to these values.

[4] SOA provision 2b states that "…the [Particulate Matter Reduction] Plan shall be designed to achieve state and federal ambient PM_{10} air quality standards." However, it does not designate a specific PM_{10} airborne concentration target for the baseline modeling scenario. Ongoing efforts to revisit the SOA target may result in establishing new targets based on modeled PM_{10} concentrations for the baseline scenario.

Dust Mitigation Indicators

Air quality indicators		**2013 (baseline)**	**2019**	**2020**	**2021**
1. Actual number of high wind event days[5]		59	30	55	51
2. Actual number of exceedances of California air quality standard[6]	2a. at CDF	58	16	30	28
	2b. at Mesa2	43	14	28	30
3. Actual number of exceedances of Federal air quality standard[7]	3a. at CDF	1	0	0	0
	3b. at Mesa2	0	0	0	0
Foredune restoration		**2013 (baseline)**	**2019**	**2020**	**2021**
4. Foredune plant fractional cover, at time of spring survey (%)	4a. Treatment 1	N/A	N/A	--	0
	4b. Treatment 2			--	0.1
	4c. Treatment 3			--	4.02
	4d. Treatment 4			--	0.76
	4e. Treatment 5			--	0.4
	4f. Treatment 6			--	3.57
5. Foredune species richness index relative to Oso Flaco site[8]	5a. Treatment 1	N/A	N/A	--	0
	5b. Treatment 2			--	33
	5c. Treatment 3			--	50
	5d. Treatment 4			--	100
	5e. Treatment 5			--	110
	5f. Treatment 6			--	110
6. Foredune sand volume, current spring survey relative to previous fall survey (m^3 m^{-2} $month^{-1}$)	6a. Treatment 1	N/A	N/A	--	TBD
	6b. Treatment 2			--	TBD
	6c. Treatment 3			--	TBD
	6d. Treatment 4			--	TBD
	6e. Treatment 5			--	TBD
	6f. Treatment 6			--	TBD

[5] Values are determined using the SLO Air Pollution Control District (APCD) definition of "high wind event day" as any day when the 3 p.m. PST hourly wind speed at CDF exceeds 8 mph and the 1 p.m. PST hourly wind direction is between 290 and 360°. The period of consideration is January 1 - June 28.
[6] CA air quality standard is a mean value of 50 µg/m^3 over a 24-hour period. The period of consideration is January 1 - June 28.
[7] Federal air quality standard is a mean value of 150 µg/m^3 over a 24-hour period. The period of consideration is January 1 - June 28.
[8] Number of native plant species recorded for each treatment area as compared to reference site at Oso Flaco. Long term goal is to have a stable or increasing richness value versus reference site.

<table>
<tr><th colspan="2">Back dune stabilization</th><th>2013 (baseline)</th><th>2019</th><th>2020</th><th>2021</th></tr>
<tr><td rowspan="5">7. Cumulative area of back dune stabilization within ODSVRA, as of July 31 of current year (acres)</td><td>7a. Planting area</td><td>TBD</td><td>89</td><td>109</td><td>168</td></tr>
<tr><td>7b. Fencing area</td><td>TBD</td><td>49</td><td>54</td><td>73</td></tr>
<tr><td>7c. Straw bales area</td><td>TBD</td><td>0</td><td>19</td><td>27</td></tr>
<tr><td>7d. Temporary vehicle exclosures</td><td>TBD</td><td>0</td><td>0</td><td>6</td></tr>
<tr><td>7e. Stabilized vegetation surface area[9]</td><td>TBD</td><td>138</td><td>182</td><td>274</td></tr>
<tr><td colspan="2">8. Native seed harvest for all plants during current ARWP reporting period (kg/year)</td><td rowspan="2">N/A</td><td>203.2</td><td>417.2</td><td>330</td></tr>
<tr><td colspan="2">9. Plant species cultivation for all plants during current ARWP reporting period (#/year)</td><td>106,350</td><td>96,600</td><td>116,986</td></tr>
</table>

[9] Area based on actual vegetation coverage determined from aerial imagery.

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 12

Compilation of Scientific Advisory Group (SAG) Responses to Comments and Studies from 08/01/20 to 07/31/21

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08-20-2020

Memorandum: SAG Critique of W. Harris Memorandum of 08-05-2020

From: Science Advisory Group

To: J. O'Brien, Environmental Program Manager, OHMVR

RE: SAG Critique of W. Harris Memorandum:

An Analysis: May and June Wind Strength Year to Year and State PM10 Exceedances with and without OHV Recreation, Oceano Dunes SVRA. August 5, 2020.

Dear Mr. O'Brien,

It is part of the SAG's purview to review scientific and technical issues related to the research, development and implementation of windblown PM_{10} controls and prepare technical specifications and analyses of proposed mitigation measures (See SOA item 3c). The SAG therefore has prepared a response to California Geological Survey employee Mr. W. Harris's memo of August 5, 2020, wherein he presents analysis of wind speed and PM_{10} data pertinent to the Oceano Dunes State Vehicular Recreation Area (ODSVRA) to Parks and other stakeholders (e.g., SLOCAPCD).

In Mr Harris's memo of August 5, 2020, he provides an analysis of wind speed and PM_{10} data from the CDF monitoring station for the months of May and June from 2013 to 2020. His purpose appears to be to contextualize or rebut the claim made by SLOCAPCD in their Frequently Asked Questions (FAQ) document (https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/June2020FAQ-42.pdf), in particular the second question in this document that reads: "Why have there been more exceedances [of the state's PM_{10} standard] in 2020 than by this point last year?" In response, the APCD states: "In simple terms, it was a very windy spring. 2020 is by far the windiest of the last 6 years, while 2019 was the least windy." Mr. Harris contends via his analysis that: "The review of the data shows that northwest wind speeds in May 2020 and June 2020 were not exceptionally elevated. In fact, May 2020 and June 2020, respectively, had lighter winds than most of the correlating months and years examined. From these data, the months of May and June in 2020 were not very windy."

The SAG would like to comment for the record on several aspects of his analysis as we feel that this analysis is poorly conceived and based on faulty statistical analysis. This comment is supported by significant expertise of SAG members in wind erosion, dust emissions, air quality monitoring, data analysis, and modelling.

Mr. Harris challenges the APCD's statement that some periods of 2020 can be judged to be windier than earlier periods. There are several fundamental problems with this approach and related arguments. First, to make a valid comparison the same metric should be used. He chose to calculate mean values of hourly wind speed over month-long intervals after applying a lower limit threshold filter of 5 mph to wind speed, an unspecified directional filter "coming from the northwest quadrant", and a temporal filter restricting the data to between 11:00 am and 7:00 pm as a means of estimating longer period (i.e., monthly) mean wind speeds. He then makes the claim that this mean filtered monthly wind speed links to exceedance of the State PM_{10} Standard (50 $\mu g\ m^{-3}$). In contrast, the metric used by the APCD is a "High Wind Event Day" defined as "any day when the 3:00 p.m. PST hourly wind speed at CDF exceeds 8 mph and the 1:00 pm PST hourly wind direction is between 290° and 360°". The main flaw in the approach is that no definition is provided to allow comparison for the determination of when one period is “windier” than another. It is also important to note that neither filtering method makes reference to any accepted metric of “windiness”. Direct comparison of the metrics from the two approaches cannot be made regarding the ambiguous term “windier”. Moreover, flaws in the analysis render it meaningless.

The second flaw in the analysis relates to the comparison of the means of filtered time-series. By removing wind speeds less than 5 mph, means are taken over different time intervals within each month. A simple and extreme example of why this is a problem is provided in reference to the CDF hourly mean wind speed dataset. Consider the wind speed histograms of June 2016 and November 2018 shown in Figure 1. Without defining what “windy” means, it is clear that there are more hours of wind above the threshold of 5 mph in June 2016 (278 hours) compared to November of 2018 (149 hours). Average values from all (unfiltered) data shows that June 2016 has a higher true average windspeed of 4.7 mph compared to November 2018 with a true average of 3.5 mph. However, after the threshold filter is applied, the mean wind speed for June 2016 increases to 8.2 mph, while the mean of November of 2018 increases to 8.6 mph. Thus, the assertion that November 2018 is “windier” because it has a higher filtered mean speed is clearly flawed. This is a result, in part, because the filtering of low wind speeds biases the distribution by changing the number of data points. Thus, the filtered mean is not statistically representative of the month for which it was computed. This approach completely ignores the effect of duration of the filtered wind data on the response of the dust emission system.

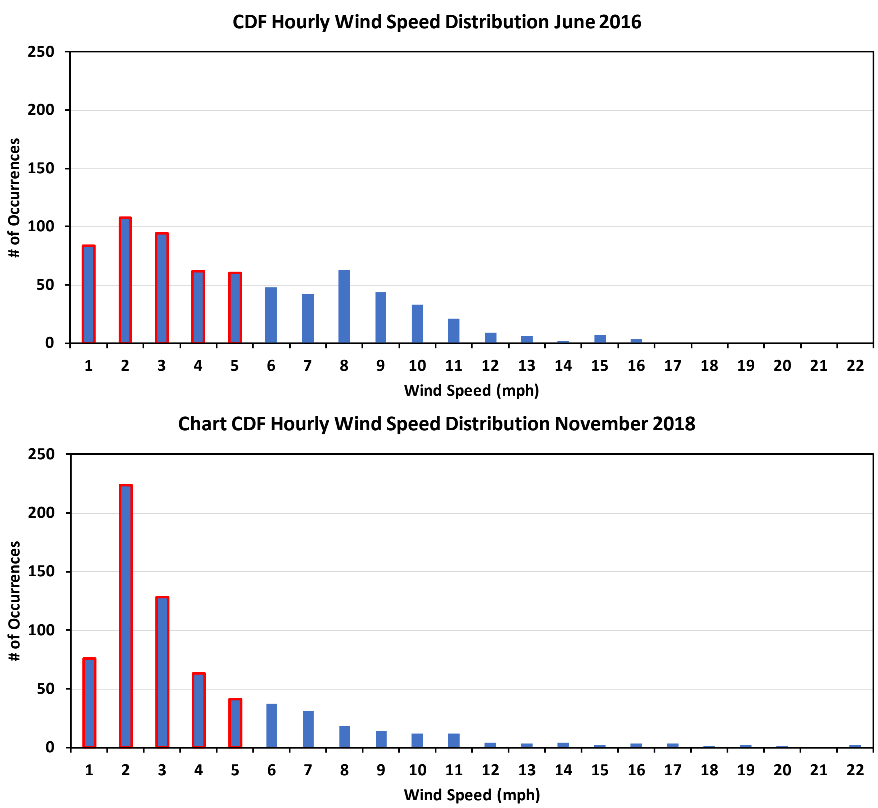

Figure 1. Hourly wind speed distributions for CDF representing June 2016 and November 2018. Red borders indicate the wind speed distribution of winds ≤5 mph.

A third flaw in the analysis is the use of means as a measure of central tendency for wind speed distributions and making conjectures about PM_{10} violations based on the mean. Wind speed distributions are not normally distributed (Hennessey, 1977). Instead, wind distributions are often ‘skewed’, with greater frequency of lower speed observations and comparatively lower frequency of higher speed events. As such, it is a fundamental statistical violation to use the mean as a measure of central tendency for highly skewed data. In the meteorological literature, wind speed distributions are typically characterized by the Weibull distribution (e.g., Corotis et al., 1978; Hennessy, 1977; Christofferson and Gillette, 1986; Garcia et al., 1998). The distribution begins at zero and has a long tail of high magnitude winds of low frequency (Fig. 2).

Figure 2 shows two hypothetical wind speed distributions with the same number of observations and having the same mean value of 4.1 mph. By comparison of means alone, they would be judged to be of the same level of “windiness” per Mr. Harris’s approach. A more appropriate metric, for example, is the percentage of winds over a threshold for sand transport and dust emissions. The observed response of increased PM_{10} concentration at CDF typically occurs when measured hourly wind speed meets and exceeds 10 mph. Windspeed distribution 2, shown in Fig. 2, more frequently exceeds 10 mph and would be judged to be “windier” and produce more dust than distribution 1. In fact, distribution 1 fails to exceed this critical threshold and, under these conditions would produce no saltation and, thus, negligible dust emissions. The use of means to describe central tendency of skewed distributions is fundamentally flawed, especially for estimating the propensity for saltation-induced dust emissions.

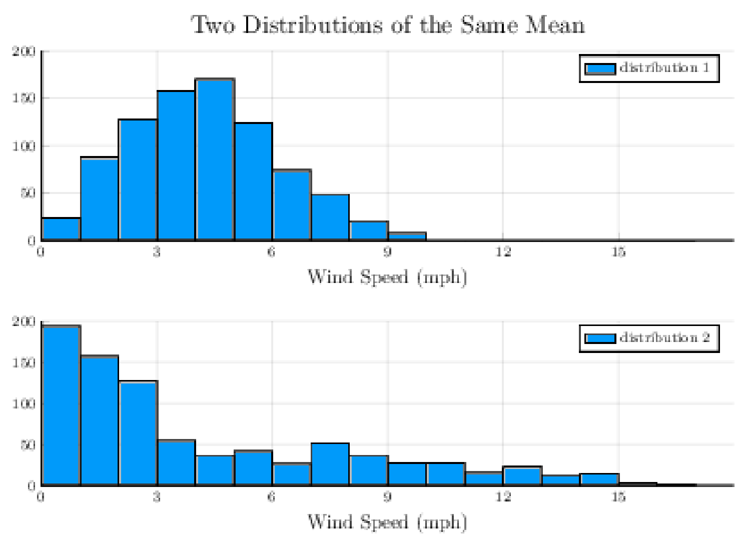

Figure 2. Two hypothetical wind speed distributions that have the same mean wind speed.

Relating dust emissions to wind speed is better understood using: i) probability density functions (Christofferson and Gillette, 1986), ii) measures of wind erosivity (Shao, 2000) or, iii) erosive wind power density (WPD, W m^{-2}) (e.g., Hagen et al., 1999). These metrics are more appropriate and useful to compare wind erosion and dust emission potential between measurement locations or for the same location for different time periods than mean wind speeds. This is because these methods can account for both wind magnitude and duration, whereas the monthly mean of hourly wind speed cannot. In that wind speeds are not normally distributed (e.g., distribution 2, Fig. 2) it is typically the case that quantifying changes or differences in the tails of the wind speed distribution are more important to characterize the influence of wind on dust emissions (and ambient particle concentration levels) than measures of central tendency, e.g., mean values. The metric developed by the APCD accounts, in part, for the importance of the heavy tail of the wind speed distribution in affecting dust emissions.

If evaluating wind and its relation to ambient PM_{10} dust is deemed a germane contribution to the discussions on why the number of air quality exceedances increased in spring 2020 as observed at the CDF monitoring site, the SAG recommends that the framework for analysis be wind power (as developed by meteorologists and wind energy engineers) or erosive wind power density metrics (as developed by, for example, agricultural scientists and aeolian geomorphologists). These provide unambiguous metrics that link the wind speed distribution to the response of the dust emission system. The SAG is concerned that Mr. Harris's analysis creates the opportunity for a false narrative to be generated that can be incorrectly championed. Decisions that will have to be made to best manage the ODSVRA, as it relates to dust emissions and air quality exceedances, must be informed by the most accurate representation and interpretation of the available data, and in this case would have been served by making use of the available scientific literature related to analyses of wind speed distributions.

Respectfully,

Science Advisory Group

References

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August 31, 2020

Memorandum: SAG Review of Draft ARWP 8-1-2020

From:
Scientific Advisory Group (SAG)

To:
Gary Willey, San Luis Obispo Air Pollution Control District (SLO APCD)
Jon O'Brien, California Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division (OHMVR)

Summary statement:
The Scientific Advisory Group (SAG) is generally pleased with the draft 2020-21 Annual Report and Work Plan (ARWP). The ARWP demonstrates tangible progress on dust mitigation treatments during the 2019-20 work year, including initiation of the 48-acre foredune restoration project. The draft ARWP also sets forth a comprehensive 2020-21 work plan, which includes continuing progress on existing and new dust mitigation treatments, as well as advancements on modeling and monitoring capabilities to inform adaptive management. The SAG is also pleased with how OHMVR has displayed a spirit of cooperation with SAG through ongoing consultation in the ARWP drafting and writing process.

The SAG is aware that the draft ARWP proposes to add only 40 acres of additional dust mitigation treatments in the 2020-21 work year, which may be insufficient to achieve the level of dust mitigation required by the Stipulated Order of Abatement (SOA) in a timely manner. The SAG therefore recommends that the 2020-21 ARWP plan for an increase in the amount of new dust mitigation treatment areas beyond the 40 acres stated in the draft ARWP to at least double this amount. To inform this recommendation, the SAG reviewed a map of existing (to February 2020) dust mitigation treatments as well as the most current Desert Research Institute (DRI) dust emission attribution maps (based on 2013 winds and the PI-SWERL testing grid) for both the CDF and Mesa2 monitoring stations. Noting extensive recent dust mitigation efforts in the north-central portion of the Oceano Dunes State Vehicular Recreation Area (ODSVRA) (e.g., BBQ Flats, Bigfoot, Eucalyptus) the SAG recommends that OHMVR focus on installing new mitigation "islands" in the south-central region of the ODSVRA, as shown in the attached Figure 1. Such areas could have additional emissions reductions benefits for Mesa2, in particular.

The SAG recognizes the challenges imposed by the terrain and other site logistics, such as maintaining safety, restroom access, and vehicle transport corridors, and indicates three general areas for consideration. Although these areas do not correspond with the most highly emissive surfaces attributed to PM10 concentrations at either Mesa2 or CDF (see attached Figures 2 and 3), such as the "sand highway," they would provide dust mitigation benefit not only within their footprint areas but also by a sheltering effect that would reduce surface shear stress, sand saltation, and resulting dust emissions downwind of the treatment areas. Possible locations for transportation/access corridors to accompany these mitigation islands are also indicated in the attached Figure 1.

In making a final selection among these possible treatment areas, the SAG urges OHMVR to consider the full available scientific evidence to determine the relative effectiveness of possible treatment alternatives. Notably, the draft ARWP includes significant activities in the 2020-21 work year to improve DRI dust model predictions by assimilating improved emissivity maps (from recent PI-SWERL surveys) and meteorological data (from the recently-installed SODAR station). In addition, planned fluid dynamic modeling during the 2020-21 work year will help to quantify secondary effects on dust emissions reductions downwind of the foredune treatment area. Therefore, as such modeling improvements are made, the SAG recommends that OHMVR revisit the specific scope and placement of planned dust mitigation treatment areas.

In addition, the SAG recommends that OHMVR engage with a subset of SAG members to seriously consider scientifically-justified alternatives to the current 50% emissions reduction target that may more directly reflect the impact of dust mitigation treatments on downwind airborne dust concentrations.

Members of the SAG offer additional specific comments on the draft ARWP below. Three figures are also attached with this review.

Respectfully,
Scientific Advisory Group (SAG)

Additional comments from SAG members

Carla Scheidlinger:

1. Typo: page 2-2, paragraph 2 line 2: remove the word "be"
2. Typo: page 2-2, remove last empty bullet from Plot 1
3. For Plot 2 description on page 2-2, indicate what the densities of "high" and "low" are in terms of nodes/acre.
4. Page 2-3, specify planting density for Parks Classic.
5. Typo: Page 2-7, capitalize the M in PM in the heading for section 2.3.1
6. Page 3-2, section 3.1.1. If the information on the foredune is not acquired before summer of 2021, there will be no opportunity to carry out planting during the current work year. The statement about planting in this section then conflicts with the timeline shown in Table 5-1 on page 5-1.
7. In Table 5-3 on page 5-2, the schedule for removing the sand fence and then replanting leaves a pretty long time between fence removal and planting; this time period should be shortened.

Raleigh Martin:

1. **Project Manager.** Please identify the name of the current project manager, as per item 13 in the amended SOA. I assume this is Jon O'Brien, but please confirm this within the ARWP text.
2. **Sec. 2.2. Statement of Progress Achieved.** Please also provide a value for the modeled concentration change at Mesa2.
3. **Sec. 2.3.1. Monitoring Activities Conducted Over the Previous Year: Meteorological, Pm, and Saltation Monitoring.** It appears that many Normalized Sand Flux (NSF) values reported here are from the 2018-19 ARWP period, not the 2019-20 ARWP period that is the subject of this report. Please provide NSF values specifically for each of the 2019-20 control measures listed in Table 2-1, as available. Please also make it clear how the reported NSF values relate to each of the specific treatment areas. (For example, does Table 2-3 refer to the 2019-WF-01 and 2019-WF-02 treatments?)
4. **Table 2-3.** Please clarify what treatment area the "two temporary sand fence arrays" are referring to – are these 2019-WF-01 and 2019-WF-02?
5. **Attachment 6. "Defining the SOA 10 Baseline Days."** The current attachment does not actually define the SOA 10 baseline days. It instead performs an analysis to justify an existing choice that is not described anywhere in the ARWP. The SAG provided a preliminary definition of the SOA 10 Baseline Days, which was included as Attachment 5 for the revised 2019-20 ARWP issued on December 31, 2020. To reflect changes that were agreed to at the February 2020 SAG meeting and which were incorporated into subsequent DRI modeling, I provided OHMVR with an update to this file on March 1, 2020. I strongly recommend including this as an attachment with the 2020-21 ARWP. This would formally settle the lingering matter over selection of the 10 baseline days.
6. **Table 3-6.** Please replace the "tbd" entries with "Consult with SAG on selection of specific dust control treatment" and "Install dust control treatment."
7. **Sec. 3.2.3.** Planned Field Measurements: Baseline Sand Flux Measurements. This subsection as currently written is not helpful, because it only describes the theory of BSNEs without any specific plans. It would be much more useful to describe the actual

plan for BSNE data collection and analysis in 2020-21, following on the deployment of BSNE arrays described in Sec. 2.3.1.

8. **Sec. 3.2.3.** Planned Field Measurements: PM10 Measurements. This subsection as currently written is also not helpful. Please provide more specific detail on expected PM10 Measurements in 2020-21.
9. **Exhibit 2.** Please update the numbering of foredune treatment areas to match what is in the report.
10. **Attachments 1 & 2: 2019-20 and 2020-21 metrics.** These need to be updated. For 2019-20 (Attachment 1), many of the values (i.e., P7-P16) are listed as "TBD – 2020 ARWP." Please provide these values or give an explanation for why the values are not included. For 2020-21 (Attachment 2), many of the target values (i.e., P4-P16) are listed as "TBD." Will an attempt be made to define these targets? If OHMVR is unable to provide these values now, could it commit to a target date for consultation with SAG on these items? In addition, to avoid confusion, I suggest removing "TBD – 2020 ARWP" in the Attachment 2 "Value" column, as well as updating or removing the items in the "Notes / Plan" column of this file.

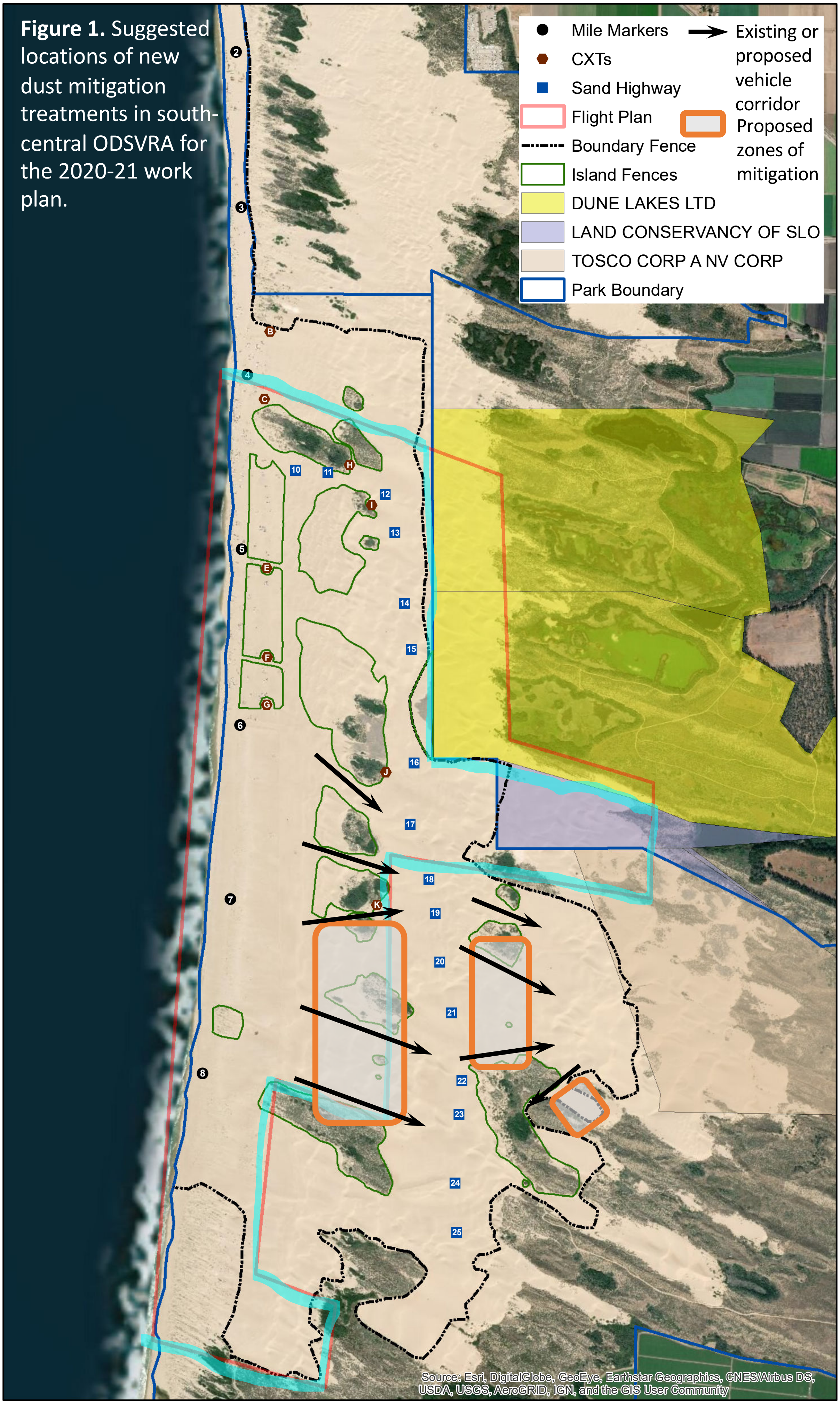

Figure 1. Suggested locations of new dust mitigation treatments in south-central ODSVRA for the 2020-21 work plan.

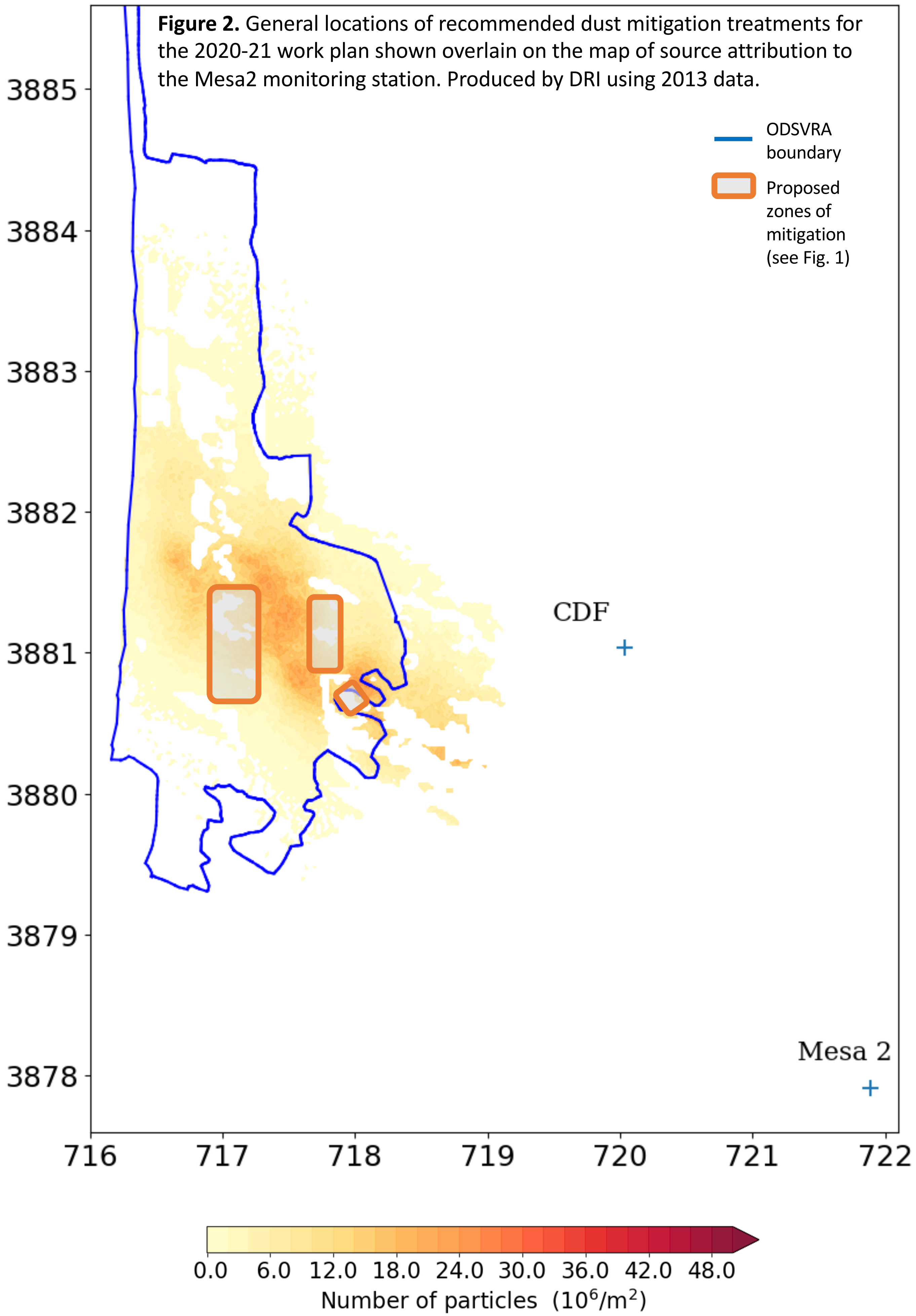

Figure 2. General locations of recommended dust mitigation treatments for the 2020-21 work plan shown overlain on the map of source attribution to the Mesa2 monitoring station. Produced by DRI using 2013 data.

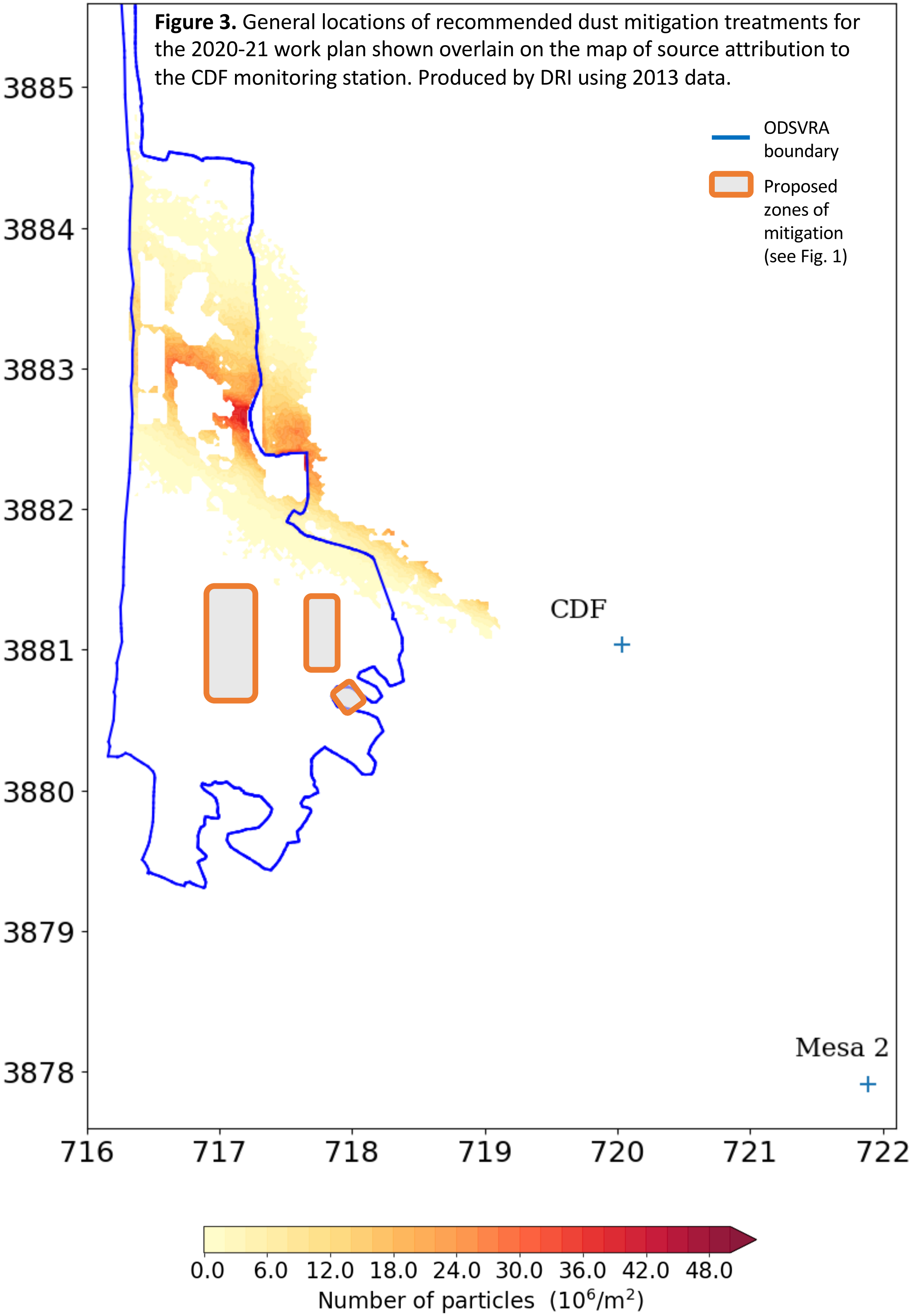

Figure 3. General locations of recommended dust mitigation treatments for the 2020-21 work plan shown overlain on the map of source attribution to the CDF monitoring station. Produced by DRI using 2013 data.

November 2, 2020

Memo: Scientific Advisory Group (SAG) Review of September 2020 Scripps Supplementary Report on Particulate Matter (PM) Sources at Oceano Dunes State Vehicular Recreation Area (ODSVRA)

From: The Scientific Advisory Group (SAG)

To: Jon O'Brien, California Department of Parks and Recreation

Background

In February 2020, Dr. Lynn Russell and colleagues from the Scripps Institution of Oceanography at the University of California, San Diego (UCSD) submitted a report, "First Year (2019) Summary Report: Investigation of Aerosol Particulates in a Coastal Setting, South San Luis Obispo County, California." Four individual members of the Scientific Advisory Group (SAG) prepared reviews of the Scripps study, which were published as Attachment 7 of the 2020-21 Annual Report and Work Plan (ARWP). Here is a summary of some of the main critiques offered by members of the SAG in their review of the Feb. 2020 Scripps report:

1. The Feb. 2020 Scripps report focused its analysis on $PM_{2.5}$ dust, whereas the Stipulated Order of Abatement (SOA) for dust mitigation at the Oceano Dunes State Vehicular Recreation Area (ODSVRA) is concerned with emissions and airborne concentrations of PM_{10}.
2. The Feb. 2020 Scripps report underestimated the contribution of mineral dust within the overall suite of $PM_{2.5}$ constituents. This underestimation by Scripps appears to be based on the use of a non-standard filter sampler that systematically underestimates $PM_{2.5}$ concentration relative to the San Luis Obispo Air Pollution Control District (SLOAPCD) BAM $PM_{2.5}$ samplers, which use U.S. EPA approved Federal Equivalent Method (FEM) regulatory methods. Furthermore, the Scripps $PM_{2.5}$ filters appear to have been sampled only for certain elements and constituents, whereas SLOAPCD measurements describe total dust mass. A SAG reviewer recommended that, in future sampling campaigns, the Scripps researchers analyze filters for total mass by gravimetry prior to further analysis.
3. The Feb. 2020 Scripps report misleadingly describes dust emitted through "natural saltation processes" as unrelated to OHV activity, when in fact areas of intensive OHV activity have been clearly associated with higher surface dust emissivity than protected areas, regardless of the presence of OHVs at the specific time of dust emissions.
4. The Feb. 2020 Scripps report baselessly dismisses the negative health effects of airborne mineral dust.

In August 2020, the Off-Highway Motor Vehicle Commission requested that Scripps prepare an updated report to describe refined analyses for determining the fraction of airborne particulate matter (PM) that are dust. In response to this request, Scripps prepared a supplementary report on September 20, 2020. The Sept. 2020 Scripps supplementary report describes gravimetric and elemental analyses of Teflon filters collected during a sampling period from April 27, 2020, to May 17, 2020. The analyses describe $PM_{2.5}$ measurements at the CDF monitoring station and PM_{10} measurements at a location near the mean high tide line serving as a benchmark for non-dune ocean sources. The subject of this current SAG review is this Sept. 2020 Scripps supplementary report.

SAG review of Sept. 2020 Scripps supplementary report

A key claim of the Scripps supplementary report is that mineral dust constitutes only 20% of the overall mass of $PM_{2.5}$ measured by the SLOAPCD BAM at CDF on high PM days. This claim implies that mineral dust emitted from the ODSVRA and associated with intensive OHV activity is not the most important cause of exceedance of state air quality standards with respect to $PM_{2.5}$ and PM_{10}. Though the SAG recognizes that mineral dust is not the sole contributor to $PM_{2.5}$ and PM_{10} measured at CDF and at other nearby air quality monitors, the SAG finds serious problems with the claim that mineral dust accounts for only a small fraction of measured PM. Similar to the concerns expressed in its review of the Feb. 2020 Scripps report, the SAG remains critical of two key aspects of Scripps' current 20% claim.

1. The Scripps work is framed with respect to the measurement of $PM_{2.5}$, whereas the air quality concern with respect to the ODSVRA PM contributions and the basis of the SOA is in the regulation of PM_{10}. A large proportion of mineral dust emissions at Oceano Dunes are known to be associated with particle sizes greater than measured in the Scripps study (i.e., in the range from 2.5-10 μm).[1] Thus, it is likely that consideration of only $PM_{2.5}$ provides an underestimate of the true contribution of mineral dust to airborne PM at ODSVRA.
2. SAG is critical of the Scripps measurement methods with respect to four main points:
    a) use of a non-Federal Reference (FRM) or Equivalent (FEM) filter sampler for measuring airborne PM
    b) lack of information on how the $PM_{2.5}$ filters were handled and analyzed
    c) computation of elemental mass from XRF, and
    d) assumption of adsorbed water effects on particle concentration mass measurements.

Combined, these technical issues, which are described in further detail in Appendix 1 below, most likely result in further underestimation of the contribution of mineral dust to airborne PM.

In addition to questioning Scripps' 20% claim, the SAG also remains critical of two additional claims about the effects of mineral dust on airborne PM, which are also repeated from the Feb. 2020 Scripps report:

1. The report claims that elevated PM during the pandemic closure proves that OHV activities do not affect the dust emission system of the ODSVRA. This claim is speculative at best and is not supported by the analysis provided. This claim also neglects direct observations (i.e., PI-SWERL emissivity measurements) obtained by the Desert Research Institute (DRI) that show distinctly higher surface dust emissivity in OHV riding areas compared to adjacent protected areas. This indicates a clear and long-lasting association between OHV activity and elevated surface dust emissivity that persists even when OHV activity is not occurring. The SAG addressed this matter in its April 6, 2020, letter on the COVID-19 closure, which is included as Attachment 8 in the 2020-21 ARWP. The mechanisms that link OHV activity to enhanced dust emissivity of dune sands are an important proposed topic of future investigation.
2. The Scripps report ignores a very large body of peer-reviewed literature related to the health effects of mineral dust. The Scripps report baselessly claims that because mineral dust is "natural," its emission has no adverse air quality health impacts. Appendix 2 of

[1] Huang Y, Kok JF, Martin RL, Swet N, Katra I, Gill TE, Reynolds RL, Freire LS (2019). Fine dust emissions from active sands at coastal Oceano Dunes, California, *Atmospheric Chemistry and Physics, 19*(5), 2947-2964. dx.doi.org/10.5194/acp-19-2947-2019

this review provides further information from the peer-reviewed literature on mineral dust and its health impacts.

Finally, the SAG notes that, as originally contracted by State Parks, Scripps was charged with quantifying the link between marine phytoplankton blooms and airborne PM measured at and downwind of the ODSVRA. The Feb. 2020 Scripps report indicated only a very minor contribution of marine phytoplankton to airborne PM, and the current Sept. 2020 Scripps supplementary report seems to completely ignore the issue of marine phytoplankton, despite this being the original motivation for this study.

In summary, the SAG rejects Scripps' claim that mineral dust constitutes only a small percentage of airborne PM at and downwind of the ODSVRA, and it further rejects Scripps claims about the role of OHV activities on PM emissions and the effects of airborne mineral dust PM on adverse health outcomes. As described below, the SAG recommends continuation of source apportionment studies for airborne PM described in the 2020-21 ARWP. Additional detail on the SAG's methodological concerns with the Scripps' Sept. 2020 supplementary report follows in Appendix 1 below. In Appendix 2 below, the SAG provides a rebuttal to baseless claims made by Scripps regarding mineral dust and its health effects.

SAG recommendations for quantifying airborne PM sources

The SAG has already recommended that additional measurement be made to improve quantification of airborne PM sources. As described in Sec. 3.1.7 of the 2020-21 ARWP, the Desert Research Institute (DRI) is planning to perform chemical analyses on 13 pairs of filters collected by the SLOAPCD from 2020 sampling days. The samples were collected using a Partisol sampler that has designation as a U.S. EPA FEM for sampling PM (i.e., equivalent to a Federal Reference Monitor) with a PM_{10} size-selective inlet. The chemically-speciated data will then be delivered to SLOAPCD and the California Air Resources Board (CARB) for PM source apportionment analysis. Results from the Scripps study will be considered as part of this analysis. Sec. 3.1.7 of the 2020-21 ARWP also describes how the SAG and Parks are engaged in ongoing meteorological, PM, and saltation measurements to more accurately quantify the effect of the temporary absence of OHV activity on airborne PM emission.

SAG position on SLOAPCD review of the Scripps supplementary report

On October 30, 2020, the SLOAPCD submitted to State Parks its own independent review of the Scripps Supplementary Report.[2] The SAG has reviewed this SLOAPCD review. The SAG fully supports the findings of the SLOAPCD review, noting that SLOAPCD raised many of the same concerns expressed by the SAG in this letter.

[2] SLOAPCD (October 30, 2020), San Luis Obispo County Air Pollution Control District Review of September 2020 Scripps Report.

Appendix 1: Issues with Scripps analytical techniques and suggestions for improvement
There are many uncertainties in the Scripps Sept. 2020 supplementary report, leading the SAG to question the claim that only about 20% of airborne $PM_{2.5}$ is attributable to mineral dust on high PM days, and that $PM_{2.5}$ is the appropriate metric, when the SOA is concerned with PM_{10}. The SAG details some of these concerns below.

(p. 3-4, Section 1.a.*)* *"The lower gravimetric mass concentrations are consistent with the expectation that the BAM method included more water than the gravimetric reference method".*

> The $PM_{2.5}$ Beta Attenuation Monitor (BAM) at CDF, like the PM_{10} BAM, is equipped with a heater in the intake tube. The heater is programmed to turn on when the relative humidity (RH) exceeds 35%. Absent measurements of the RH of the inlet and outlet flows through a BAM, this "expectation" cannot be conclusively confirmed.

(p. 4, Section 1.a.) *It is likely that the 38% difference in mass on high PM_{10} days is due to water evaporating, although other semivolatile compounds (ammonium nitrate and organic mass) could also be included in the BAM method and not in the gravimetric method."*

> Studies of the loss of semivolatile compounds from $PM_{2.5}$ Federal Reference Method (FRM) filters report up to a 40% loss of $PM_{2.5}$ mass from filters collected at two sites in Southern California.[3]

(p. 5, Section 2.a.) *"This suggests that at least 28% of the EBAM mass concentration was water."*

> (see responses to p. 3-4, Section 1.a. and p. 4, Section 1.a.)

(p. 5, last paragraph) *"The breakdown by weight and by component of the BAM concentrations measured at the CDF and Beach sites are summarized in Figure 9, where we have interpreted the difference between BAM and gravimetric mass as the evaporated fraction that is likely water and illustrated the measures mass component contributions from Dust, Salt, and Other."*

> It would very helpful if the report described the specific methods used in handling and analyzing the $PM_{2.5}$ filters. It is incongruous that 25% to 35% of filter mass is assumed to be water without the inclusion of any laboratory analysis to support this assumption. It is also incongruous that if XRF were used to identify the elemental composition of the solid mass collected, the remaining XRF results are not reported. There is also no description of how elemental mass results from the XRF analysis were used to compute the "sand" fraction of mass. Were elemental results converted to predominant geological species mass, for example?

Rough correlation of mineral content in $PM_{2.5}$ and PM_{10}:

> The Scripps Supplemental Report states that 20% of $PM_{2.5}$ monitored at the CDF monitor was mineral in origin. The Report also states that 36% of $PM_{2.5}$ monitored on the 10 afternoons with 24-hour PM_{10} concentrations exceeding 140 $\mu g/m^3$ was mineral in origin. Unfortunately, the Report does not specify the hours of "afternoon" operation to enable

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[3] Final Report: Continuous Measurement of PM2.5 and Associated Semi-Volatile Particulate Species, Eatough D.J., U.S. EPA Grant R825367, 1999, https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/520/report/F

an analysis of the equivalent mineral content of hourly PM_{10} concentrations recorded during the 10 afternoons.

Daily average $PM_{2.5}$ and PM_{10} concentrations recorded at the CDF monitor are available at CARB's AQMIS website.[4] The $PM_{2.5}$ and PM_{10} 24-hour concentrations recorded at CDF on April 27 through May 17, 2020 – the period of monitoring conducted by UCSD – average 11.0 and 47.1 $\mu g/m^3$, respectively. The Report states that 20% of $PM_{2.5}$ collected on filters during this monitoring period was of mineral derivation. This would equate to an average of 2.2 $\mu g/m^3$ of $PM_{2.5}$ being composed of mineral contributions. Analyses published over the past two decades indicate that the fraction of windblown dust in PM_{10} samples that is smaller than $PM_{2.5}$ is about 10%. Using this ratio, the equivalent mass concentration of mineral origin in PM_{10} samples would be about 22 $\mu g/m^3$ (=2.2 $\mu g/m^3$ / 10%). This value is about 50% of the average PM_{10} concentration measured by SLOAPCD at CDF (47.1 $\mu g/m^3$) during the same time period. On the basis of this rough correlation, I think we can assume that the mineral content of PM_{10} measured at the CDF monitor is at least 50%, which is a substantially higher fraction than is assumed in the Report.

Definition of "mineral dust":

Figure 9 attributes a large proportion of CDF $PM_{2.5}$ and PM_{10} to the nebulous category of "other," which "may include additional water, ammonium, nitrate, sulfate and organic compounds." Scripps should further clarify how it is using the elemental analysis to distinguish between percentages of "mineral dust" and "other," noting that mineral dust emissions at Oceano include a significant fraction of feldspar and clay- and iron-rich sand grain coatings.[5] In addition, Scripps should also report contributions of mineral dust and other constituents as a percentage of non-water components, in addition to its existing descriptions of these components as a fraction of total $PM_{2.5}$ measured by the SLOAPCD sampler.

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[4] Air Quality and Meteorological Information System, California Air Resources Board, https://www.arb.ca.gov/aqmis2/aqmis2.php

[5] Swet N, Elperin T, Kok JF, Martin RL, Yizhak H, Katra I (2019). Can active sands generate dust particles by wind-induced processes? *Earth and Planetary Science Letters, 506*, 371-380. dx.doi.org/10.1016/j.epsl.2018.11.013

Appendix 2: Mineral dust and its health impacts

The statement that airborne mineral dust has not been associated with health effects in humans is unsupported and contra to published literature. Investigation of health effects due to the inhalation of mineral dust PM extends from *in vitro* and epigenotoxicity studies that have shown that mineral dust PM can cause distinct cellular, molecular, genetic and epigenetic alterations in cells (e.g., Miousse, et al., 2015) to observations of increased admissions to hospitals due to respiratory related ailments during dust outbreaks from the Sahara/Sahel (e.g., Uduma and Jimoh, 2013), the deserts of Asia (e.g., Kanatani et al., 2010), as well dust from North American deserts such as the Chihuahuan (e.g., Rodopoulo et al., 2014). Morman and Plumlee (2014) provide a good overview of dust and human health.

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Kanatani, K., et al. (2010). Desert dust exposure is associated with increased risk of asthma hospitalization in children. *Am J. Respir Crit Care Med 182*, 1475-1481.

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Rodopoulo, S., et al. (2014). Air pollution and hospital emergency room and admissions for cardiovascular and respiratory diseases in Doña Ana County, New Mexico. *Environmental Research, 129*, 39-46, doi: 10.1016/j.envres.2013.

Uduma, A.U. and Jimoh, W.L.O. (2013). High incidence of asthma, bronchitis, pneumonia and sinusitis in Kano State, north west Nigeria during Saharan dust events. *American Journal of Environment, Energy and Power Research, 1*(8), 174 – 185.

Additional references are easily gleaned using search engines such as Google Scholar.

November 20, 2020

Memo: Scientific Advisory Group (SAG) Review of 90 Acre Treatment Options for 2020-21 ARWP

From: The Scientific Advisory Group (SAG)

To: Jon O'Brien, California Department of Parks and Recreation

In its conditional approval of the 2020-21 Annual Report and Work Plan (ARWP), the San Luis Obispo Air Pollution Control District (SLOAPCD) directed Parks, in consultation with the SAG, to identify approximately 90 acres within the ODSVRA for new temporary/seasonal dust controls and their expected impacts on dust emissions and downwind PM_{10} consultations. Parks presented four treatment options to the SAG, along with dust emissions modeling analysis prepared by the Desert Research Institute (DRI).

Among the options presented, the SAG recommends Option 2 as the most effective for dust emissions reduction, but the SAG also supports Option 1 as potentially achieving a similar level of dust emissions reduction.

The SAG finds that **Option 2** is likely to provide the greatest reduction in dust emissions and downwind PM_{10} concentrations among the options presented. The effectiveness of Option 2 is supported by the DRI model, which predicts a greater net emissions reduction for Option 2 than for any of the other options presented. In addition, the vast majority of acreage for Option 2 is contained within the Riding Area, which is known to be (on average) more emissive than Non-Riding Areas. All of the other options presented place a substantial fraction of dust mitigation treatments in Non-Riding Areas. Thus, the Option 2 treatments are likely to provide a greater per-acre reduction in PM_{10} dust emissions as compared to these other options.

The SAG also supports **Option 1.** Though the DRI model predicts smaller emissions reductions for Option 1 than for Option 2, the SAG notes that the modeled difference between these two options is within the margin of uncertainty between modeled and observed values for the DRI model (see 2020-21 ARWP, Sec. 2.3.3.1). Thus, the SAG cannot unambiguously state that Option 2 will necessarily reduce dust emissions by more than Option 1.

Nickling Environmental Ltd

Air quality and wind erosion specialists

March 12, 2021

Mr. Jack Ainsworth, Executive Director, California Coastal Commission
Mr. Steve Padilla, Chair of the California Coastal Commission
455 Market Street, Suite 300
San Francisco, CA. 94105

Re: Oceano Dunes State Vehicular Recreation Area

Dear Mr. Ainsworth and Mr. Steve Padilla,

The Scientific Advisory Group (SAG) was established in April 30, 2018 through a Stipulated Order of Abatement (SOA) to advise California State Parks on potential methodologies to reduce dust emissions at Oceano Dunes State Vehicular Recreation Area (ODSVRA), California, to comply with State and Federal Air Quality PM_{10} Standards. SAG is comprised of 7 well published research scientists (geomorphologists, air quality engineers and biologists) whose primary expertise is directly related to sediment transport by wind, wind erosion control methodologies and air quality issues.
Since its inception it has been SAG's goal to reduce dust emissions at ODSVRA using environmentally sustainable techniques that attempt to mimic or enhance natural dune processes and landforms that tend to slow down near surface wind speeds and trap sediment (e.g., planting of natural vegetation, promoting the development of dune forms near the coast where sediment is deposited by wave action). Importantly the SAG has always been focused on finding the most effective ways to improve air quality with the least possible disruption to existing uses.

Over the past 3-5 years the control strategies and field trials that have been implemented at ODSVRA have been very promising with significant sand deposition behind sand fences and within planted vegetation. Of particular importance is the development of the 48 acre (0.19 km^2) "proto" foredune that was established using different forms of roughness (tillage, addition of straw mulch and planting of different varieties and densities of vegetation). In the past 2 years small dunes (nebhkas) have now begun to form, providing evidence that they will continue to grow, trapping sand moving down wind, thereby reducing dust emissions and PM10 concentrations.

…cont'd

Although we understand that the Coastal Commission and Parks must weigh a variety of factors in their decisions, from an air quality perspective the work of the SAG thus far indicates that there is a workable approach to achieving the targets set by the SOA while retaining some level of off-highway vehicular activity at the ODSVRA. We would like to make sure that these scientifically informed findings, which are reflected in multiple Parks reports in response to the SOA, are appropriately considered within broader debates about management of the ODSVRA.

Yours Sincerely,

W.G. Nickling PhD
Special Master
Chair, Science Advisory Group

Science Advisory Group
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M. Bush MS
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I.J. Walker PhD
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cc: Gavin Newsom, Governor
Wade Crowfoot, Secretary for Natural Resources Agency
Armando Quintero, Director DPR
Sarah Miggins, Deputy Director OHMVR Division
OHMVR Commissioners
Coastal Commissioners

April 30, 2021

Memo: Scientific Advisory Group (SAG) Review of *Report to the SAG and Parks Evaluating the Potential for Developing a New Baseline Mass Emissions Rate and Target Reduction within the SOA*, by J.A Gillies, J. Mejia, and E. Furtak-Cole, Desert Research Institute (DRI), Reno, NV

From: The Scientific Advisory Group (SAG)

To: Jon O'Brien, California Department of Parks and Recreation

Background. The 2020 Annual Report and Work Plan (ARWP) states, "All parties will continue coordination on possible SOA Goal Alternatives, noting that the foremost goal is to achieve reductions in PM10 concentrations toward attaining state and federal air quality standards while minimizing impacts to public recreation opportunities." Following approval of the 2020 ARWP, the SAG initiated a process of reviewing the existing Stipulated Order of Abatement (SOA) target of reducing PM10 mass emissions by 50% relative to the 2013 baseline and examining scientifically-informed alternatives. The SAG is exploring an alternative approach that, unlike the current target, defines a "pre-disturbance" reference scenario of dust emissions prior to OHV disturbance, and then models the differences in PM10 mass emissions and airborne concentrations relative to the SOA "baseline" of 2013 dust emissions.

To inform this alternative approach, the SAG requested (and California State Parks agreed) that the Desert Research Institute (DRI) use the extensive available PI-SWERL emissivity data collected from 2013 to 2019 and the DRI emission/dispersion model (Mejia et al., 2019) to perform a preliminary implementation of the SAG's proposed alternative approach. DRI's report seeks to answer the following questions. First, what is the effect on <u>PM10 mass emissions</u> from the Oceano Dunes State Vehicular Recreation Area (ODSVRA) for the SOA-defined 10 baseline days of 2013 if the emissivity of the riding area is represented by the mean emissivity relationship for all non-riding (i.e., undisturbed) areas. Second, what is the effect of such a change in emissions on <u>downwind PM10 concentrations</u>?

SAG's intention in requesting this analysis from DRI was to provide a *preliminary* sense of the feasibility of identifying an alternative to the existing SOA target that is referenced to an emissions scenario that reflects conditions prior to OHV activity. Based on DRI's report, the SAG would then advise Parks on how to move forward (if at all) on use of this alternative approach to defining the SOA dust mitigation target and related progress in attaining the SOA goals of improved air quality. Below, the SAG provides a review of the DRI report and offers its recommendations for next steps.

Technical Review. The SAG affirms that the analyses described in the DRI report fulfill SAG's request for modeling to determine the feasibility of an alternative approach to the SOA target based on modeling a scenario representative of dust emissions prior to OHV disturbance, and that the methodology deployed to pursue this analysis is scientifically sound. The approach to mapping PM10 emissivity based on PI-SWERL measurements is justified by extensive scientific literature, as is the method for modeling emissions and downwind transport of PM10 using the DRI model (Mejia et al., 2019). Furthermore, DRI correctly identifies the limitations of their current modeling of the pre-disturbance emissions scenario, which does not yet consider the effects of spatial gradients of PM10 emissivity and/or historical differences in vegetation coverage. Given the preliminary nature of this analysis, and the complication of accounting for these factors, the SAG advised DRI not to include these factors in their initial modeling efforts.

Key Findings of DRI Report.

1. Independent of the question of the specific SOA target, the DRI report demonstrates the unambiguous impact of OHV activity on increased PM10 emissions within the ODSVRA. In terms of emissivity, under strong winds (~u*=0.61m/s), the emissivity of Riding Area surfaces appears to be roughly double that of Non-Riding Area surfaces, and this ratio is even more pronounced for weaker winds (e.g., Figs. 4 and 9). Furthermore, there is also an unambiguous impact of OHVs on increased downwind airborne PM10 concentrations, especially at the CDF monitoring site and, to a lesser degree, at the Mesa2 site. Also notable is the fact that, even for the modeled scenario without OHV disturbance, these monitoring sites experience exceedances of the 50 μg m^{-3} California PM10 air quality standard on the windiest days. Therefore, the key question is not whether OHVs have an impact on PM10 emissions, but rather how big that impact is.
2. Preliminary modeling of a pre-disturbance emissions scenario indicates that Riding Area PM10 mass emissions for the 2013 baseline days would be 37.6% lower in the absence of OHV activity than in the presence of OHVs (i.e., 118.2 metric tons/day versus 189.4 metric tons/day). It is probable that the preliminary DRI model analysis overestimates pre-disturbance PM10 emissivity in the southern portion of the Riding Area (e.g., right panel in Fig. 5) and underestimates historical vegetation cover, so the SAG expects that refinement of the pre-disturbance emissions scenario to account for a spatial emissions gradient and/or historical vegetation cover would likely decrease overall PM10 mass emissions further. Though it is hard to predict what exact effect these model refinements might have, it is plausible that they would reduce PM10 mass emissions for the pre-disturbance emissions scenario to the point where emissions could approach or exceed 50% lower than the 2013 baseline scenario, in line with the existing SOA target.

Recommendations. The SAG finds that the approach of modeling PM10 emissions and concentration for a pre-disturbance emissions scenario, and then comparing this to a scenario of OHV disturbance, is highly instructive for understanding the effect of OHVs on PM10 mass emissions and airborne concentrations. The current SOA-defined target does not consider these realities. Therefore, the SAG advises that Parks consider use of this modeling approach in the future as a valuable tool for understanding the effects of dust control treatments on reducing PM10 dust emissions and concentrations to levels commensurate with the absence of OHV impacts. However, based on the DRI report, the SAG questions whether it is worthwhile to revisit the SOA 50% mass emissions reduction target. Already, the preliminary model analysis shows a 37.6% reduction in PM10 mass emissions for the pre-disturbance scenario relative to the 2013 baseline scenario of OHV-impacted dunes, and model refinements to account for a spatial gradient in PM10 emissions and historical vegetation coverage are likely to yield further reductions approaching the existing SOA 50% reduction target. In any case, any further use of the pre-disturbance emissions scenario modeling approach should incorporate refinements to account for spatial emissivity gradient and historical vegetation coverage, and it should also include a robust treatment of model uncertainty.

References

Mejia, J. F., Gillies, J. A., Etyemezian, V. R., Glick, R. (2019). A very-high resolution (20 m) measurement-based dust emissions and dispersion modeling approach for the Oceano Dunes, California, Atmospheric Environment, 218, https://doi.org/10.1016/j.atmosenv.2019.116977

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

DRAFT 2021 Annual Report and Work Plan

ATTACHMENT 13

Examining Dust Emissions and OHV Activity at the ODSVRA

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Examining Dust Emissions and OHV Activity at the ODSVRA

J.A. Gillies, E. Furtak-Cole, G. Nikolich, and V. Etyemezian

Introduction

California State Parks has undertaken ambitious dust control efforts at the ODSVRA to move towards meeting the Stipulated Order of Abatement targets for reducing the mass emissions of PM_{10} from the ODSVRA and lowering the PM_{10} concentrations at key monitoring sites CDF and Mesa2. It is assumed that lowering the total mass emissions and the PM_{10} levels at these two sites indicates that air quality across the Mesa is being improved for all residents.

A recent Report to Parks from DRI (Gillies et al., 2020) presents analysis based on modeling and empirical data, that suggests PM_{10} levels have been lowered by approximately 45% in the vicinity of the CDF monitoring site since dust controls have been emplaced within the riding area of the ODSVRA beginning in 2014. This has been achieved by controlling in 2020, 223 acres using vegetation and temporary wind fencing to reduce dust emissions.

A question that has been posed by stakeholders is: if OHV activity augments the emissivity of the dunes, what fractional increase may this represent? Here we present several lines of evidence that this increase can be defined. The analyses to be reported uses the available PI-SWERL data collected between 2013 through 2020, and the wind and PM_{10} data from the in-Park monitoring network in 2019 and 2020.

PI-SWERL

Since 2013 DRI has undertaken PI-SWERL measurements of PM_{10} emissivity (E, mg m^{-2} s^{-1}) across the ODSVRA in riding and non-riding areas on an annual basis. Measurements have been repeated through time by revisiting locations that were established in 2013, which defined west to east and north to south transects. In addition, over the same period PI-SWERL measurements were also made in the Plover exclosure area during periods when it was and was not accessible. Measurements have also been made in areas where it was deemed critical to obtain data that could be used to, for example, define the change in emissivity as a function of distance past the riding-nonriding boundary on the eastern side of the ODSVRA.

In 2020 OHV activity ceased in April due to restrictions based on health concerns for the transmission of COVID19. The cessation of OHV activity provided an opportunity to investigate how emissivity may change through time due to the absence of OHV. A program was undertaken to repeatedly measure emissivity using the PI-SWERL in the Lagrande Tract at the same geographic positions (30 in number) from April through October (Fig. 1). The positions within the Lagrande Tract selected for repeat measurements were selected from the 2013 transects. A subset of sample locations (62 in number) was also selected that represented the wider riding area domain of the ODSVRA (Fig. 2) to allow comparison with the same locations measured in 2019. The measurement protocols for PI-SWERL have remained the same since 2013 and the testing sequence of RPM and ramping between RPM values used has been the Hybrid3500.

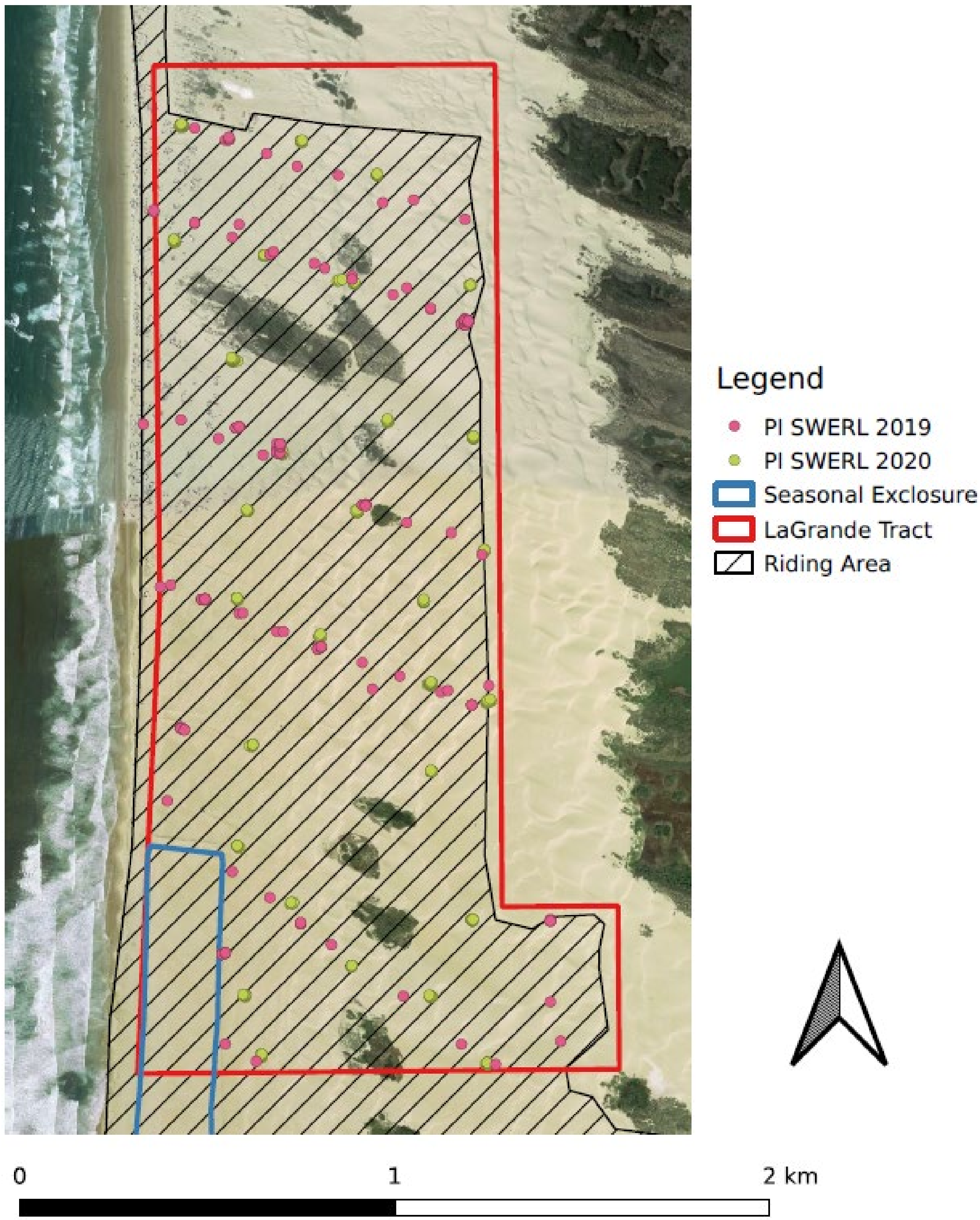


Figure 1. Locations of PI-SWERL tests in the Lagrande Tract in 2019 (pink circles) and in 2020 (green circles).

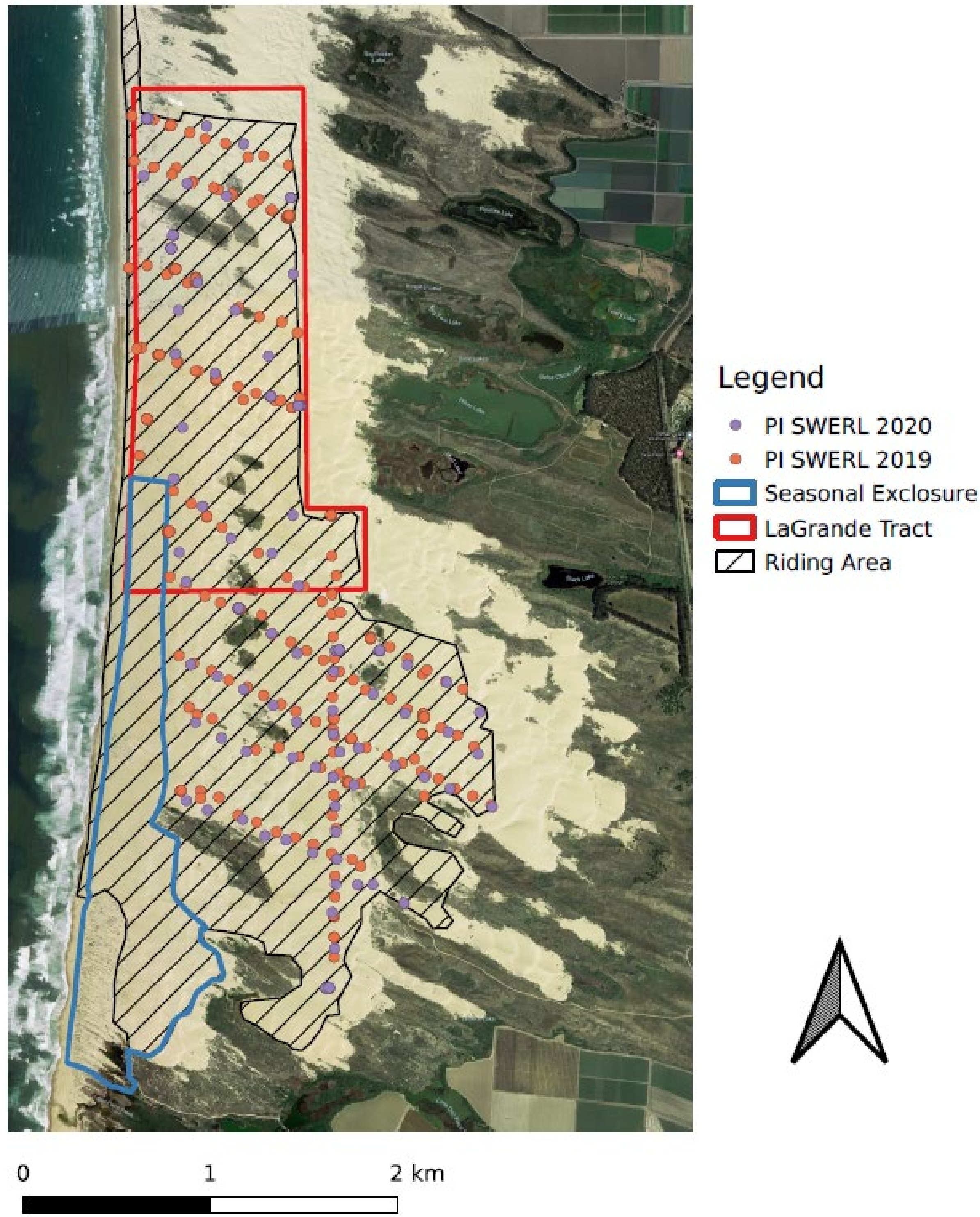


Figure 2. The PI-SWERL test locations for 2020 (purple circles) and 2019 (orange circles).

2013-2019

At the broadest level of comparison of emissivity between riding and non-riding areas the data for all years (2013-2019) can be aggregated together to produce an emissivity and u_* relation for each. For the riding area approximately 932 individual PI-SWERL tests representing the three RPM set points in the Hybrid 3500 test are available. In the same period approximately 317 PI-SWERL tests were made in non-riding areas. These tests do not include those made in the Plover exclosure area between 2013 and 2019.

The mean emissivity (E, mg m^{-2} s^{-1}) as a function of shear velocity (u_*, m s^{-1}) relation for the riding and non-riding areas are shown in Fig. 3. The shear velocity is estimated from the RPM value of the PI-SWERL Hybrid 3500 test sequence using the conversion equation of Etyemezian et al. (2014). An Analysis of Variance (ANOVA) test was conducted on the E values for each of the three sets of u_* values to test whether they are statistically different at the 0.05 level of confidence (i.e., the set P value). The nonparametric ANOVA test was used because these data are not normally distributed. For each of the three u_* values the difference in E between the riding and non-riding tests is statistically significant based on the calculated P values being <0.05 and the F value being greater than the F critical value (generated by the ANOVA test). This demonstrates that the long term mean emissivity of the entire riding area is greater than the long term mean emissivity of the non-riding area for the aggregated data from 2013 to 2019.

These aggregated data sets indicate at the broadest level that, all else being equal, the riding area has a higher emissivity than the non-OHV impacted surfaces, providing some suggestion as to the impact of OHV activity on emissivity. Because the relationship between E and u_* is non-linear (i.e., a power function) the scaling of the OHV effect on emissivity cannot be quantified as a single value. At lower shear velocities (e.g., 0.38 m s^{-1}) emissivity of OHV-impacted sand is enhanced by a factor of 3.6 while at the higher value of 0.61 m s^{-1} it is enhanced by a factor of 1.9 (Fig. 3). OHV activity exerts mechanisms of anthropogenic influence on the dunes throughout the area designated for active riding. The mechanisms consist of rotating vehicle tires that: 1) create a shearing force between sand particles at and near the surface, 2) mix the surface layer of sand, and 3) displace sand particles away from the path of vehicle travel. We hypothesize that these three mechanisms (and perhaps other unidentified near-surface mechanisms) related to OHV activity have the potential to augment the emissivity of the dune sand creating higher concentrations of dust in the air than would occur if this dune system was not impacted by OHV activity.

The mean emissivity relationship for riding and non-riding areas can be disaggregated to examine for geographic influence on the emissivity across space (Fig. 4). For the non-riding area the emissivity data can generally be grouped as: northern dune preserve, areas east of the riding/non-riding boundary in the middle zone of the ODSVRA, and the southern dune preserve. For each of the three zones an ANOVA test was done on the paired data for each PI-SWERL test u_*. The ANOVA tests indicated that the mean emissivity values for each test u_* are significantly different between the geographic locations, with the north having higher emissivity than the east and the south, and east higher than the south (Fig. 5).

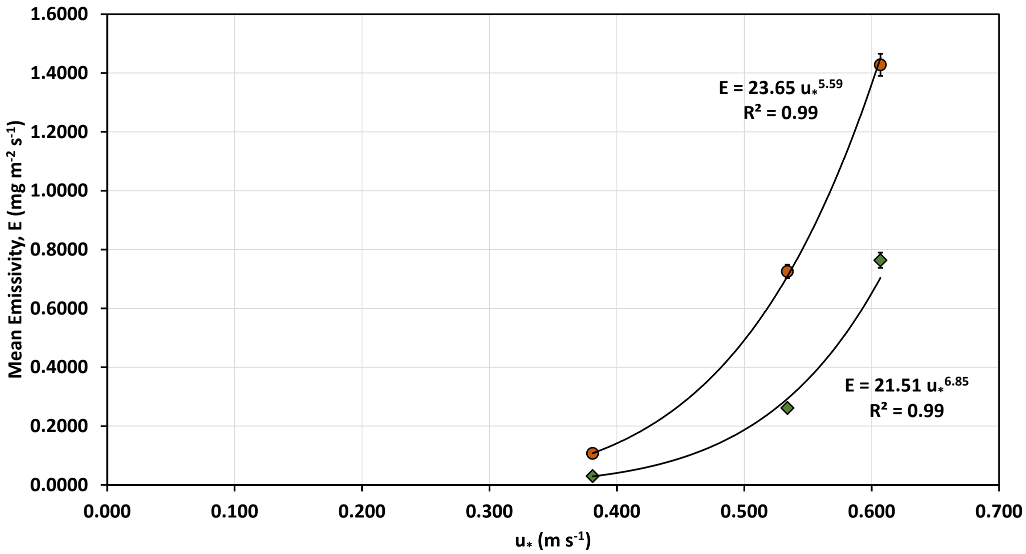


Figure 3. The relation between mean E (mg m^{-2} s^{-1}) and u_* (m s^{-1}) for the amalgamated data from 2013 to 2019 for the riding (orange circles) and non-riding areas (green diamonds). Error bars represent the standard error of the estimate (standard deviation/(#observations-1)$^{0.5}$).

The gradient of increasing emissivity towards the north in the non-riding area also is observed in the emissivity data for the riding area of the ODSVRA. This is demonstrated in Fig. 6, which shows the increase in mean emissivity as a function of latitude bins of 0.005 (decimal) degrees expressed as the factorial increase in emissions when normalized to the southern-most measurement group for all available data (i.e., mean emissivity in latitude bin/mean emissivity in southern-most latitude bin) from 2013 to 2019. This holds for each of the three test u_* values (Fig. 6). In each latitude bin for each test u_*, the emissivity represents the mean of all tests that fall within the bin. This emissivity gradient is a function, in large part, of the gradient in mean grain diameter increasing from north to south. The emission of dust from the dune sands due to saltation is more efficient for sand of smaller mean grain diameter than larger mean grain diameter. This was observed in the analysis of the mean grain size and emissivity data from measurements made in 2013 (Fig. 7).

As identified previously, at the broadest scale the emissivity of the riding area was between 3.6 and 1.9 times greater than the non-riding area for the three PI-SWERL test u_* values. The available data can be interrogated further by pairing specific regions of the riding and non-riding area based on the latitude of the tests. Keeping the non-riding groupings as shown in Fig. 4 and grouping the riding area tests closest in latitude to the non-riding tests, the difference in emissivity can be examined between them along the north to south axis of the ODSVRA. The factorial difference between the riding and non-riding emissivity (i.e., E riding/E non-riding) as a function of north, middle, and southern non-riding latitudinal ranges is shown in Fig. 8. This figure suggests that the difference between the riding and non-riding areas along the north to south gradient is similar for each PI-SWERL test u_* regardless of distance along the gradient. For the lowest test u_* (0.381 m s^{-1}) the difference in emissivity between riding and non-riding is, on average, riding emissivity is 4.3 times greater. For test u_*=0.534 m s^{-1} the factor is 2.7, and for test u_*=0.607 m s^{-1} the factor is 2.0. The lower emissivity of the non-riding area across the north-south

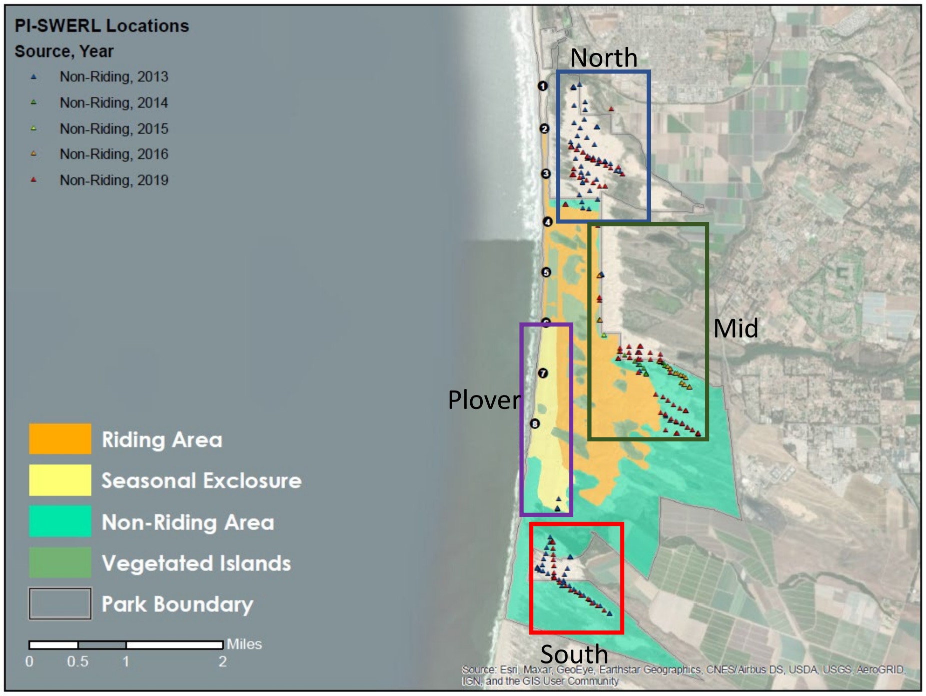


Figure 4. The grouping of the PI-SWERL tests by geographic position in the ODSVRA. In the north west quadrant of the Mid zone, the area east of the non-riding in the ODSVRA is private land and inaccessible for measurements.

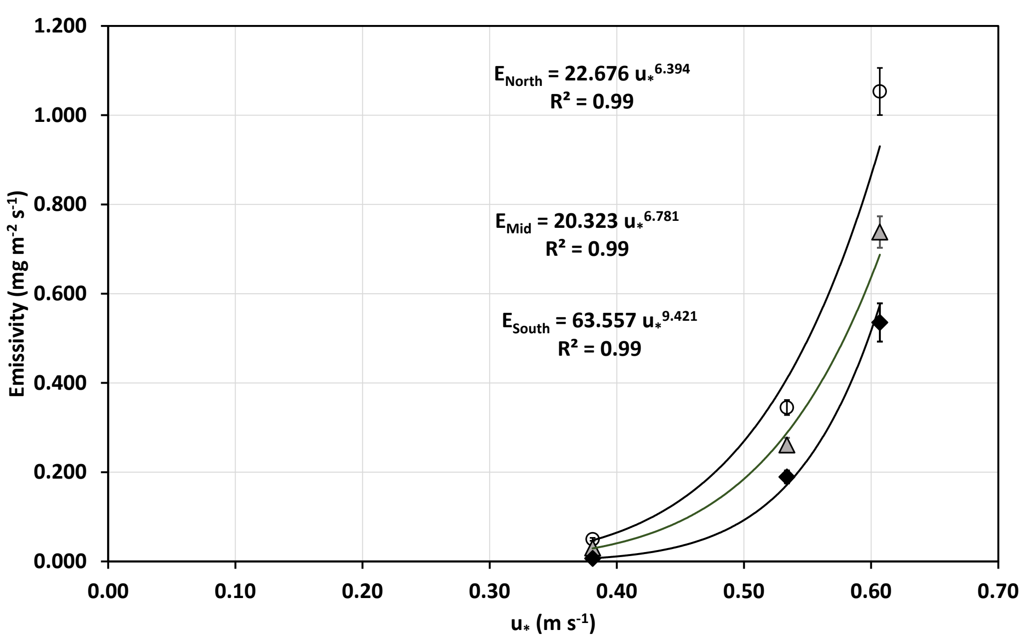


Figure 5. The relation between mean E (mg m^{-2} s^{-1}) and u_* (m s^{-1}) compared by geographic position for the non-riding areas: white circle, north; grey triangle, middle, black diamond, south. Error bars represent the standard error of the estimate (standard deviation/(#observations-1)$^{0.5}$).

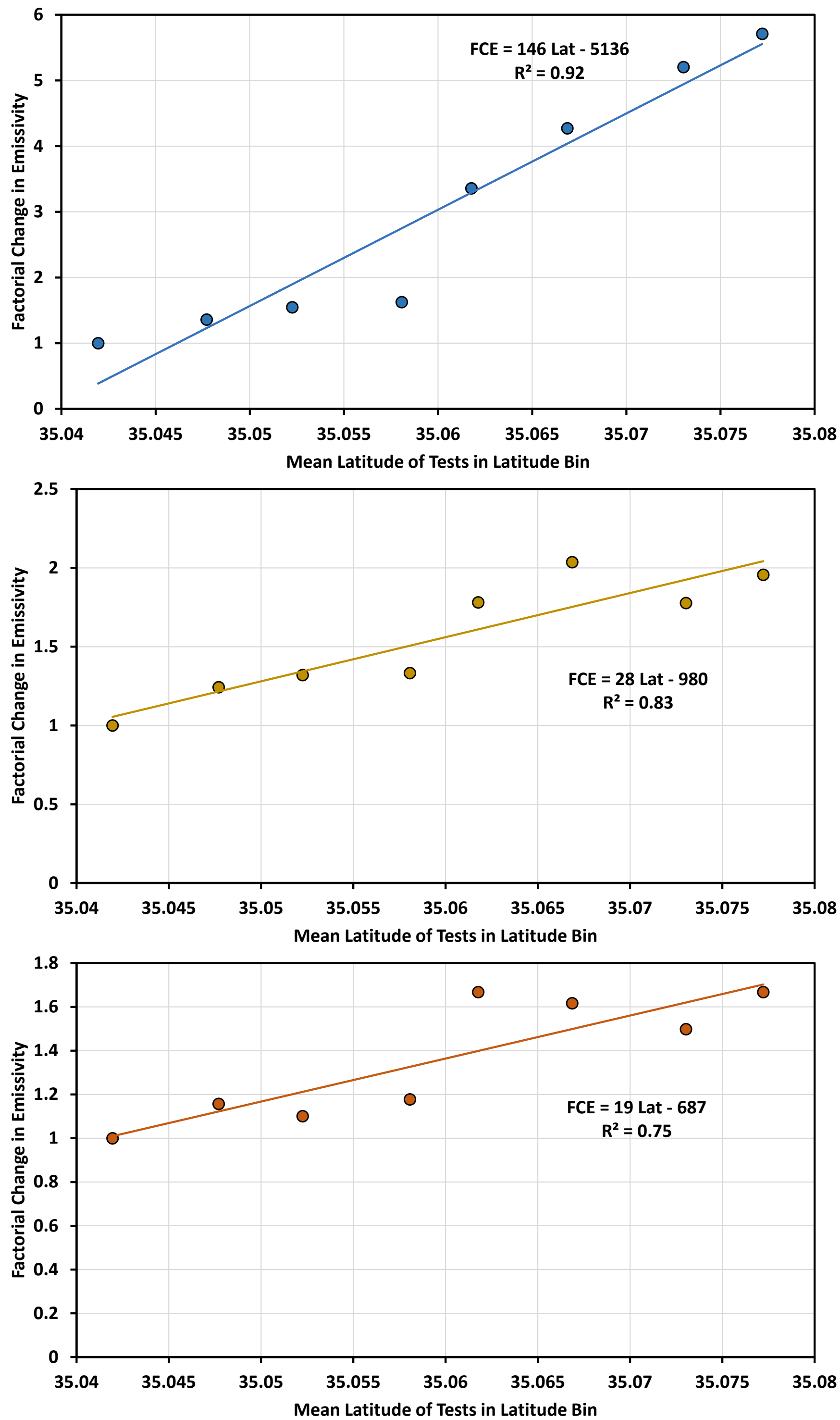


Figure 6. The factorial increase in emissivity as a function of position along the north (35.08 decimal degrees) to south (35.04 decimal degrees) gradient of the PI-SWERL tests in the ODSVRA riding area. Data represent mean emissivity in each latitudinal bin normalized to the mean emissivity in the southern-most latitude bin for the three PI-SWERL u_* values: 0.381 m s^{-1} (top panel), 0.534 m s^{-1} (middle panel), and 0.607 m s^{-1} (bottom panel).

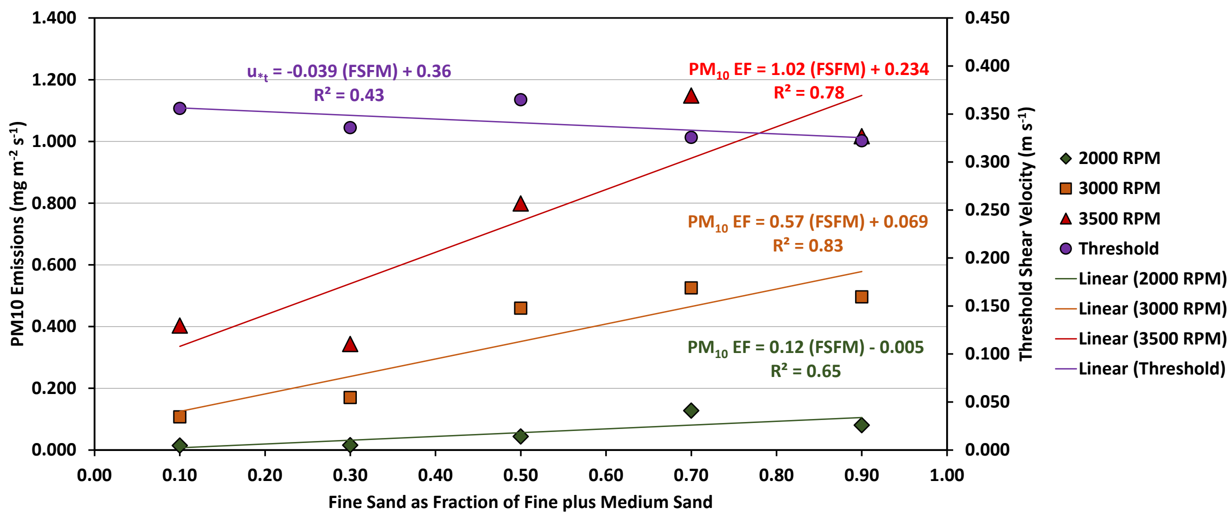


Figure 7. Relationships between PM_{10} emissions and the ratio of fine sand as a fraction of fine sand +medium sand. Data are from 2013 as reported in "Addendum to the Pi-SWERL Report" (Etyemezian et al., 2014, refer to Fig. 15).

distance of the ODSVRA, and the fact that this difference scales consistently as a function of latitude and u_*, suggests this represents, in part, the augmentation of dune sand emissivity due to OHV activity. Unfortunately, there are no data to evaluate if there is a north-south gradient in vehicle activity, which could also be influencing the relation shown in Fig. 8.

2020 Lagrande Tract Repeated PI-SWERL Survey

PI-SWERL tests were repeated within the Lagrande Tract area from April to October 2020 during which time OHV activity was largely prohibited (NB, no measurements were made in August). The locations of the tests remained constant during that time (Fig. 1). It must be recognized that although the positions of the tests remained the same, the sand was intermittently being transported by the wind. The wind redistributes the sand and the bedforms (ripples and dunes) migrate in the direction of the sand transporting wind during transport events. Although the tests were conducted at the same locations, clearly the sand at those locations was not the same sand from the previous tests. The wind essentially randomizes the surface with each transport event and makes comparison of emissivity at a particular position questionable. For these data it is more reasonable to aggregate them by creating a mean emissivity for the tests made during set periods of time, for example by month.

In addition to the randomization of the surface by the wind, moisture conditions due to precipitation dew and fog varied across space and through time during the PI-SWERL testing. This creates a degree of difficulty for comparing emissivity as a function of time and requires that some aggregation of the data be undertaken to try and account for the variability, particularly due to moisture effects. Ideally the data would be aggregated by a moisture-based criterion, but a reliable metric and measurement method remains to be developed.

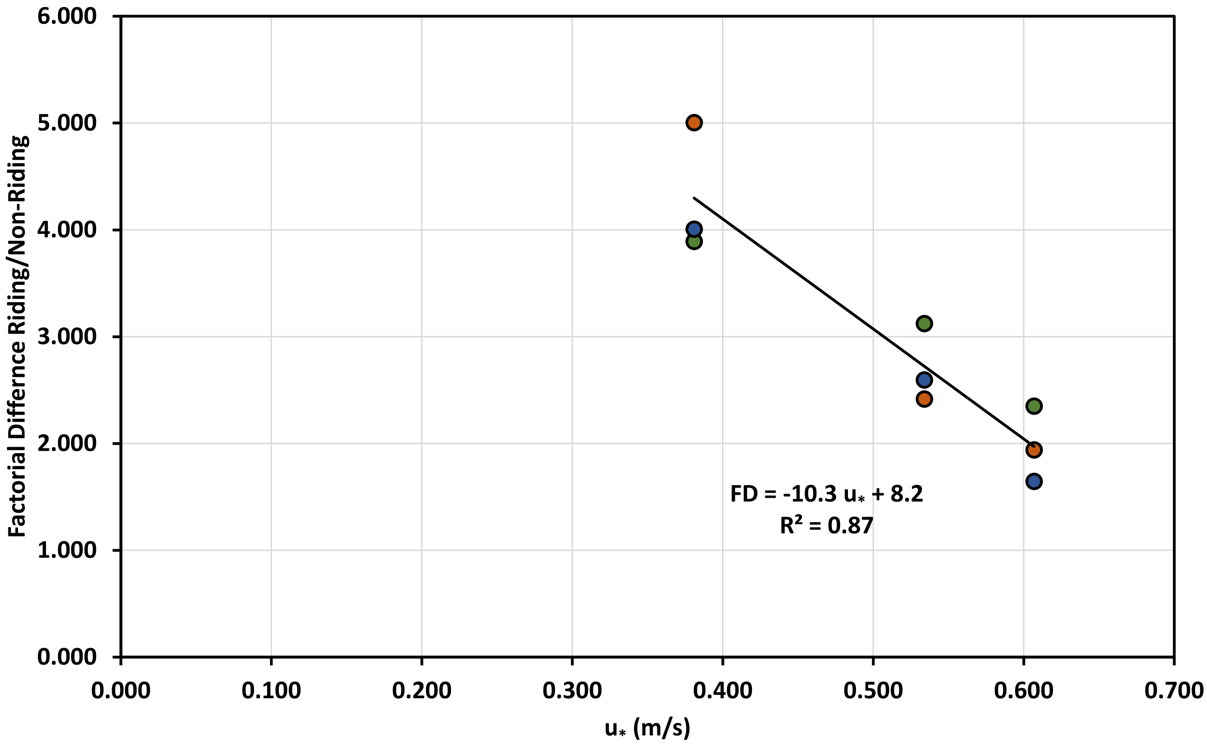


Figure 8. The factorial difference in emissivity between riding and non-riding areas as a function of PI-SWERL test u_* and as a function of the latitudinal range of the northern (blue circles), middle (green circles) and southern (orange circles) non-riding area groupings.

The mean emissivity and u_* relations for the Lagrande Tract for April, May, June, and July are represented by color-coded circles in Fig. 9. For comparison they are plotted along with the mean emissivity and u_* relations for the Lagrande Tract in 2019 (for tests in the same area as 2020), all riding area tests (2013-2019), and all non-riding tests (2013-2019). These data show that in April 2020, the emissivity is most similar to the mean non-riding area relationship, likely due to moisture effects linked with precipitation events in April 2020. In May and June 2020, the emissivity is similar to the emissivity in the same general area as was measured in 2019, differing by less than a factor of 1.5 for the two highest shear velocities in the PI-SWERL test. In July 2020, the emissivity is most like the mean non-riding area relationship based on PI-SWERL testing between 2013 to 2019. The factorial difference (i.e., E-2019/E-2020 for the same test u_* values) between emissivity for 2019 and 2020 for April through October for the same area of the Lagrande Tract where measurements were made in 2020 is shown in Fig. 10. In general, the emissivity of the Lagrande Tract in 2020 was less than in 2019. The month to month pattern of change in emissivity illustrated in Fig. 10, could, in part, be due to moisture effects from precipitation, fog and dew events. The lower emissivity in 2020 may also be indicative of changes in the sand due to the cessation of riding, caused by, for example, removal of the PM_{10} source material by winnowing, coarsening of the sand near the surface due to wind-driven sorting processes, and the cessation of the mixing of the surface sand by vehicle tires.

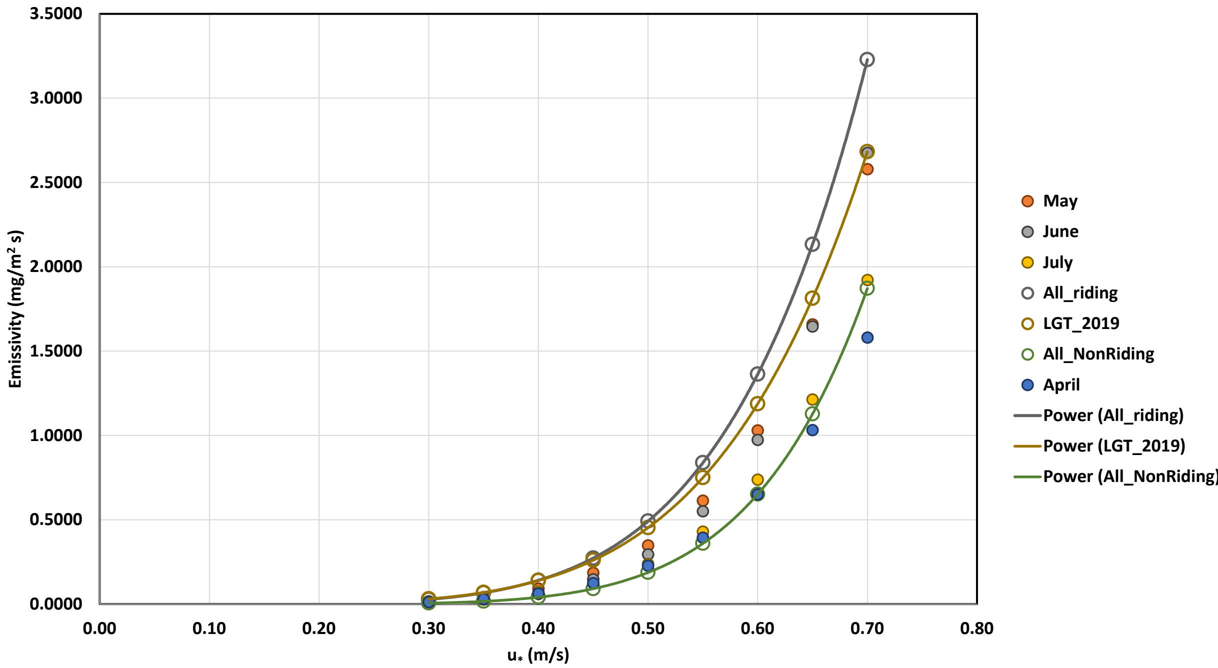


Figure 9. The mean emissivity and u* relations for the Lagrande Tract for April, May, June, and July 2020 compared with Lagrande Tract 2019, all riding area (2013-209), and all nonriding area (2013-2019).

2020 Compared to 2019 for Areas Outside the Lagrande Tract

In May 2020 PI-SWERL measurements were made across the ODSVRA riding area that represent a sub-set of the sampling grid that was established in 2013 (Fig. 2). These measurements were made between May 12 to May 17. The mean emissivity measured in 2020 for the three test u* values were compared to the emissivity data from PI-SWERL testing in May 2019 to evaluate if a significant change in emissivity had occurred across a larger spatial domain than just the Lagrande Tract. An ANOVA test for each of the test u* values between the two years was carried out and the results show that the mean emissivity in 2020, E=0.064 mg m^{-2} s^{-1} for u_*=0.381 m s^{-1} (RPM=2000), was not different than the mean value of E=0.075 mg m^{-2} s^{-1} for 2019. For the higher test u* values of 0.534 m s^{-1} (RPM=3000) and 0.607 m s^{-1} (RPM=3500), the mean E values in 2020 were 0.324 mg m^{-2} s^{-1} and 0.831 mg m^{-2} s^{-1}, respectively, while for the 2019 data they were 0.503 mg m^{-2} s^{-1} and 1.037 mg m^{-2} s^{-1}, respectively. ANOVA testing for each pair indicate that the E values are significantly different for the higher u* test values between the two years. This indicates that the mean emissivity of the riding area as a function of u* in May 2020 (Fig. 11) was lower than in 2019, as was also observed for the Lagrande Tract repeat survey area. This could be a result of the cessation of OHV activity, but it could also be due to the effects noted in the previous section.

Due to constraints due to weather and accessibility, PI-SWERL measurements in the nonriding areas were extremely limited in 2020. Comparison with 2019 measurements could not be made.

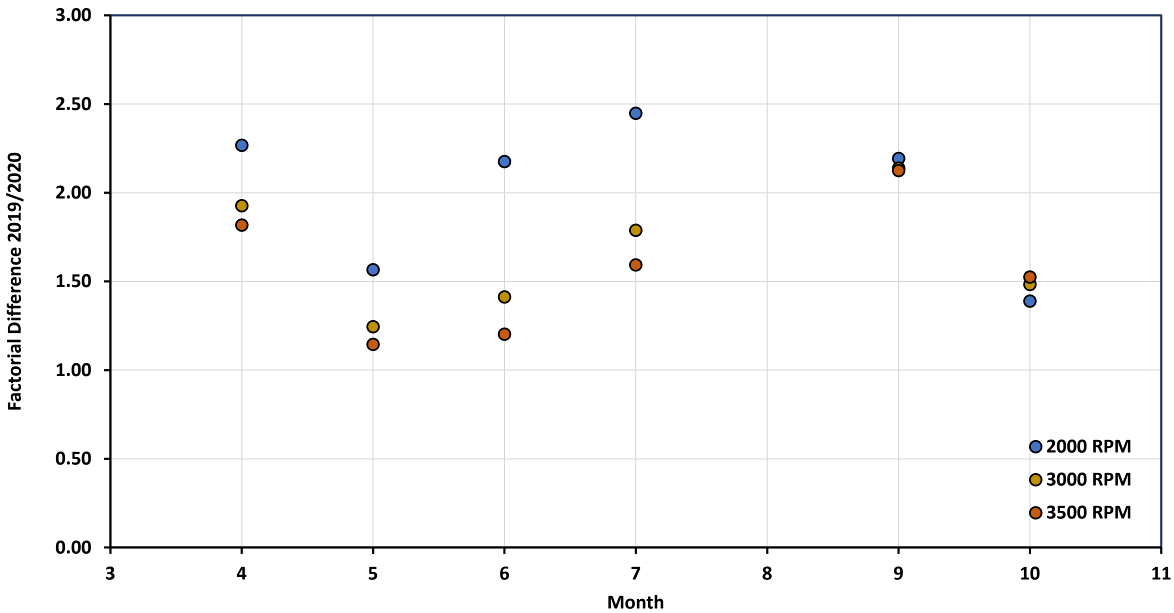


Figure 10. The factorial difference in mean emissivity between 2019 and 2020 for each PI-SWERL test u_* (RPM) from April (month 4) through September (month 10).

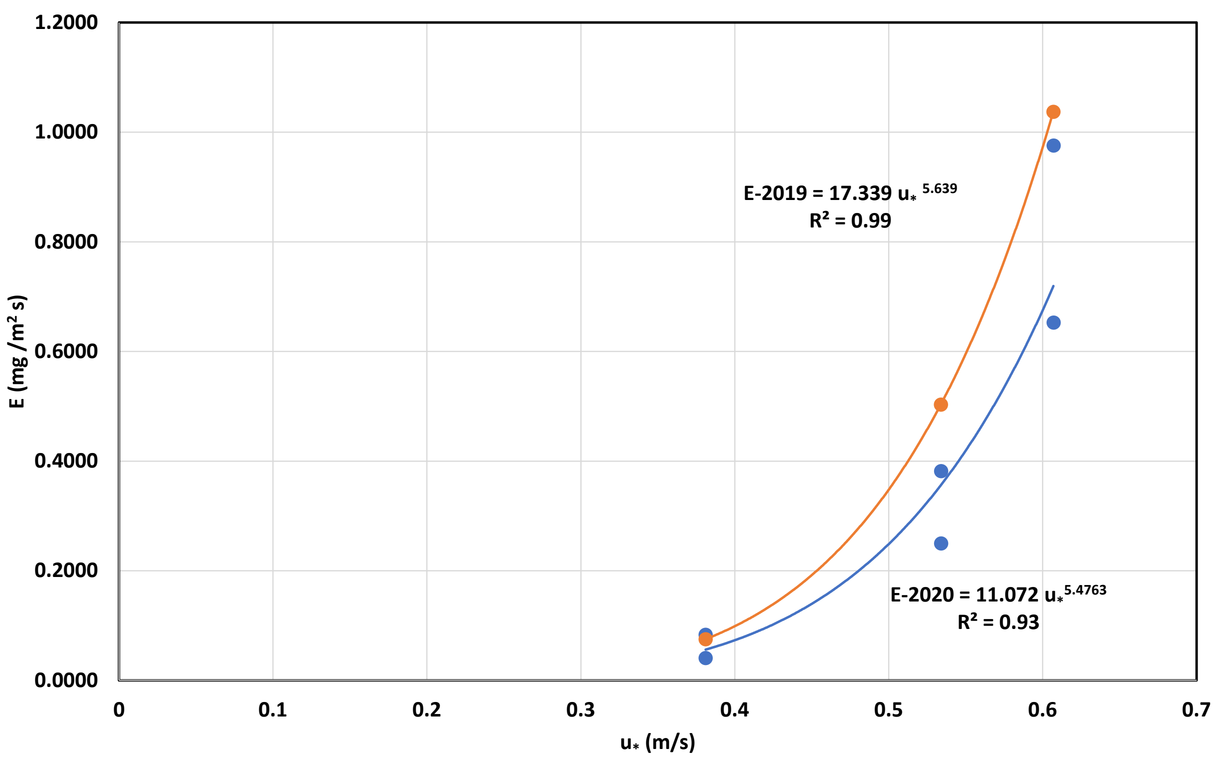


Figure 11. The mean emissivity and u_* relations for the ODSVRA in May 2019 (orange circles) and May 2020 (blue circles).

PM Concentration and Wind Data from the In-Park Monitors, 2019-2020

During 2019 and 2020, a meteorological and airborne dust monitoring network (Fig. 12) consisting of 15 monitoring locations was installed at the ODSVRA in active riding areas, at the eastern border of the Park, and exterior to the Park on Philips 66 land and at the CDF monitoring site. These monitoring networks served to characterize wind conditions and the distribution of airborne particulate matter (PM) during wind events exceeding the threshold wind speed for saltation that contribute to elevated concentrations of PM_{10} (particulate matter ≤10 micrometers in aerodynamic diameter). Data from 2019 and 2020 derived from the in-Park monitoring network allow for an examination of PM_{10} and wind relations across a wide area of the ODSVRA and to examine for changes in the dust emission system through time.

The wind speed and direction data at these sites are measured with the MetSense instrument, which uses 2-D sonic anemometry to derive these parameters. Particulate matter at each station is measured using a MetOne Instruments 212-2 Particle Profiler that measures particle counts in eight size bins. These particle count bins are used to derive a PM_{10} concentration on a minute and hourly basis. In order to achieve a measure of PM_{10} from this instrument that can be compared between stations and to the PM_{10} measured by an EPA Federal Equivalent Method Beta Attenuation Monitor (BAM), a calibration procedure has been developed to convert the MetOne particle count data to a BAM-equivalent PM_{10} concentration.

The BAM equivalent PM_{10} concentration for each 212-2 instrument is achieved by collocating the 212-2 instruments in an environmentally controlled chamber in a lab at DRI's campus in Las Vegas, NV, and establishing a unit-specific calibration relation. The instruments are rack-mounted in the chamber beside a BAM and a filter-based sampler (US EPA approved cyclone-style sampler). Under controlled

Figure 12. Locations of the meteorological and airborne dust monitoring stations at the ODSVRA and exterior to the ODSVRA.

temperature and humidity conditions dust created by simulated saltation of Oceano Dune sand is generated in the chamber that all instruments are exposed to simultaneously. The data stream (particle counts in each bin size) from the 212-2 units and the BAM (µg m^{-3}) are recorded by a datalogger.

Each 212-2 outputs a data string corresponding to the counts of particles that are greater than a given size in a given volume (0.01667 liters). In order to translate this into a PM_{10} concentration: 1) the number of particles in a size bin is calculated by subtracting the number of counts associated with all larger size bins, 2) a diameter representing all the particles within a size bin is estimated (taken to be the geometric mean of the minimum and maximum of the size bin), 3) the volume of an individual particle of the characteristic diameter of the size bin is calculated assuming particles are spheres, 4) the total volume of particles in a volume of air is calculated by multiplying the volume of a single particle by the number of particles in the size bin in the known volume of air, and 5) a particle density of 2600 kg m^{-3} is used to estimate the mass concentration of particles in the size bin. The cumulative mass concentration of particles through size bin 6 is denoted as PMbin6. A calibration relationship between the BAM and the PMbin6 value is defined through the paired values of BAM-measured PM_{10} and calculated PMbin6 for each 212-2 instrument. Hereafter the measurements made with the 212-2 and corrected with the calibration relationships will be identified as 212-PM_{10}. An example of this relationship is shown in Fig. 13. The consistency of the calibration relations among the 212-2 units as measured in March 2020 was quite good. The mean slope value for all units combined was 4.106 (±1.100) and mean intercept was -4.741 (±3.514). The mean correlation coefficient was 0.950 (±0.013).

In addition to the chamber testing, an in-Park calibration station was established in 2020. This station consisted of a BAM, mounting hardware for two 212-2 units, wind speed, wind direction and RH instruments, and datalogging with modem telemetry. The purpose of the in-Park calibration was to determine the performance of the 212-2 and BAM instruments under ambient conditions at the ODSVRA. Of concern was their ability to perform under high wind conditions and whether this resulted in a bias in the measurement compared to the BAM. In 2020, 10 of the 212-2 units were collocated with the in-Park BAM. The available data from the in-Park calibration testing indicates that the 212-2 units were not adversely affected by wind speeds that exceeded 5 m s^{-1} compared to the chamber conditions (i.e., no wind). The mean slope value and intercept values were 4.481 (±0.889) and -8.332 (±24.605), respectively. The mean correlation coefficient was 0.917 (±0.119). The differences in slope, intercept, and correlation coefficient are due to the dynamic nature of the field environment, but the degree of change indicates that under these conditions the correlation between the two instruments remained high and provides confidence that the 212-2 performs well at the ODSVRA. In this report, because we do not have in-Park calibrations for all relevant stations, the PMbin6 data are converted to 212-PM_{10} using the March 2020 chamber derived relationships for each 212-2 unit. The analysis to be presented is based largely on the use of ratio values so the absolute values of 212-PM_{10} may not match the actual values. Using the 212-2 chamber-derived calibration coefficients ensures the inter-comparisons among the different units can be made with confidence, as differences in 212-PM_{10} measurements are not due to a mixing of calibration methods, i.e., in-lab versus in-Park.

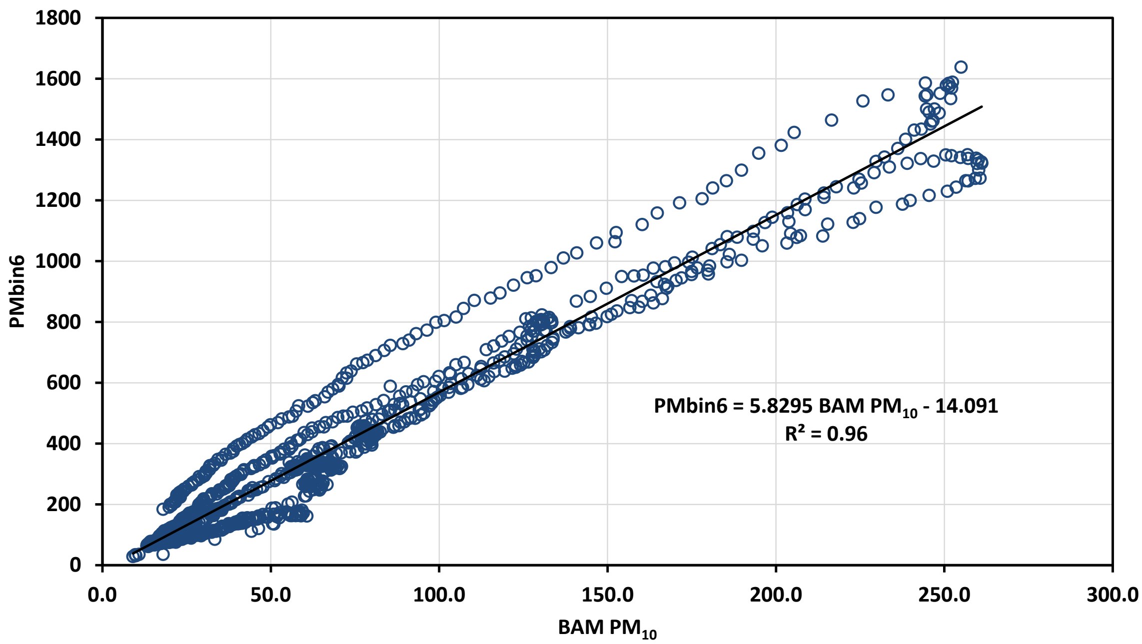


Figure 13. An example of the calibration relationship between BAM and PMbin6 from chamber testing.

Of key interest in 2020 due to the closure of the riding area to OHV activity is whether a change in the observed PM_{10} levels as measured by the in-Park monitoring network is observed for similar wind conditions through time. As previously reported in Etyemezian et al. (2019), the in-Park PM_{10} monitoring data suggest a changing pattern in the emissions between April and August based on analysis of the 2017-2018 data. These data suggested that the magnitude of the wind speed that was required to reach the observed concentrations of dust decreased as the months progressed from April to August. That is, for comparable wind speeds, PM_{10} concentrations were higher during later months (August) than earlier in the season (May-July), which suggests the emissivity of the surface had increased with time in this period.

Based on recent reports by Furtak-Cole and Gillies (2020) and Gillies et al. (2020), a different analytical approach than was used by Etyemezian et al. (2019) was used for the 2019 and 2020 in-Park monitor data (i.e., stations located on sand) to evaluate if the pattern of PM_{10} concentrations through time as described by Etyemezian et al. (2019) was repeated in 2019 and 2020. The list of these stations and their latitude/longitude are provided in Table 1. In this report the method of Furtak-Cole and Gillies (2020) and Gillies et al. (2020) using total of wind power density (WPD, W m^{-2}) and total 212-PM_{10}, and the calculation of the T212-PM_{10}:TWPD ratio has been adopted. This ratio can be used as a metric to evaluate changes in the dust emission system across the sampling domain and through time. Recall, WPD is defined as (e.g., Kalmikov, 2017):

$WPD=0.5\ \rho_a\ u^3$ (1)

where ρ_a is air density (kg m^{-3}), and u (m s^{-1}) is wind speed at a given height above ground level (AGL) common to all sites. For the in-Park monitors the wind speed measurement height was 3 m. The ratio of total PM_{10}:total WPD serves as a metric to evaluate how the dust emission system is changed by

Table 1. The station names and position data for the PM and met monitoring stations. Stations shaded gray are not surrounded by sand or are outside the ODSVRA.

Station Name	Latitude	Longitude
Moymell	35.0751	-120.6199
BBQ	35.0700	-120.6197
Lagrande	35.0664	-120.6197
Camping	35.0662	-120.6218
Foredune	35.0650	-120.6264
Windfence	35.0644	-120.6221
Acacia	35.0605	-120.6205
Cottonwood	35.0597	-120.6190
Haybale	35.0535	-120.6016
Phillips66	35.0489	-120.5939
Scout	35.0482	-120.6032
Tabletop	35.0478	-120.6168
CDF	35.0467	-120.5877
Pipeline	35.0406	-120.6180
Sodar	35.0368	-120.5962

changes to or in the landscape. With no changes to the surface where the emissions originate from, this ratio will reflect the efficiency of the wind and saltation system to produce PM_{10} for the prevailing environmental conditions during the period of interest. If, however, the surface from which the emissions are originating from is changing, for example, by removal of the PM_{10} source material or coarsening of the surface sand (i.e., increasing mean grain diameter), the ratio should diminish as dust production by saltation processes becomes less efficient in producing PM_{10} dust. There is a limit to the explanatory power of this ratio, which is that if winds are at or close to the designated threshold speed either at the monitoring location or in the source area for a large part of the record, the value becomes unstable due to a potential paucity of data but also because as wind speed diminishes the strength of the coupling between the wind and the saltation-generated PM_{10} weakens and is subject to influence of PM_{10} from other sources.

In the analysis presented here only one filter is applied to the data, that wind speed measured at 3 m above-ground-level be ≥5 m s^{-1}, which for most cases will be above the wind speed across the domain that will cause the sand to saltate and emit dust-sized particles. Total WPD for a month is the sum WPD for all hours that meet the wind speed filter criterion. Total 212-PM_{10} for the month is the sum of T212-PM_{10} for each hour that met the wind speed criterion. This was done to produce a stable ratio of total PM_{10}:total WPD. As the in-Park stations of interest are surrounded by sand that can emit dust whenever the wind exceeds the threshold for transport regardless of wind direction, we chose not to filter for wind direction.

For each of the in-Park stations (see Table 1) the relation between T212-PM_{10} and TWPD as a function of month was derived for 2019 (May/June through September) and 2020 (April through August). For all stations in both years this relation was highly correlated. Examples of this relation for stations Moymell, Windfence, Scout, and Tabletop for 2019 are shown in Fig. 14. Examples of this relationship for the same stations for 2020 are shown in Fig. 15. These examples span the north-south distance of the in-Park stations. As the T212-PM_{10} and TWPD relation is highly correlated for all stations in both years the T212-PM_{10}:TWPD ratio can be used to examine if the dust production due to wind-driven saltation changes across space and through time. The mean number of hours in each month above the threshold WPD of 77 W m^{-2} for calculating TWPD and T212-PM_{10} ranged from 72 (April 2019) to 116 (September 2019).

In 2019 the in-Park stations did not all begin collection in the same month with stations coming on line in either May or June. To demonstrate how the T212-PM_{10}:TWPD ratio changed through time in 2019, this ratio as a function of month for the same four stations shown in Fig. 14 is shown in Fig. 16. The examples of the change in the T212-PM_{10}:TWPD ratio as a function of month shown in Fig. 16, suggest that, as Etyemezian et al. (2019) noted, higher PM_{10} concentrations are observed in the late summer month of August compared with previous months for similar wind conditions. These plots indicate that as time progressed the dunes were producing higher concentrations of PM_{10} for lower, but above threshold wind speed because the T212-PM_{10}:TWPD ratio increased through time. To compare among all the in-Park sites and to account for the different time intervals the stations were operational, the T212-PM_{10}:TWPD ratio for each month the station operated was normalized to the ratio estimated for its beginning month of operation for each station (i.e., [T212-PM_{10}:TWPD-month-n]/[T212-PM_{10}:TWPD-month-1]). The mean normalized T212-PM_{10}:TWPD ratio for each increment of month is shown in Fig. 17. When all in-Park stations are considered, the normalized mean T212-PM_{10}:TWPD ratio shows an incremental increase from spring through to fall across the span of the monitoring stations in 2019. In general, the data in Fig. 17 indicate that in 2019, when OHV activity was not restricted, from May to September concentrations of PM_{10} for equivalent WPD increased by ≈48%, or 12% per month.

A further demonstration of the change in concentrations of PM_{10} for equivalent WPD for the Park as a function of time can be demonstrated using the 2017 and 2018 data from the available Met/PM stations operating in those years and calculating the TPM_{10} and TWPD for each available month.

The monthly normalized mean T212-PM_{10}:TWPD ratio (normalized to the initial month of monitoring) for these years is shown in Fig. 18. In both year there is an increase in this ratio from spring to summer, for the in-Park and out-of-Park stations, followed by a decrease into the fall months, similar to the patterns shown for the example stations for 2019 shown in Fig. 14. Note that for the out-of-Park stations compared to the in-Park stations the pattern of change through time is similar, but the absolute value range is not. This is because the height of wind speed measurement at those locations is 10 m, not 3 m, so they are not directly comparable.

The same analyses were carried out for the available 2020 in-Park station data, which operated from April through to early September 2020. The measurement record in September 2020 was not deemed sufficiently long for allowing comparisons with the previous months, so it was not used (# hours >77 W m^{-2} ranged between 3 and 26). The mean number of hours in each month, April to August, above the threshold WPD of 77 W m^{-2} for calculating TWPD and T212-PM_{10} ranged from 69 (August 2020) to 173 (May 2020). Examples of the T212-PM_{10}:TWPD relation for stations Moymell, Windfence, Scout, and Tabletop for 2020 as a function of month are shown in Fig. 19. The plots in Fig 19 suggest that in 2020, concentrations of PM_{10} due to saltation of dune sand within the ODSVRA changed substantially compared to 2019, and the general pattern of emissions increasing incrementally through the summer months first noted by Etyemezian et al. (2019) and repeated again in 2019 does not hold. Using all the available in-Park stations (Table 1) for 2020, the mean normalized T212-PM_{10}:TWPD ratio was estimated by normalizing to the ratio for April (Fig. 20). The relation shown in Fig. 20 indicates that across the spatial domain of the PM and meteorological monitoring network, the concentrations of Total PM_{10}

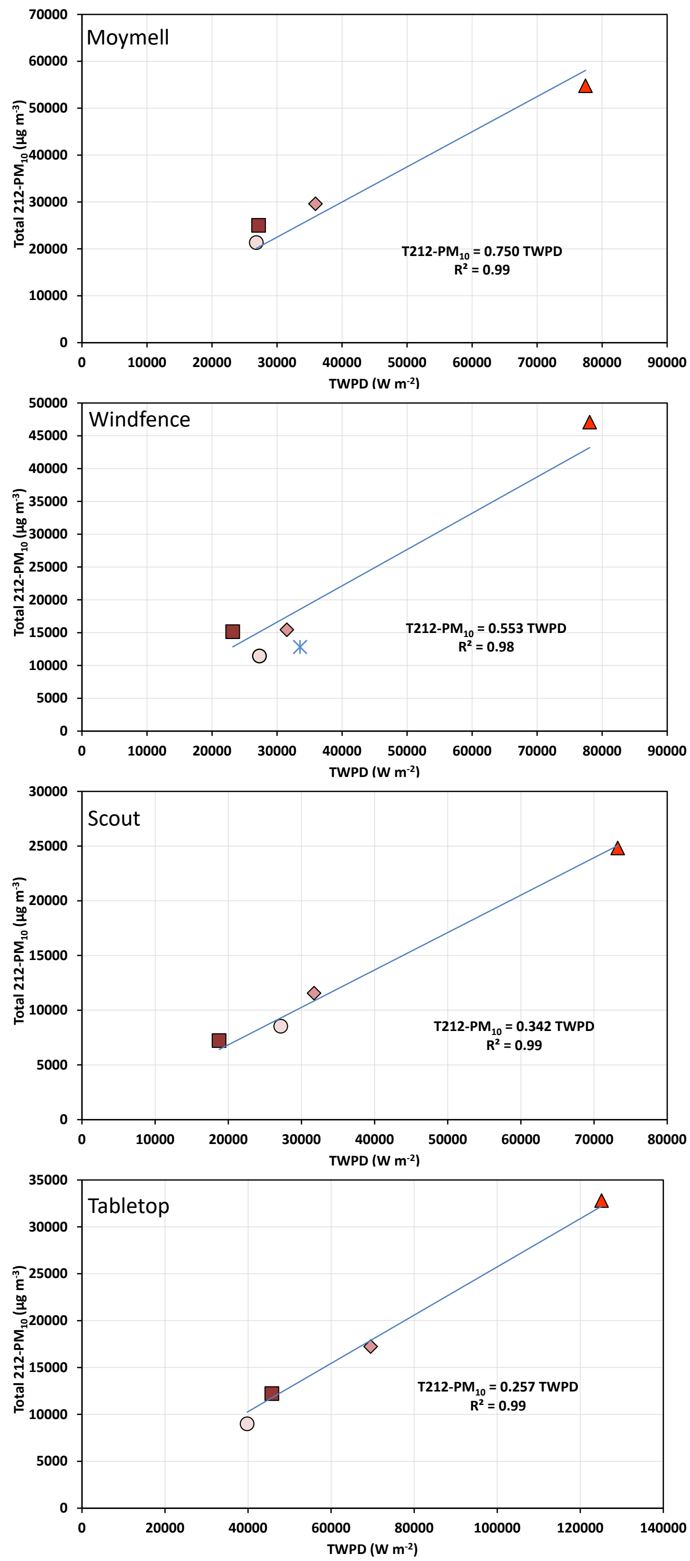


Figure 14. Examples of the T212-PM_{10} and TWPD relation for stations Moymell, Windfence, Scout, and Tabletop for 2019. Shape/color indicates the months; light red circle, June; medium-red diamond, July: dark red square, August; orange triangle, September.

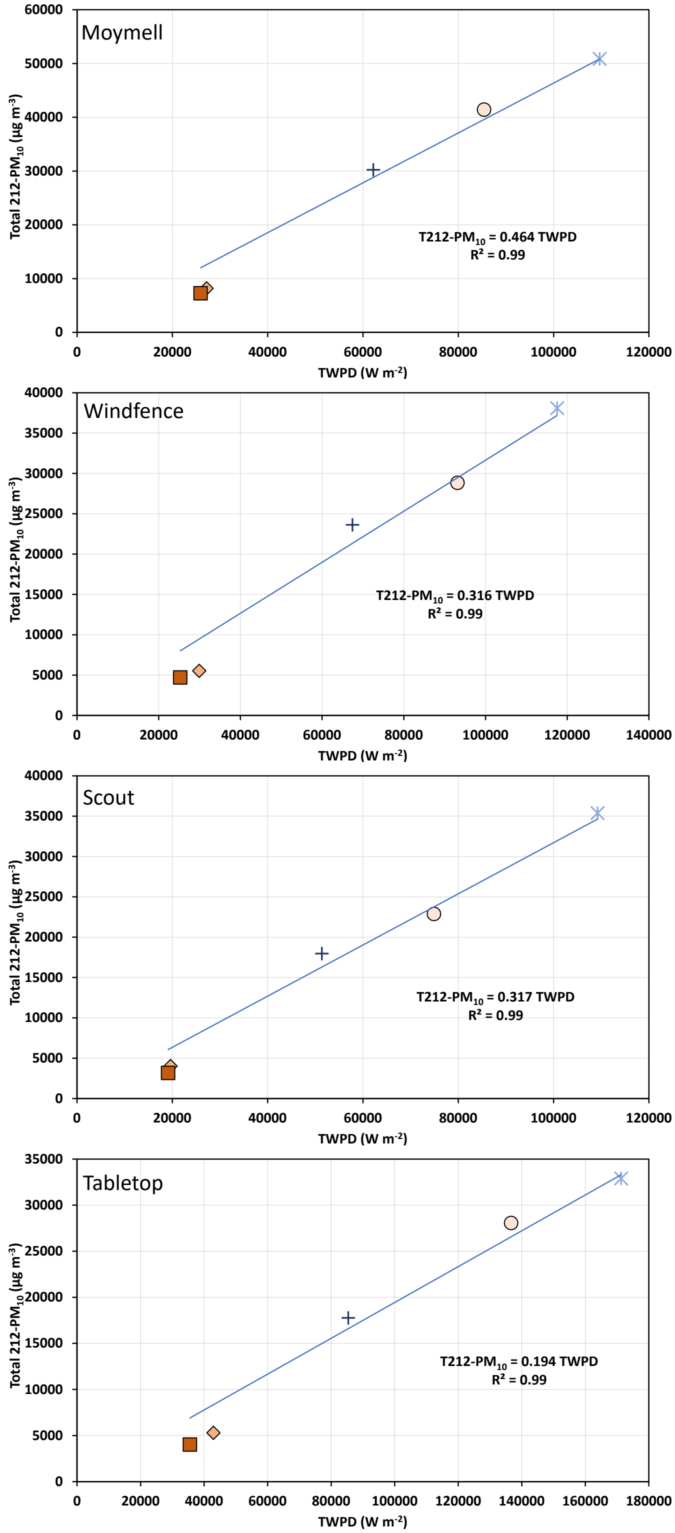


Figure 15. Examples of the T212-PM_{10} and TWPD relation for stations Moymell, Windfence, Scout, and Tabletop for 2020. Shape/color indicates the month; dark blue +, April; light blue ✳, May; light red circle, June; medium-red diamond, July; dark red square, August.

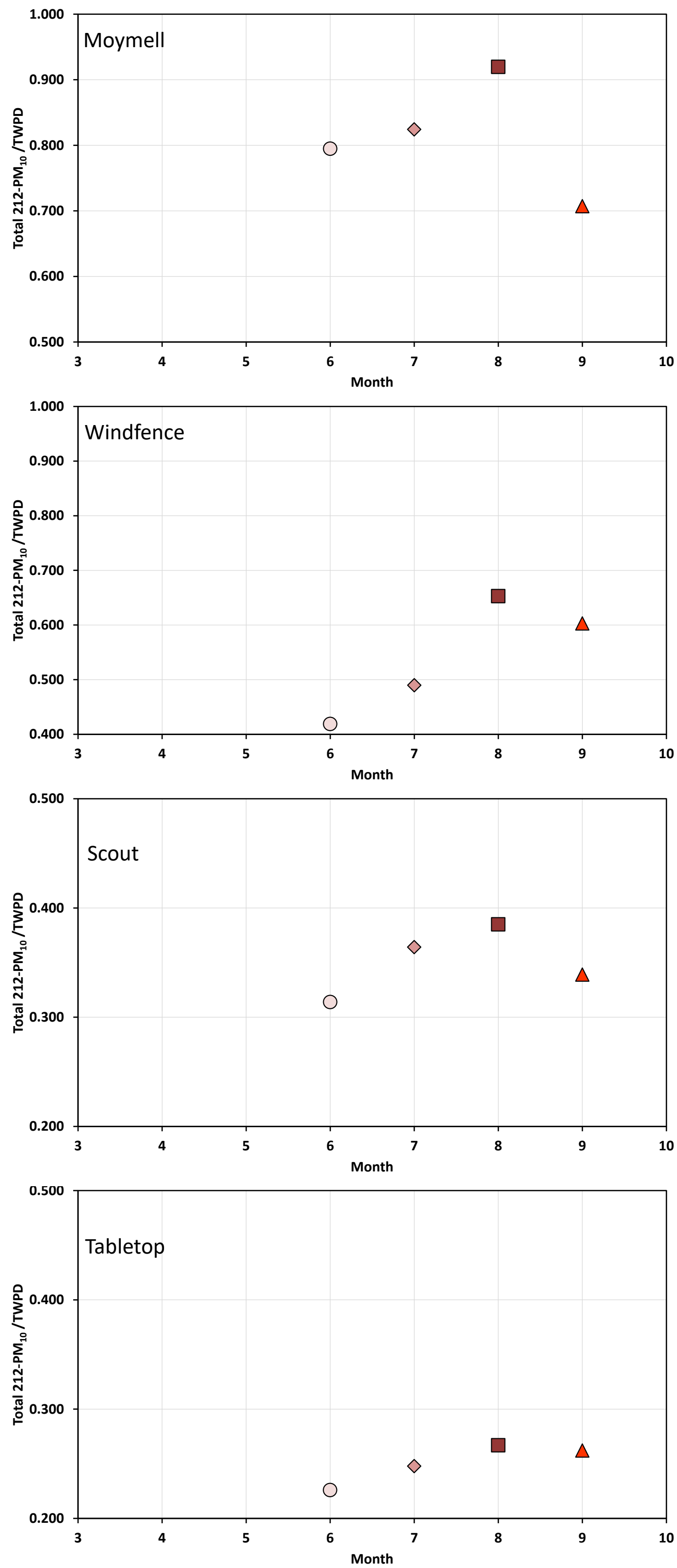


Figure 16. Examples of the T212-PM_{10}:TWPD relation for stations Moymell, Windfence, Scout, and Tabletop for 2019. X-axis number represent month of the year by number, e.g., 6=June.

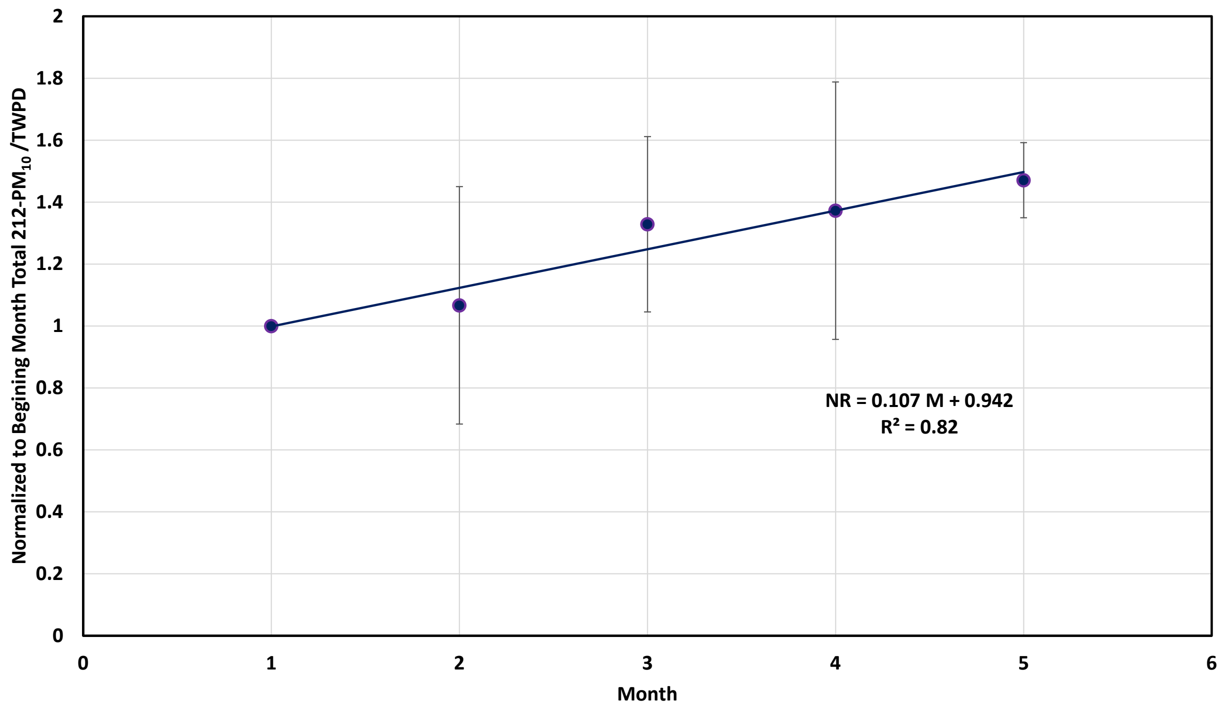
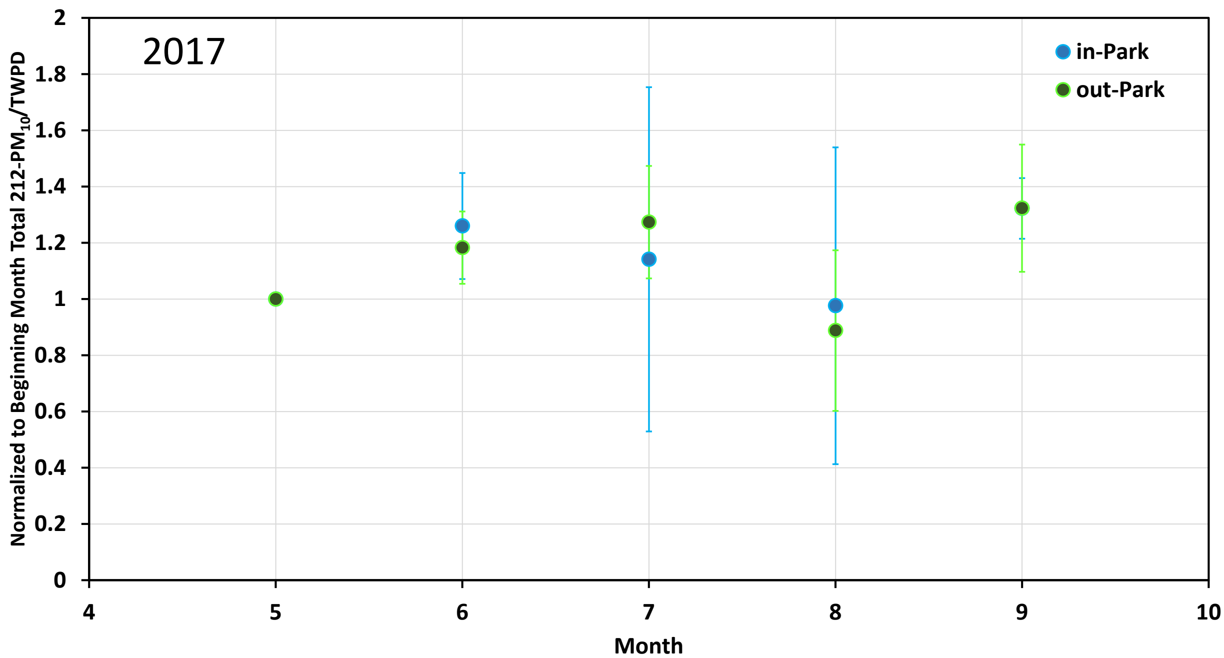


Figure 17. The mean normalized T212-PM_{10}:TWPD ratio as a function of month-long increments of time. Data represent the period from May to September 2019 and include all in-Park stations (see Table 1). Note number on the X-axis does not represent month of the year, as the starting month for the normalization may be May or June.

resulting from saltation created emissions decreased by 46.5% (% change from T212-PM_{10}:TWPD=1 to T212-PM_{10}:TWPD=0.535) between April and August for equivalent conditions of Total WPD, approximately 11.6% each month. This suggests that the cessation of OHV activity has likely allowed the dust emission system to evolve towards a new state representing a less impacted dune system.

The T212-PM_{10}:TWPD values as a function station latitude for 2019 and 2020 are shown in Fig. 21. These data show that the northern stations (latitude >35.005) produced greater concentrations of 212-PM_{10} in 2019 than in 2020, for equivalent WPD values. Of note is the T212-PM_{10}:TWPD ratio for the Lagrande station in 2020 (red circle datum in Fig. 21). This monitoring location has the highest ratio value among all the monitoring stations for all months from April to August, with the mean value, T212-PM_{10}:TWPD=0.805, which is between 2 to 8 times greater than the other stations (Fig. 21). Unfortunately, there was a failure of the MetOne 212-2 unit in 2019 at the Lagrande monitoring station so a direct comparison between 2019 and 2020 is not possible. However, in 2020 the mean T212-



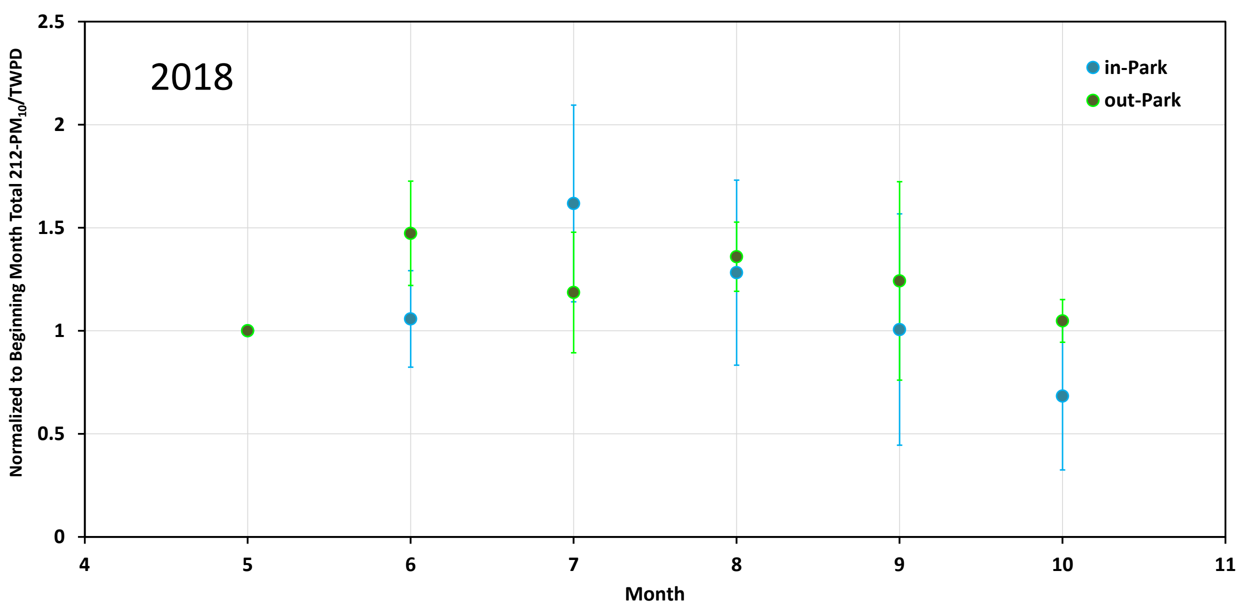


Figure 18. The mean normalized T212-PM_{10}:TWPD ratio (normalized to the starting month of monitoring) as a function of month-long increments of time. Data represent the period from May to September/October in either year. Out-of-Park stations are SODAR, P66, and CDF.

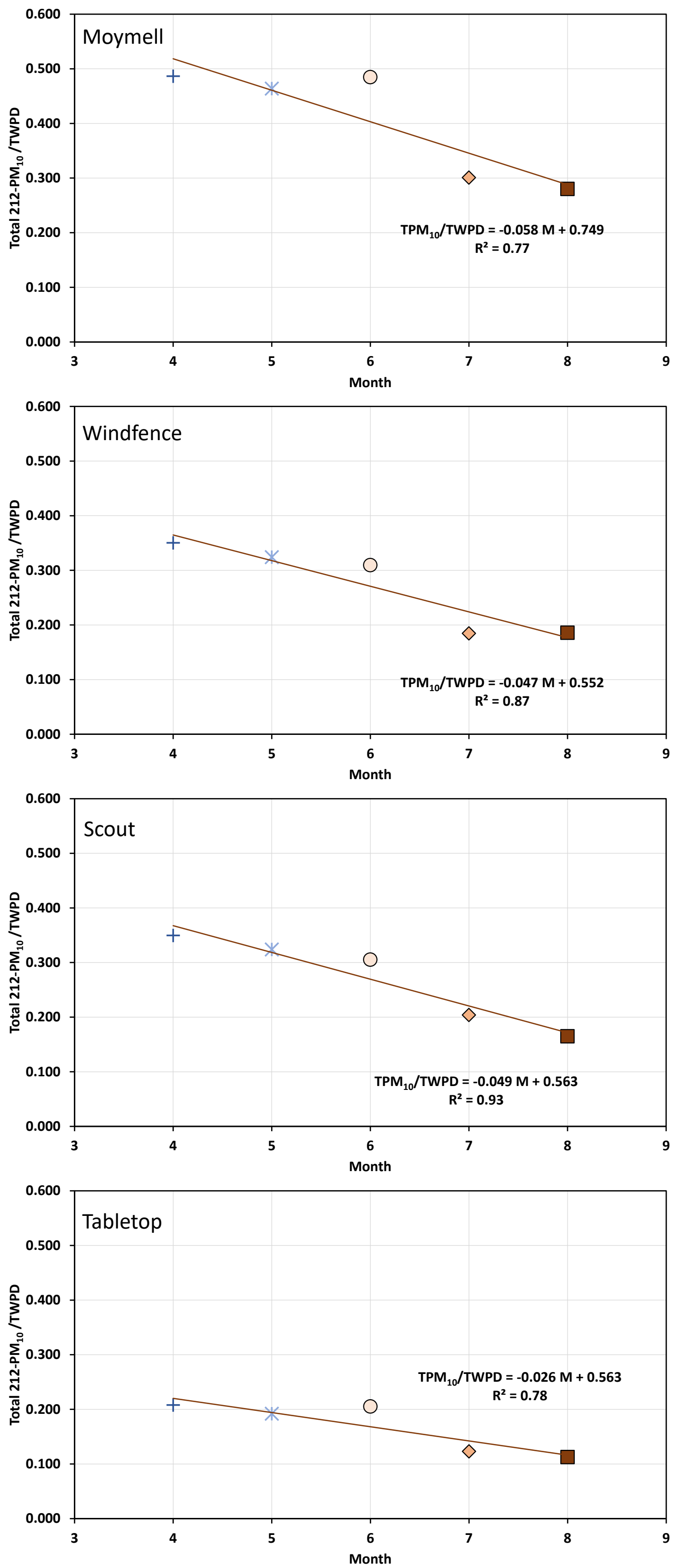


Figure 19. Examples of the T212-PM_{10}:TWPD relation for stations Moymell, Windfence, Scout, and Tabletop for 2020. X-axis number represents month of the year by number, e.g., 4=April.

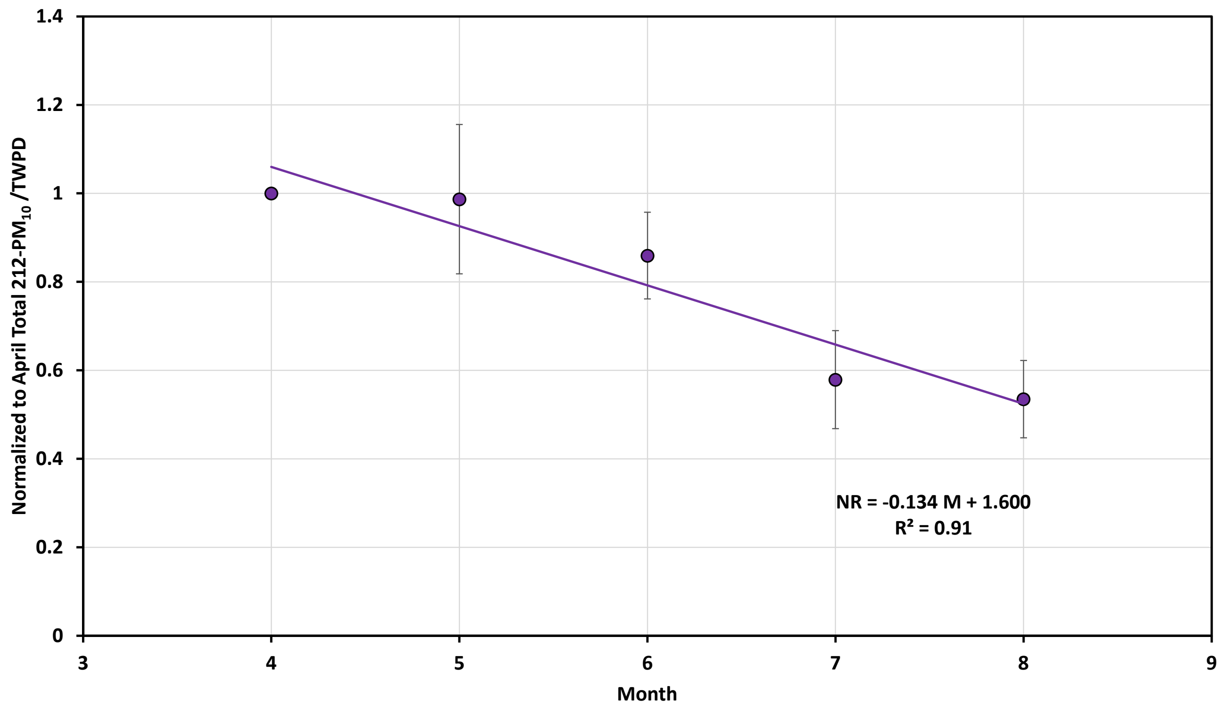


Figure 20. The mean normalized T212-PM_{10}:TWPD ratio as a function of a month-long increments of time. Data represent the period from April to August 2020 and include all in-Park stations (see Table 1).

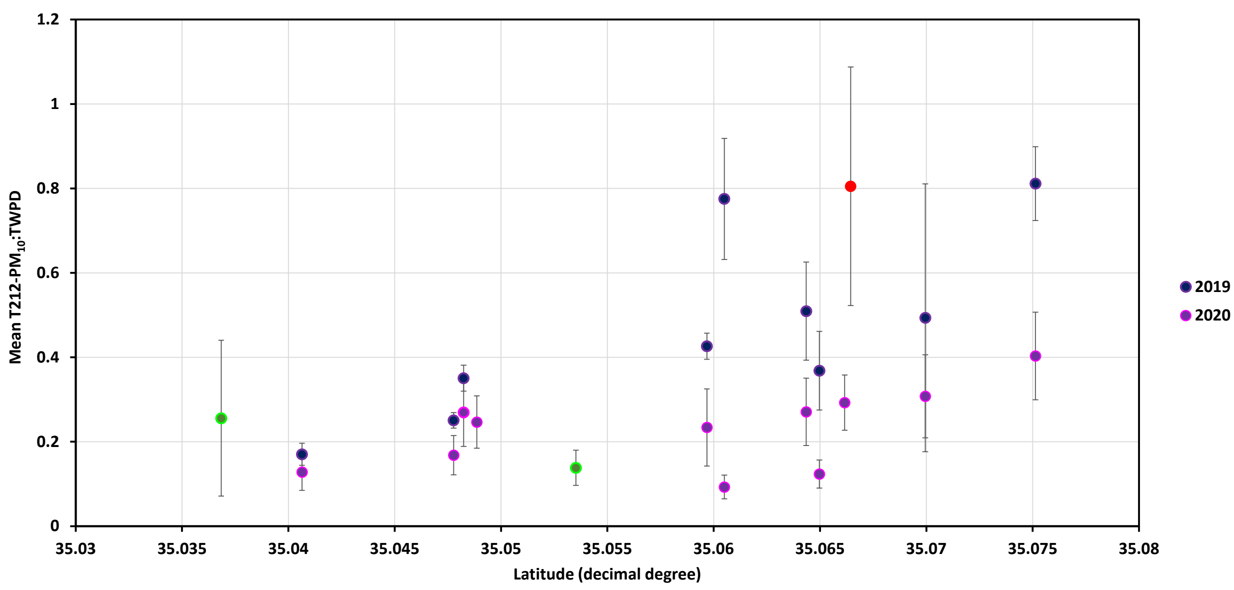


Figure 21. The mean T212-PM_{10}:TWPD ratio for each of the in-Park stations as a function of latitude in 2019 (May or June-Sept) and 2020 (April-Aug). Error bars represent the standard deviation of the mean ratio for the available months of data. The red circle datum marks the Lagrande Tract value in 2020. The green circles are the out-of-Park stations. Green circles are out-of-Park stations (SODAR [35.03684] and Haybale [35.05352], 2020)

PM_{10}:TWPD value for the Lagrande station was in the range reported by nearby stations in 2019. This indicates that the areas upwind of this monitoring station were much more emissive than other parts of the Park in 2020. This is important as emissions from the Lagrande tract impact, to a high degree, the CDF monitoring site.

Since there are no comparable data to define the pattern of TPM_{10}:TWPD across space or through time prior to 2017 and hence for times before OHV activity periods, it is not possible to unambiguously declare the absolute effect of OHV activity on increasing the dune emissivity above a pre-impact condition. The station data from 2019 suggest that on the seasonal time frame May to August, OHV activity increased the saltation-generated PM_{10} concentrations from the dunes by approximately 50% for similar values of WPD (Fig. 17). Upon restriction of OHV activity in 2020, the station data indicate the saltation-generated PM_{10} concentrations from the riding area decreased by approximately 50% from April through to the end of August for similar values of WPD (Fig. 20).

Conclusions

Based on the record of PI-SWERL measurements from 2013 to 2020, and the in-Park monitoring of meteorologic and 212-PM_{10} in 2019 and 2020, it appears that the cessation of OHV activity in 2020 had a demonstrable effect on the emissivity of the dune surfaces in the riding area. In 2019 as OHV activity was unrestricted the PI-SWERL data from across the ODSVRA riding area and the Lagrande Tract, in particular, indicate that emissivity was higher in 2019 than 2020. Although variable through time, due likely to moisture effects on emissivity, the emissivity of the Lagrande Tract by September 2020 was ≈50% less emissive than it was in 2019, according to the PI-SWERL measurements.

The in-Park met-PM stations provide a more continuous record of the dust emissions system across the spatial domain of the ODSVRA than can be obtained with periodic PI-SWERL measurements of emissivity. The instrument network enables characterization of the PM_{10} concentrations through a broad range of environmental conditions in which dust emissions occur. Data from the network indicates that the emissivity of the riding area decreased between April and August in 2020 because PM_{10} concentrations were lower for similar values of WPD. This holds across the entire spatial domain of the monitoring network. It is noted, however, that the Lagrande station, located downwind of the Lagrande Tract, produced much higher PM_{10} concentrations for equivalent WPD values than all the other in-Park stations in 2020. This suggests that the Lagrande tract remained a rich source area for PM_{10} from April-to August 2020. Although the T212-PM_{10}:TWPD ratio for this station did decline through time from April to August similar to all the other stations. The station data from 2020 suggest that the removal of OHV activity in April allowed the dune system to move to a different emissive state that was approximately 50% lower following the passage of four months of time. This correlates with the observed reduction in emissivity in 2020 as measured with the PI-SWERL.

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 14

Proposal for 2021 Speciation Sampling

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Proposal for 2021 Speciation Sampling

Background

In 2020, APCD collected 13 PM_{10} samples for speciation analysis at CDF. Each sample was a pair of filters, one Teflon and one quartz, exposed for 24 hours. These samples were analyzed by DRI for total PM_{10} mass concentration, certain ions (sodium, potassium, chloride, ammonium, nitrate, sulfate, and methanesulfonate), various organic and elemental fractions, and elements from sodium through uranium by XRF. State Parks funded the analysis, and Karl Tupper (APCD) and Earl Withycombe (CARB/SAG) have been analyzing the data.

Three sample were collected on “normal” days, uninfluenced by wind blown dust or other obvious sources, and these are considered background samples. Eight samples were collected on days predicted to be wind blown dust event days, though it should be noted that in 2020 wind event PM_{10} concentrations were lower that in previous years, and the highest concentration of these 8 samples was only 93 ug/m^3 (as measured by the BAM). One sample was collected on day heavily influenced by wildfire smoke, and another sample on a day influenced by transport from the San Joaquin Valley.

A report on the results from 2020 is not yet available, but a preliminary analysis indicates:

- The 13 samples are not enough to do a state-of-the-art apportionment analysis, i.e., positive matrix factorization (PMF). Attempts to run PMF with the data resulted in physically reasonable solutions; however, they were not stable. CARB’s PMF specialist indicates that 150 samples are ideal, though there are examples of successful analyses with fewer.

- The correlation between the collocated APCD BAM concentrations and the DRI filter concentrations is good (r^2 = 0.97)—much better than what Scripps reported for their PM2.5 filters (r^2 = 0.69)—but there is a slight bias between the two. In 2019, the District collected filter samples with this same equipment and had them weighed by two different labs. There was also a good correlation with the BAM then, but with a slight bias in the *opposite* direction.

- The mass closure is poor. This refers to the difference between the measured total PM_{10} concentration and an estimate constructed by taking the raw concentrations of the measured elements and ions in each sample and applying standard equations and assumptions to estimate how much salt, inorganic aerosol, crustal material, etc., there is in the sample, and finally summing all these constituents up. The "reconstructed mass" should be close to the mass measured on the filter. While the mass closure is never perfect, for our samples the comparison is poor. For the 4 background and smoke samples, the reconstructed mass is 91 to 103% of the measured mass—which is acceptable—but for the 8 wind event samples the range is 71-98% with a mean of 82%, and for the lone SJV transport day, it is only 36%.

Proposal for 2021

In light of these preliminary results, we would like to propose a more ambitious sampling plan for 2021. This plan is designed to generate enough data to hopefully run a successful PMF analysis and to also address some of the questions noted in the preliminary review of the data.

- 1-in-3 day sampling (so ~10 samples per month) from (ideally) mid-March through at least June and possibly through October. This would yield 35 to 75 pairs of samples, with DRI doing at least the same suite of analyses as in 2020 (and thus, at least the same cost per sample). *If possible,* we would like to get quantitative elemental analysis for chlorine. DRI typically does the analysis (XRF) under vacuum, which causes volatilization loss for choline, but it can be done under ambient pressure and thus yield quantitative results. Similarly*, if possible*, it would be preferable to get quantitative—as opposed to qualitative—XRF results for sodium and magnesium, since these elements are present in feldspar and clay minerals, which are major components of ODSVRA sand.
- *If possible*, we would also like add XRD analysis to a subset of samples to determine what minerals are present. A possible explanation for the poor mass closure is that the mass closure algorithm determines the geological contribution by multiplying the concentrations of certain elements by coefficients derived from the average contributions of those elements to the Earth's crust. The actual composition of ODSVRA

sand is likely much different, so comparing the minerology of the collected dust to the standard assumptions may explain some of the poor mass closure.

- For QA purposes, in addition to the 1-in-3 day speciation samples, we would like to also collect collocated samples on 1-in-6 day schedule to be weighed (total mass only, no speciation) by an independent lab. Thus, in addition to the 35 to 75 speciation samples, there will also be half as many QA samples. We would rotate which sampler is used for each filter, in order to detect/rule out biases due to the samplers themselves.
- For QA purposes, it would be preferable to include blank samples in the analyses. One or two blanks for each field sample would be adequate.

Responsibilities

- **APCD:** As in 2020, the APCD would be responsible for the field work—setting and collecting the samples, storing and shipping the samples, maintaining the samplers and performing QC/QC checks. APCD Senior Scientist Karl Tupper would collaborate with Earl Withycombe on analyzing the data.
- **SAG/DRI:** DRI would provide analysis of the 1-in-3 day sample pairs and associated blanks. They would also provide pre-weighed sample cassettes to the APCD. Assuming a mid-March thru mid-October sampling period, this would be about 85 sample pairs (75 field samples plus 10 field blanks). The analyses provided would include anions (including methanesulfonate), elemental/organic carbon, elements by XRF (sodium through uranium, with quantitative Cl, Na, and Mg, if possible). A subset of samples (10-12?) would also undergo XRD analysis to identify specific minerals. Earl Withycombe (CARB) would collaborate with Karl Tupper (APCD) on analyzing the results.
- **Third Party Lab:** Provide pre-weighed sample cassettes and gravimetric analysis of 1-in-6 day QA samples. Assuming mid-March thru mid-October sampling, this would result in approximately 40 to 45 samples, including blanks. Previously, Bay Area AQMD, South Coast AQMD, and CARB have been able to provide these services to the District at no cost; however, recent conversations with these agencies have indicated that they would

be unable to do this now, due to resource constraints related to COVID-19. Thus, a contract lab would likely have to provide these services.

- **State Parks:** Provide funding for DRI and third-party lab activities.

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 15

Scripps Study Information

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GRADUATE DEPARTMENT
SCRIPPS INSTITUTION OF OCEANOGRAPHY

9500 GILMAN DRIVE
LA JOLLA, CALIFORNIA 92093-0221

21 September 2020

The Off-Highway Motor Vehicle Recreation Commission
c/o
Off-Highway Motor Vehicle Recreation Division
California Department of Parks and Recreation
1725 23rd Street, Suite 200
Sacramento, CA 95816

Dear Commissioners,

Please find attached my supplemental report of findings regarding gravimetric and elemental analyses of airborne particle samples collected at the Oceano Dunes State Vehicular Recreation Area and on the Nipomo Mesa. My colleagues and I are in the second year of a three-year investigation to determine marine and terrestrial sources contributing to airborne particulate matter (PM) detected seasonally on Nipomo Mesa (Mesa). The San Luis Obispo County Air Pollution Control District (APCD) operates equipment on the Mesa at a location called CDF that monitors PM10 and PM2.5 (PM that is 10 microns or less in diameter and 2.5 microns or less in diameter, respectively) with an instrument called a beta attenuation monitor (BAM).

This supplemental report was prepared in response to your request made at your August 6, 2020 meeting. As I understand it, your request was prompted by our February 20, 2020 report, which detailed a difference between the PM2.5 mass of the chemical components that we measured and the PM2.5 mass measured by the APCD BAM. Those findings prompted us to use additional techniques to more accurately determine what fraction of airborne particles are dust. As detailed in this report, I have found that mineral dust, on average on high PM days, accounts for 20% of the overall mass of the PM2.5 measured by the APCD BAM at CDF. On lower PM days, the mineral dust mass is lower still. This shows that it is incorrect to assume that all PM2.5 measured at CDF monitors is mineral dust.

I would like to extend our appreciation to the California Geological Survey and to the California Department of Parks and Recreation for their assistance and access that has made our investigation possible. I look forward to continued collaboration as this project continues.

Sincerely,

Lynn M Russell

Lynn M. Russell
Professor of Atmospheric Chemistry

UCSD Supplemental Report 2020:

Preliminary Results from May 2020 Aerosol Measurements

Lynn M. Russell
20 September 2020

Introduction

Building upon the results of the UCSD Report of 5 February 2020, this project has undertaken additional quantitative chemical sampling to improve the understanding of the sources of airborne particles in the Oceano Dunes area. This supplemental report covers the gravimetric and elemental analyses of the teflon filters collected during the most recent sampling period from 27 April 2020 to 17 May 2020. The objectives of this part of the research were to

1) Quantify the gravimetric mass and elemental component mass of PM2.5 aerosol particles at CDF;
2) Quantify the gravimetric mass and elemental component mass of PM10 aerosol particles at a near-beach site just beyond high tide, designated as the "Beach" site.

It is important to note that recreational vehicles were not allowed during this period because of COVID-19 restrictions that had been in place since March 2020. Vehicles for park services including habitat restoration continued essential activities.

Background

The particle concentration in the Oceano Dunes region is expected to be a mixture of organic and inorganic components from natural and man-made sources. Its seaside location means that sea spray from breaking waves in the ocean will contribute particles with salt (NaCl as well as some trace additional salts) and organic components (from nutrients and exudates that are produced and consumed by marine biota) [Russell et al., 2010]. Another proximate natural source is mineral dust from sand-covered areas. Both sea spray and sand (or mineral) dust are increased by wind speed as well as coverage and proximity, both have substantial supermicron mass contributions with short atmospheric lifetimes, and neither is associated with evidence of chronic respiratory effects (since they are removed by impaction in the nasal passages and upper airways and since the salt and mineral components have not been associated with toxicity). In addition to these natural sources, local emissions associated with motor vehicles [Russell et al., 2011], residential and commercial activities (including use of personal care products [McDonald et al., 2018], food preparation [Chen et al., 2018], and heating), and seasonal agricultural harvesting and fertilizing, wildfires, and long-range transport from high-population areas also contribute both organic and inorganic particle mass to PM2.5 and PM10, with the contribution from each varying with wind direction as well as other conditions.

PM2.5 and PM10 are regulated by U.S. clean air standards because of their known association with degraded visibility and detrimental health effects [US Clean Air Act (https://www.epa.gov/laws-regulations/summary-clean-air-act); Dockery et al., 1993; Pope et al., 2009; Apte et al., 2018]. Recently Apte et al., calculated the U.S. average life expectancy decrement to be 0.38 yr for PM2.5, which is 3 times lower than that of countries with higher PM2.5 (e.g. China, India). While the widespread availability of PM2.5 measurements often makes it the best proxy for epidemiological studies of populations, physiological studies of health effects have shown that the causes of cell degradation are most likely from specific toxic compounds, which are also regulated and include such compounds as polycyclic aromatic hydrocarbons that are associated with fossil fuel combustion and black carbon. Recent evidence also suggests that nanoparticles (less than 100 nm diameter) and transition metals, which are also associated with fossil fuel combustion, may also play an important role [Knol et al., 2009; Oberdorster et al., 2007; Gwinn and Vallyathan, 2006; Janssen et al., 2003; Hoek et al., 2002]. Since the association of PM2.5 with toxics is likely responsible for the association of PM2.5 with health effects, the use of PM2.5 as a health indicator assumes it co-occurs with toxics.

However, it is worth noting that there is no evidence that toxic compounds are associated with the two major PM2.5 sources (dune dust and sea spray) during windy conditions at Oceano Dunes, so association of PM2.5 with detrimental health effects may be without foundation. In urban locations that serve as the basis for epidemiological health studies, the large population density means that PM2.5 is largely associated with emissions from motor vehicles that include high amounts of toxics, nanoparticles, and transition metals. In areas where PM2.5 is dominated by natural emission sources rather than man-made combustion activities, the causal link between toxics and health effects would not hold. For this reason, assessing whether health effects are associated with PM2.5 requires identifying what fraction of PM2.5 is from natural (non-toxic) sources and what fraction is from combustion emissions.

The chemical composition provides the first critical step to identifying how much of total particle mass is associated with each of these different sources. In the 5 February 2020 UCSD Report, we used Fourier Transform Infrared (FTIR) spectroscopy and X-ray Fluorescence (XRF) to provide a first cut at these sources, using elemental composition to provide tracers for sea spray, mineral dust, and combustion emissions. This report builds on those results to examine the substantial difference between the chemical measurements of dust components and the BAM PM2.5 measurements regularly measured by the San Luis Obispo County Air Pollution Control District (APCD) at its CDF air monitoring station on the Nipomo Mesa, approximately 3.2 kilometers (2 miles) inland from Oceano Dunes. First, gravimetric measurements (at partially dried conditions of 35% relative humidity (RH)) are used to provide a lower bound on the water fraction of the particle mass. Then dust components from XRF measurements are used to assess the fraction of the remaining mass that is associated with dust.

Results

Samples were collected at CDF site and the Beach site for the period of 27 April to 17 May 2020. The CDF site was co-located with the ongoing APCD sampling by BAM, which provides a metric representing the PM2.5 (and PM10) concentration at modified ambient conditions, which means that water and other semi-volatile organic and inorganic components (notably ammonium nitrate) are included. The number of sampling days was maximized to document the day-to-day variability in the aerosol and to capture multiple days with high PM2.5 (and PM10) concentration. The Beach site was sampled from 28 April to 16 May 2020, with more limited samples targeting only high wind (high PM) afternoons. The number of samples at this site was limited by the lack of sufficient power for 24-hr operation and the lack of support personnel due to access restrictions (and COVID-19). The Beach site was selected to provide a benchmark for non-dune ocean sources, since it is estimated to be approximately 100 meters from the mean high tide line. Notably, the days with high PM at CDF were often predicted successfully from short-term forecasts of high-wind conditions, consistent with prior studies.

The results addressing the objectives of the research are summarized below. We note that all of the results may differ by season, and their variability may be larger than could be captured in this short study.

1. <u>Quantify the gravimetric mass and elemental component mass of PM2.5 aerosol particles at CDF.</u>
    a. The time series of SIO gravimetric mass, EBAM, and APCD BAM PM2.5 concentration measurements tracked reasonably well (Figure 1) and

showed a moderate correlation (R^2~0.7). The offline gravimetric method is 26% lower on average than the online BAM instrument for all 26 afternoon and overnight samples at CDF (Figure 2). If only the 10 afternoons with 24-hr PM10 exceeding 140 μg m^{-3} are averaged (https://ww3.arb.ca.gov/qaweb/site.php?s_arb_code=40853), then the gravimetric method is 38% lower than BAM. The lower gravimetric mass concentrations are consistent with the expectation that the BAM method includes more water than the gravimetric reference method. The PM2.5 sampling reference method (https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/m212.pdf) requires that samples be stored at 35% relative humidity for 24 hr in order to partially dry the particles. In contrast, BAM and EBAM measurements are made very close to ambient relative humidity (although there may be some heating in the instrument). At CDF relative humidity frequently exceeded 35%, meaning that the BAM and EBAM measurements were wetter (that is, contained more water than the gravimetric measurements). It is likely that the 38% difference in mass on high PM10 days is due to water evaporating, although other semivolatile components (ammonium nitrate and organic mass) could also be included in the BAM method and not in the gravimetric method. It is unlikely that any dust was lost by the gravimetric method. The water contribution could be assessed by repeating the gravimetric method at higher relative humidities.

b. The time series of dust from elemental composition by XRF frequently tracked gravimetric mass (Figure 3). The scatter plot showed that dust accounted for ~17% of PM2.5 gravimetric mass on average and salt accounted for ~11% for all 26 afternoon and overnight samples (Figure 4). If only the 10 afternoons with 24-hr PM10 exceeding 140 μg m^{-3} are averaged, then the dust accounted for 33% and the salt for 7%. Dust and PM2.5 were strongly correlated with R^2~0.8, whereas salt and PM2.5 were only weakly correlated with R^2~0.3. The correlation of dust and PM2.5 could be explained by the lofted dust including a proportionate amount of water that contributes to the PM2.5. Other semi-volatile components that may associate with the higher surface area provided by the dust would also proportionately increase the PM2.5 concentration. The weak correlation between salt and PM2.5 is consistent with salt being a small fraction of PM2.5 that is affected by factors other than local wind speed (including offshore winds and whitecap coverage).

2. Quantify the gravimetric mass and elemental component mass of PM10 aerosol particles at the Beach site.

a. The time series of gravimetric mass and EBAM PM10 concentration measurements tracked reasonably well (Figure 5) and showed a moderate correlation (R^2~0.5), with the offline gravimetric method being on average ~28% lower than the online EBAM instrument for the 7 afternoons sampled (Figure 6). The poor correlation is limited by the small number of samples (7). The lower gravimetric mass concentrations are consistent with the expectation that the EBAM method includes more water than the gravimetric reference method, which requires 35% relative humidity even though ambient relative humidity at the Beach site frequently exceeded this value. This means that the gravimetric mass concentration includes less water than the EBAM measurement, although other semivolatile components (ammonium nitrate and organic mass) could also be included in the EBAM method. This suggests that at least 28% of the EBAM mass concentration was water. It is unlikely that any dust was lost by the gravimetric method. The water contribution could be assessed by repeating the gravimetric method at higher and lower relative humidities.
b. The elemental composition showed that dust accounted for ~16% of PM10 gravimetric mass on average and salt accounted for ~7%. Both dust and salt were strongly correlated with PM10 and R^2~0.9. The correlations of dust, salt, and PM10 is likely caused by wind speed serving as the primary driver of all three. The lofted dust and salt may also bring with them water proportionate to their hygroscopicity, a property determined by the chemical composition of the suspended salt mixture. Other semi-volatile components that may associate with the higher surface area provided by the dust may also increase the PM10 concentration.

The breakdown by weight and by component of the BAM concentrations measured at the CDF and Beach sites are summarized in Figure 9, where we have interpreted the difference between BAM and gravimetric mass as the evaporated fraction that is likely water and illustrated the measured mass component contributions from Dust, Salt, and Other. The gravimetric fraction of BAM PM2.5 is lower at 62% on high PM10 afternoons compared to 74% for all samples measured. Dust accounts for 33% of gravimetric PM2.5 at CDF on high PM10 afternoons compared to only 17% for all samples measured. Combining the gravimetric and dust measurements, the end result is that on days with high 24-hr PM10 at CDF, the combination of the gravimetric mass as 62% of the BAM PM2.5 mass and the dust accounting for ~33% of gravimetric PM2.5 mass means that dust accounts for on average 20% of the BAM PM2.5 at CDF on high PM10 days. This means that on average one fifth of the BAM-based PM2.5 at CDF can be attributed to dust during the ten high PM10 days sampled in April-May 2020.

Conclusions

PM2.5 mass concentrations at CDF show large contributions of sea spray and mineral dust during high wind episodes. This result means that a substantial fraction of PM2.5 was not associated with fossil-fuel combustion emissions, so that PM2.5 is not a good predictor of toxic emissions or health effects for this location in high wind conditions. For this reason, direct measurements of toxics would be needed in order to associate PM2.5 with health effects at this location.

The association of high PM10 and PM2.5 with high wind conditions, even when recreational vehicles were not allowed at Oceano Dunes, indicates that dune-derived mineral dust is more likely to be caused by natural forces (i.e. wind) rather than human activities. While the short duration of this study provides only limited statistics in support of this result, the longer records provided by APCD provide additional confirmation. For this reason, the high dust concentrations measured on high wind days in and downwind of Oceano Dunes are likely dominated by natural saltation processes associated with the indigenous geomorphological dune structure.

The correlation between the online BAM and EBAM measurements with filter-based gravimetric measurements indicated good correspondence of the metrics given the limited sampling and differences in relative humidity. The moderate correlation of the gravimetric PM2.5 with the BAM PM2.5 (R^2=0.7) at CDF provides general support for the BAM PM2.5 calibration and operation with the moderate correlation being consistent with expected differences in relative humidity between the methods. The fact that the mass concentrations of the gravimetric PM2.5 (CDF) and PM10 (Beach) were consistently lower (by 26-38% and 28%, respectively) than the corresponding CDF BAM measurements supports the idea that a third or more of the BAM mass is likely water at coastal locations like the APCD CDF BAM site. The most probable reason for this is that the gravimetric measurements are partially dried by equilibrating at 35% relative humidity whereas the BAM measurements vary with ambient conditions. The more consistent fractions of PM10 (i.e. R^2>0.95) would be consistent with the remaining mass being controlled by the components present, which would be the case for water.

To remove the contributions of the additional water in the BAM measurements, the chemical mass fractions are compared on the basis of the gravimetric mass. Relative to the partially dried gravimetric mass, the chemical mass measurements show that on average less than 33% of PM2.5 at CDF and less than 16% of PM10 at the Beach site can be attributed to dust. About 7-11% can be attributed to sea salt at both sites for the sizes measured. The remaining 60-72% of gravimetric PM2.5 at CDF and 77% of gravimetric PM10 at the Beach is likely from additional water (beyond the 26-38% included in the BAM), organic components, ammonium, nitrate, and other semi-volatile chemical species.

On days with high 24-hr PM10 at CDF, the combination of the 38% water in the BAM method relative to the gravimetric method (leaving 62% of the BAM PM2.5 mass as non-water) and the dust accounting for ~33% of gravimetric PM2.5 means that dust accounts for on average 20% of the BAM PM2.5 at CDF (on high PM10 days). This means that on average one fifth of the BAM-based PM2.5 at CDF can be attributed to dust during the ten high PM10 days sampled in April-May 2020.

Since the sampling reported here was limited by resources because of other activities at Oceano Dunes, additional offline chemical and gravimetric analysis are planned in order to provide additional evidence of the variability of the fraction of PM2.5 that is dust on high PM2.5 days.

Methods

Aerosol particle sampling used sharp-cut cyclones operated with calibrated flows to collect particles for analysis at ambient diameters with a calibrated cut at 2.5 μm (SCC 2.229 operated at 7.5 lpm, BGI Inc., Waltham, MA) and a sampling head with nominal cut at 10 μm (16.7 lpm, provided by State Parks). Teflon filters were used as substrates and have shown negligible adsorption of volatile organic compounds (VOCs) on duplicate back filters collected simultaneously with each sample [Maria et al., 2003; Gilardoni et al., 2007]. Blank filters provided a measure of adsorption during sampling and contamination during handling (loading and unloading) and storage.

Simultaneous sampling by BAM, EBAM, and filters were used to check for sampling consistency by comparing gravimetric mass on filters to co-located BAM measurements. The hourly BAM and EBAM concentrations reported between the start and stop times for the filters were averaged (without interpolation) to provide approximate comparison points. Further refinement would be provided by a more exact integration and interpolation of beginning and ending hours.

All filters were weighed prior to sampling to provide filter-specific tare weights. After sampling, filters were weighed again, and the difference between the sampled weight and the tare was the reported gravimetric mass. The weighing procedure (Chester LabNet) for all samples used the PM2.5 reference method of 35%+/-5% for the 24 hr period (logged every 5 min), making the samples potentially drier or wetter than the ambient conditions in which they were collected. BAM and EBAM may also be drier than ambient humidity due to heating of the air when it is drawn into the instrument. Other differences may result from the hour-to-hour differences in the online measurements compared to the offline storage at constant conditions.

Each sample (and associated blank filters) were non-destructively analyzed by X-ray Fluorescence (XRF) measurements conducted by Chester LabNet (Tigard, OR) on the same filters used for gravimetric measurements. XRF analysis provided trace metal concentrations for elements heavier than Na [Maria et al., 2003]. Elemental concentrations were above detection for 30% to 100% of the ambient teflon filters collected.

Acknowledgments

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Figures

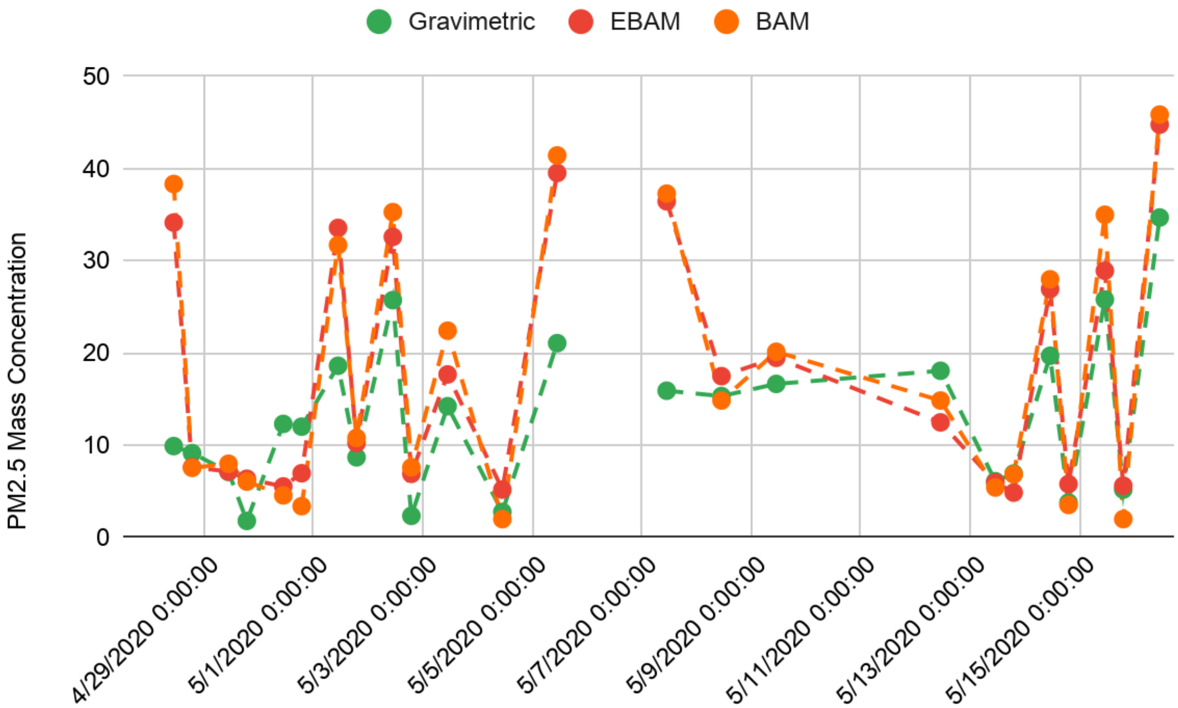

Figure 1. Time series of PM2.5 mass concentrations [μg m^{-3}] by Gravimetric, EBAM, and BAM methods at CDF for sampling from 27 April to 17 May 2020.

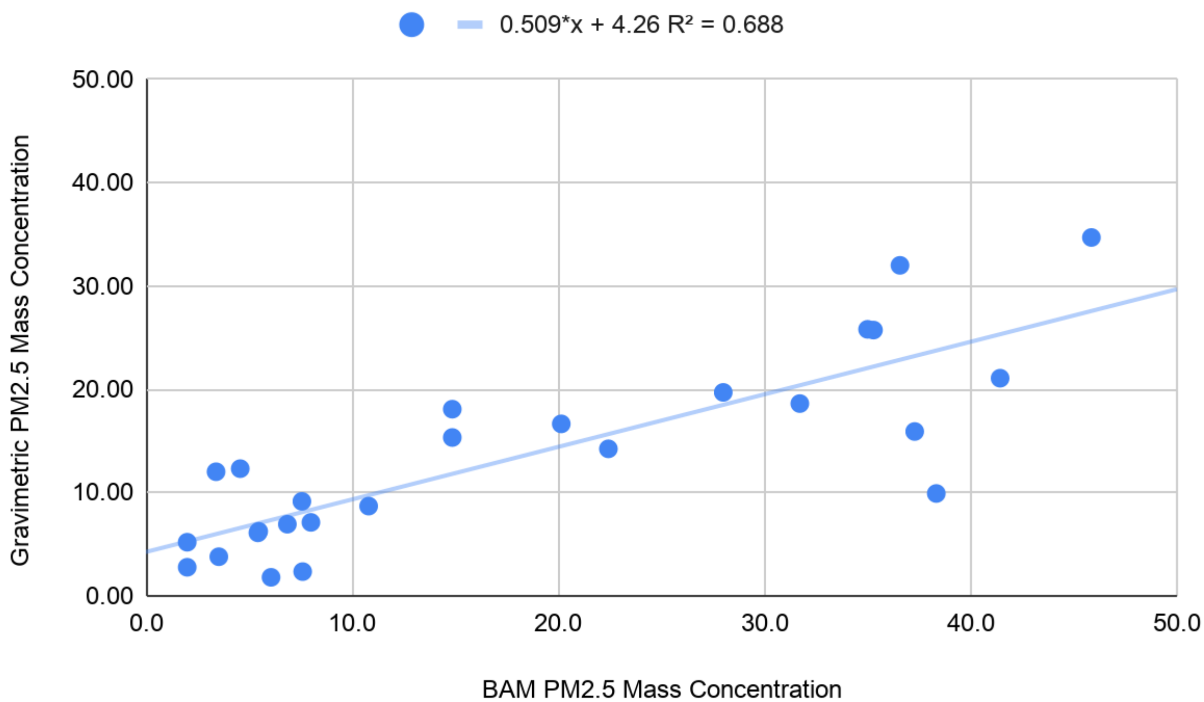

Figure 2. Scatter plot of PM2.5 mass concentrations [μg m^{-3}] by Gravimetric and BAM methods at CDF for sampling from 27 April to 17 May 2020. The fitted trendline indicates that the Gravimetric concentrations correlate to BAM concentrations with R^2=0.687.

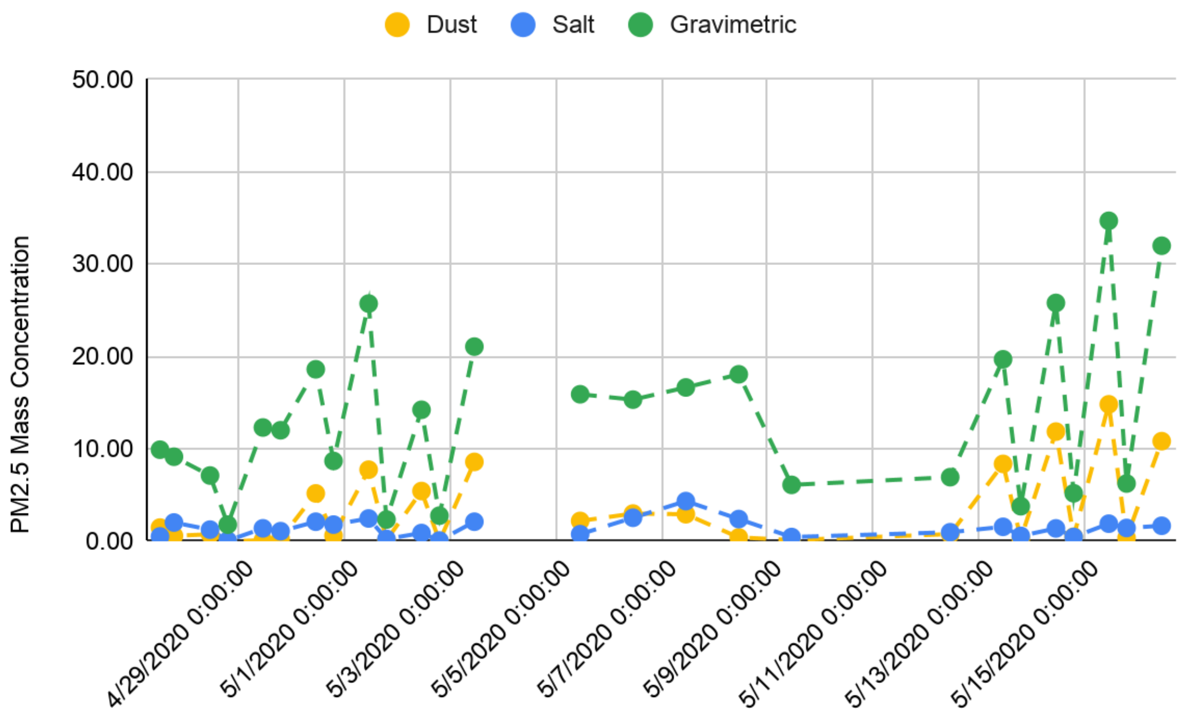

Figure 3. Time series of PM2.5 mass concentrations [μg m^{-3}] for Dust, Salt and Gravimetric (total) concentrations at CDF for sampling from 27 April to 17 May 2020.

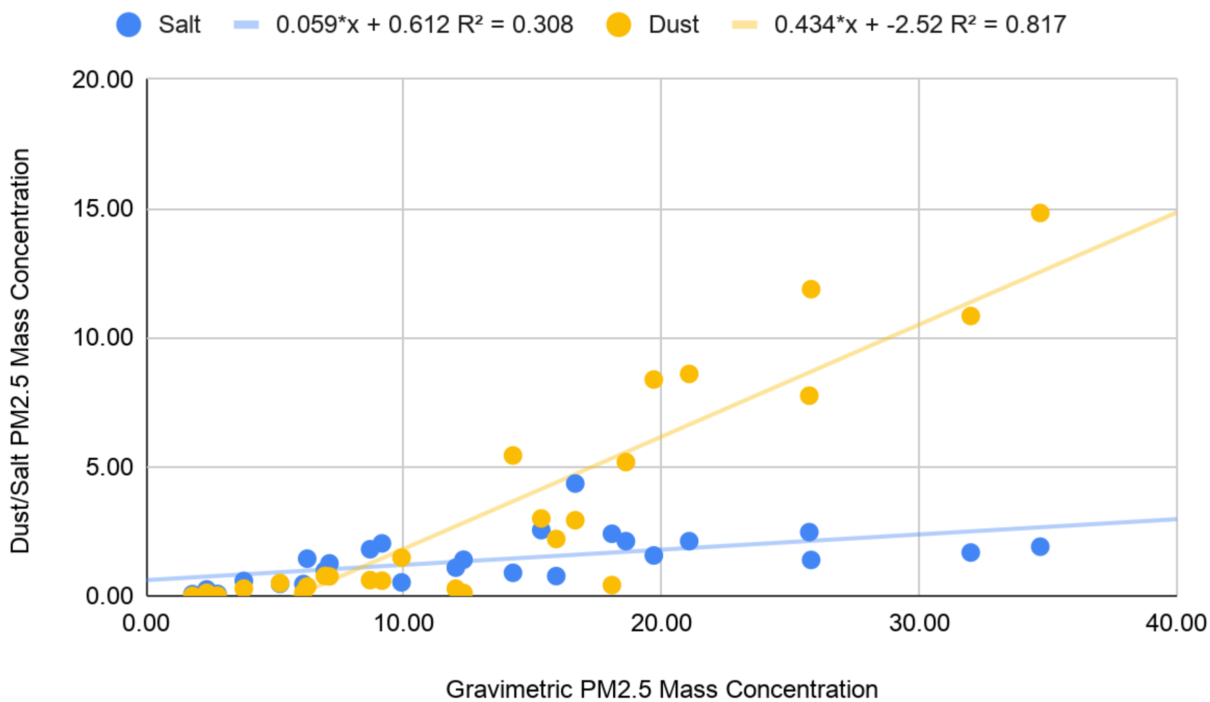

Figure 4. Scatter plot of PM2.5 mass concentrations [µg m^{-3}] for Dust, Salt and Gravimetric (total) concentrations at CDF for sampling from 27 April to 17 May 2020. The fitted trendline indicates that for this limited data set the Dust concentrations correlate to Gravimetric concentrations with R^2=0.817 and the Salt concentrations correlate to Gravimetric concentrations with R^2=0.308.

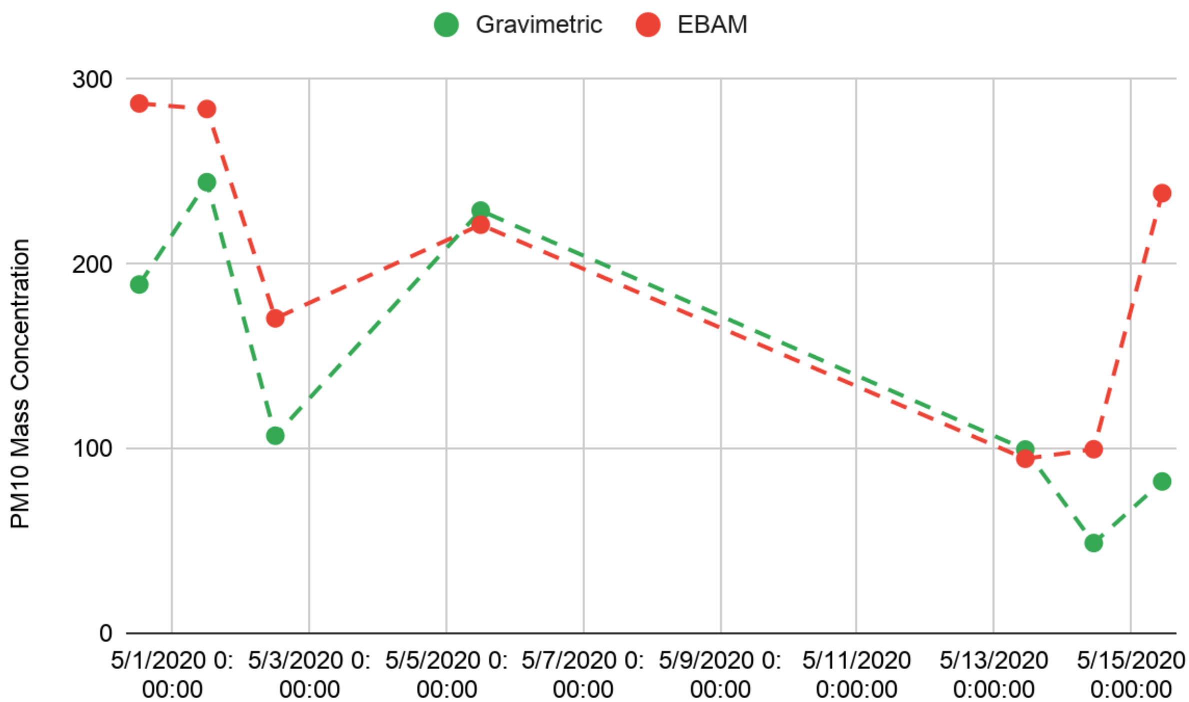

Figure 5. Time series of PM10 mass concentrations [$\mu g\ m^{-3}$] by Gravimetric and EBAM methods at Beach for sampling from 27 April to 17 May 2020.

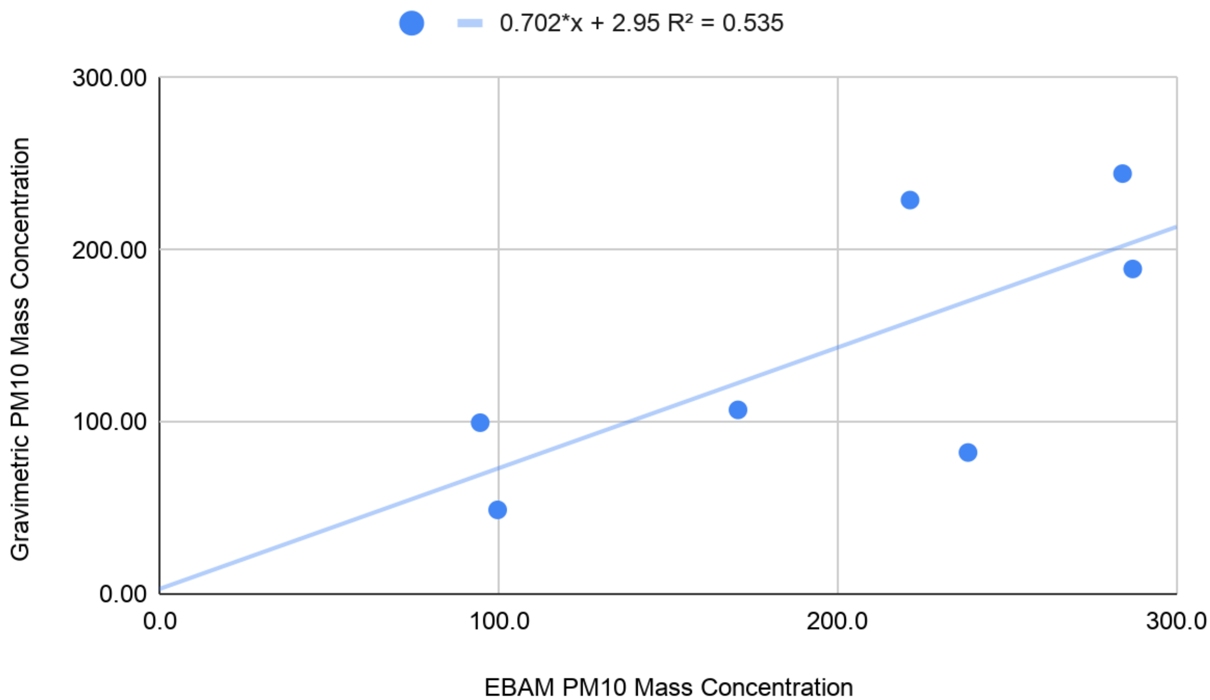

Figure 6. Scatter plot of PM10 mass concentrations [µg m^{-3}] by Gravimetric and EBAM methods at Beach for sampling from 27 April to 17 May 2020. The fitted trendline indicates that for this limited data set the Gravimetric concentrations correlate to EBAM with R^2=0.535.

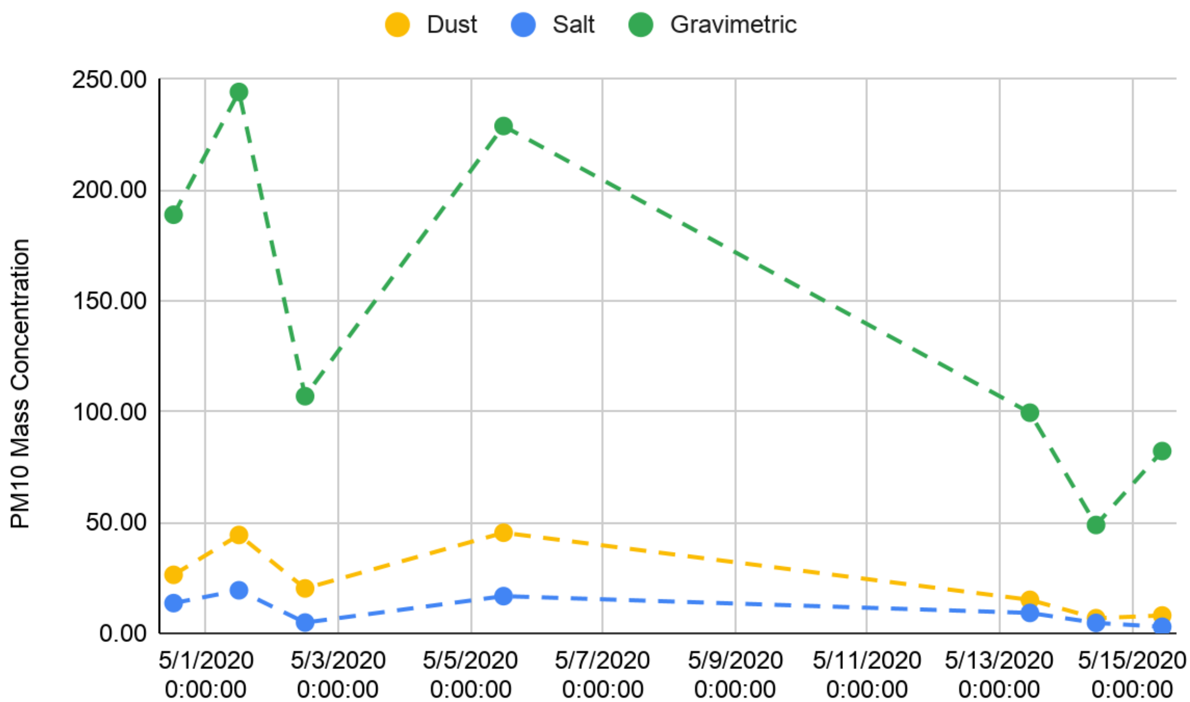

Figure 7. Time series of PM10 mass concentrations [$\mu g\ m^{-3}$] for Dust, Salt and Gravimetric (total) concentrations at Beach for sampling from 27 April to 17 May 2020.

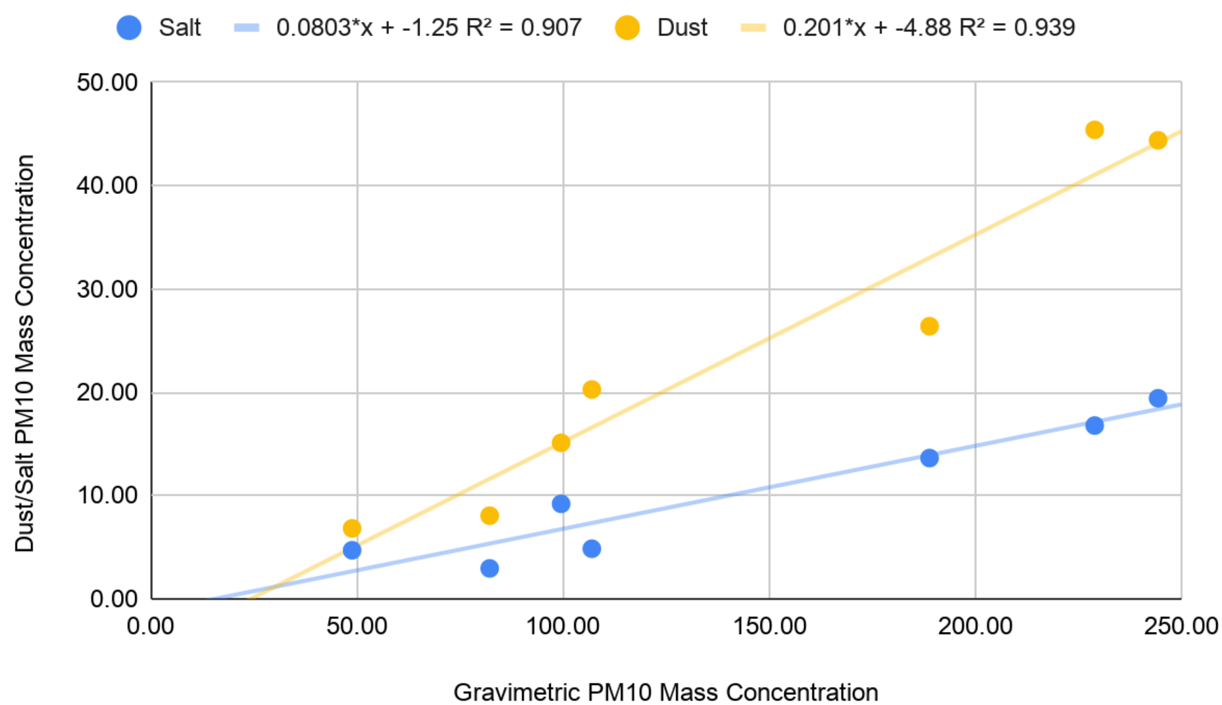

Figure 8. Scatter plot of PM10 mass concentrations [µg m^{-3}] for Dust, Salt and Gravimetric (total) concentrations at Beach for sampling from 27 April to 17 May 2020. The fitted trendline indicates that for this limited data set the Dust concentrations correlate to Gravimetric concentrations with R^2=0.939 and the Salt concentrations correlate to Gravimetric concentrations with R^2=0.907.

Figure 9. Summary of apportionment of BAM mass concentrations by Weight (a,c,e) and by Component (b,d,f) for (a,b) all CDF BAM2.5 (26 afternoon and overnight samples), (c,d) high PM10 day CDF BAM2.5 (10 afternoon samples), and (e,f) Beach PM10 (7 afternoon samples). High PM10 day samples are those with 24-hr PM10 exceeding 140 µg m^{-3}. The category labeled "Other" (green) may include additional water, ammonium, nitrate, sulfate and organic components, and trace metals.

APCD Review of September 2020 Scripps Report

Executive Summary

The most recent Scripps Report asks the wrong question and then uses the wrong tools to answer that question. Therefore, nothing in it alters our understanding of the dust issue on the Nipomo Mesa, which is built on more than a decade of study by several independent researchers.

The Oceano Dunes dust issue is driven by the dozens of exceedances of the PM_{10} standard that occur each year downwind of the ODSVRA, yet the Scripps study measured $PM_{2.5}$, the standards for which are only rarely exceeded. Therefore, even if their samples had been collected with the right tools, their results would only be of very limited relevance to the issue.

Scripps collected their $PM_{2.5}$ samples using a novel sampler, which is not EPA-approved for $PM_{2.5}$ sampling and to our knowledge has never been tested; in fact, we are unaware of any other $PM_{2.5}$ studies using this method. Scripps's measurements are systematically lower than and correlate poorly with our BAM measurements taken at the same site (the District's CDF monitoring station downwind of the ODSVRA). Scripps argues this is due to water evaporating from their $PM_{2.5}$ filters prior to them being weighed by the EPA-approved gravimetric method. The District finds explanation unlikely, since samples collected and weighed according the full EPA-approved method generally show good correlation with collocated BAM measurements. The major difference between what Scripps did and the full EPA method is Scripps's sampling apparatus; their filter analysis was reportedly done according to the EPA protocol. Thus, the discrepancy between their $PM_{2.5}$ measurements and the District's is likely due to their sampling method. This may also explain why the Scripps speciation results are different from previous speciation studies of Oceano Dunes dust.

The District also identified several inconsistencies in the graphs and figures in the report. For example, from one figure to the next, some samples are depicted as starting at different times. One figure shows concentrations from the District's $PM_{2.5}$ BAM instrument, but some of the values depicted do not appear to match the values we actually measured.

Finally, the author appears to misunderstand how OHV activity contributes to the dust issue, writing: "The association of high PM10 and PM2.5 with high wind conditions, even when recreational vehicles were not allowed at Oceano Dunes, indicates that dune-derived mineral dust is more likely to be caused by natural forces (i.e. wind) rather than human activities. … [T]he high dust concentrations measured on high wind days in and downwind of Oceano Dunes are likely dominated by natural saltation processes associated with the indigenous geomorphological dune structure." As the District has stated elsewhere, "it is not the dust kicked up by OHV activity (i.e. 'rooster tails') that causes poor air quality downwind, nor is it their tailpipe emissions. Rather, it is the secondary effects to

vegetation and dune shapes that leads to greater wind erosion and more dust when the wind blows." And as the SAG noted in a letter shortly after the ODSVRA was closed to OHV activity, "decades of OHV activity have fundamentally altered the natural beach-dune landscape, making the dunes significantly more susceptible to PM emissions than they would be in a natural state. The SAG does not expect a few weeks or months of temporary OHV restrictions to substantially alter the balance of human versus natural contributions to PM emissions at ODSVRA."

Introduction and Background

The subject of this review is the "Scripps Report" released on September 23, titled "UCSD Supplemental Report 2020: Preliminary Results from May 2020 Aerosol Measurements."[1] Prof. Lynn Russell, the report's author, discussed its findings at the OHMVR Commission's meeting the following day.[2] The report describes sampling conducted at CDF and within the ODSVRA in April and May 2020.

The current report follows up on two previous reports, the most recent of which described sampling conducted in 2019 and is titled "First Year (2019) Summary Report: Investigation of Aerosol Particulates in a Coastal Setting, South San Luis Obispo County, California."[3] Members of the Scientific Advisory Group (SAG) and APCD staff previously reviewed that report, and the reviews are compiled in Attachment 7 of State Parks' 2020 Annual Report and Work Plan.[4] Those reviews noted several methodological and other issues with the study and its findings, and they provided suggestions for improving future sampling campaigns.

The first report in the series, "Marine Contributions to Aerosol Particulates in a Coastal Environment,"[5] described the results of DNA analysis of E-BAM filter tapes. While the report was touted in some circles as evidence that OHV activity is not the cause of the PM_{10} issue, the District did not find the study to be relevant to the issue, as we described in a June 2019 FAQ[6] and a

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[1] L. Russell (2020). "UCSD Supplemental Report 2020: Preliminary Results from May 2020 Aerosol Measurements," September 20, 2020. Available online at https://ohv.parks.ca.gov/pages/1140/files/03-Scripps%20Report.pdf.

[2] Video of September 24 OHMVR Commission meeting—including Prof. Russell's presentation and responses to questions from Commissions—is available online at https://cal-span.org/unipage/?site=cal-span&owner=OHMVR&date=2020-09-24.

[3] L. Russell, M. Kahru, B. Palenik (2020). "First Year (2019) Summary Report: Investigation of Aerosol Particulates in a Coastal Setting, South San Luis Obispo County, California," February 21, 2020. Not online.

[4] State of California. Department of Parks and Recreation, Off-Highway Motor Vehicle Recreation Division (2020). "Oceano Dunes State Vehicular Recreation Area Dust Control Program 2020 Annual Report and Work Plan (Draft)," August 2020. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2020%20Draft%20ARWP%208-1-2020%20w%20exhibits.pdf (main document) and https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2020%20ARWP%20Attachments%208-1-2020%20%28002%29.pdf (attachments).

[5] B. Palentik, M. Nagarkar (2018). "Report: Marine Contributions to Aerosol Particulates in a Coastal Environment," March 3, 2018. Not online.

[6] SLOCAPCD (2019). "Response to Comments on the May 1st Workshop Version of the Draft Particulate Matter Reduction Plan Required by Stipulated Order of Abatement 17-01," June 12, 2019. Available online at

comment letter to State Parks.[7] The District also offered suggestions for how future investigations along the same lines could be made more relevant to the PM_{10} issue.

Relevance of $PM_{2.5}$ vis-à-vis PM_{10}

The dust issue in south San Luis Obispo County is a PM_{10} issue. The California PM_{10} standard is exceeded dozens of times per year on the Nipomo Mesa,[8] including on 51 occasions in 2019 at CDF. While some of these exceedances are due to wildfire smoke, regional dust transport, and other sources, the bulk are due to windblown dust from the ODSVRA. In contrast, exceedances of the $PM_{2.5}$ standards are rare (most years have none) and often occur in association with wildfires rather than windblown dust events.[8]

The latest Scripps study, like the last one, did not measure PM_{10} at CDF but instead measured $PM_{2.5}$. In her presentation to the OHMVR Commission, Prof. Russell explained that they focused on $PM_{2.5}$ because it is associated with more deleterious health impacts than PM_{10}. We agree that $PM_{2.5}$ is generally a greater health hazard than PM_{10}, but if the research goal is inform the dust mitigation process (as it seems to be, since the study was commissioned by the OHMVR Division, paid for out of the OHV Trust Fund, and presented in this context), then sampling PM_{10} would have been far more informative. During windblown dust events $PM_{2.5}$ is only about 21% of PM_{10}, and the chemical composition of the $PM_{10-2.5}$ fraction may be very different from the composition of the $PM_{2.5}$ fraction.

Several reviewers of the previous Scripps report made this same point.[4] In her comments to the OHMVR Commission, Prof. Russell mentioned that they had also planned to conduct PM_{10} sampling at CDF this spring, but due to the global COVID-19 pandemic they were unable to. Nonetheless, they were able to accomplish other elements of their sampling plan, so clearly PM_{10} was not the priority.

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https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Response%20to%20Comments_FINAL_PostedJune122019.pdf.

[7] Gary E Willey to Dan Canfield (2019). "California Department of Parks and Recreation's February 1, 2017 Oceano Dunes SVRA Concept Draft Particulate Matter Reduction Plan in Response to Stipulated Order of Abatement Number 17-01," February 25, 2019. Available online at: https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Feb%2025%202019%20APCD%20Response%20to%20SP-Feb%201%202019%20PMRP%20%28Signed%29%20%281%29.pdf

[8] SLOCAPCD (2019). "2018 Annual Air Quality Report," November 2019. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/2018aqrt-FINAL.pdf.

Evaporative Loss Does Not Explain the Discrepancy in $PM_{2.5}$ Mass

The Scripps researchers collected 26 multi-hour $PM_{2.5}$ filter samples at CDF, a short distance from the District's regulatory $PM_{2.5}$ monitor, which is a continuous BAM 1020 instrument. The report states that the "concentration measurements tracked reasonably well … and showed a moderate correlation (R2~0.7). [Scripps's] offline gravimetric method is 26% lower on average than the [the District's] online BAM instrument" and even lower (38%) during wind events. These results are plotted in Figure 2 of the report, shown below. The report argues that "[i]t is likely that the 38% difference in mass on high PM_{10} days is due to water evaporating, although other semi-volatile components (ammonium nitrate and organic mass) could also be included in the BAM method and not in the gravimetric method."

The District does not agree that evaporative loss is the likely cause of the discrepancy. While the gravimetric method is known to be subject to losses of water and semi-volatiles, the BAM 1020 instrument was designed to mimic this effect and thus produce comparable results. This was accomplished by incorporating an inlet heater which maintains the relative humidity of the incoming air flow at or below 35%. Through rigorous field trials at geographically diverse test sites around the

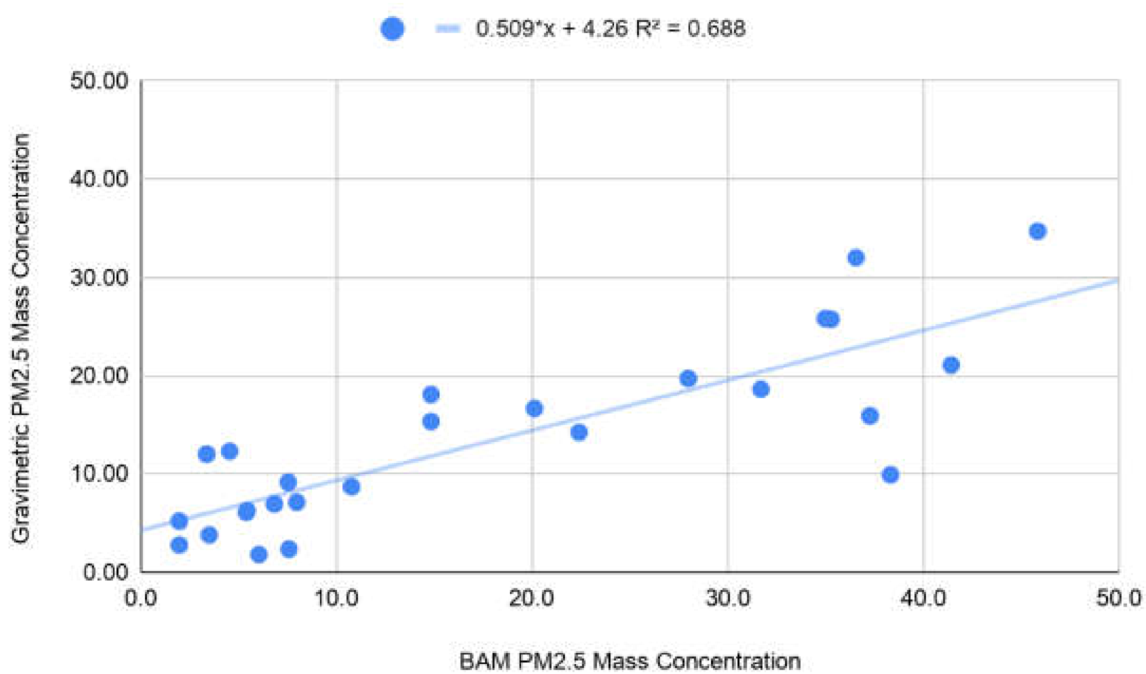
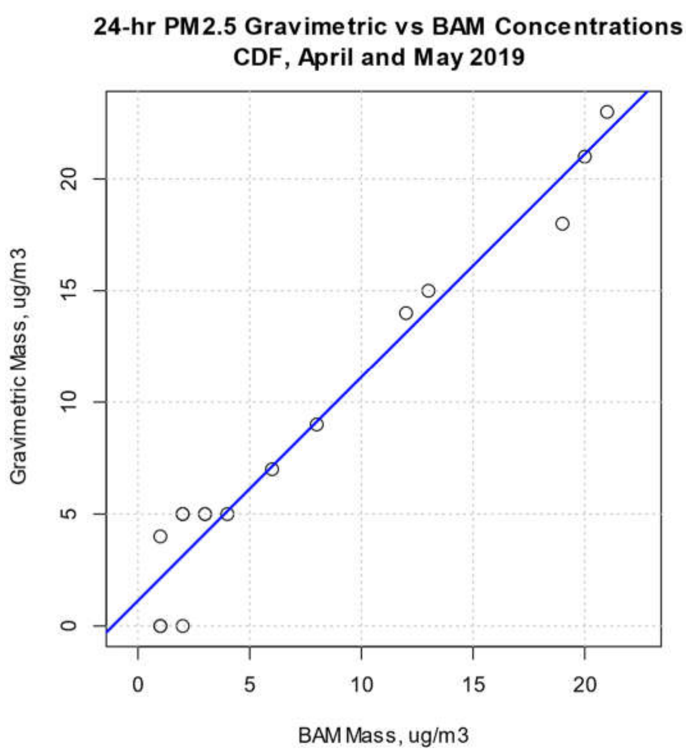


Figure 2. Scatter plot of PM2.5 mass concentrations [μg m^{-3}] by Gravimetric and BAM methods at CDF for sampling from 27 April to 17 May 2020. The fitted trendline indicates that the Gravimetric concentrations correlate to BAM concentrations with R^2=0.687.

county, the BAM 1020 was demonstrated to yield very comparable results to the established gravimetric method, and it was thus designated a Federal Equivalent Method by the EPA.[9] Today, BAM 1020 instruments measure $PM_{2.5}$ at hundreds of regulatory sites across the United States.

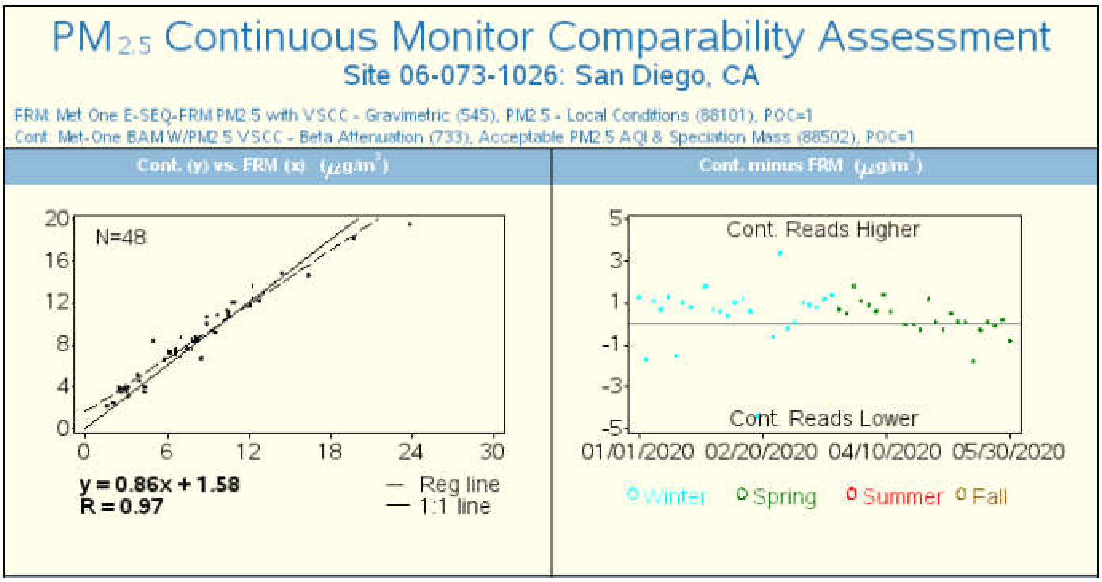
Numerous studies and trials have run BAM instruments alongside gravimetric samplers, and in general these have shown much better correlation and much less bias that what Scripps reports. In fact, the District collocated a filter-based $PM_{2.5}$ sampler with the BAM 1020 at CDF in the spring of 2019, and the results are plotted below.[10] For these data, the least squares fit (shown in blue) has slope = 0.999, intercept = 1.13, and R^2 = 0.955; the Scripps results are significantly poorer with slope = 0.509, intercept = 4.26, and R^2 = 0.688. The Scripps samples were shorter in duration (8 or 16 hours vs 24 hours), so somewhat more scatter is expected in their results; however, this difference in sample duration cannot account for the marked difference in R^2 values or for Scripps's low slope and high intercept.

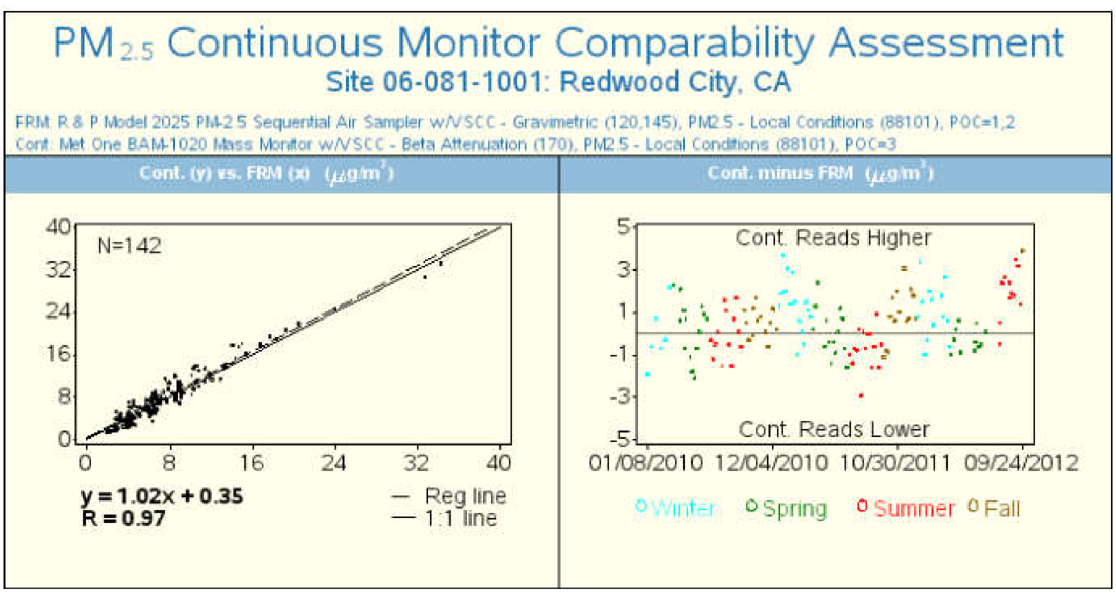
Other examples abound. For example, the EPA hosts a "PM2.5 Continuous Monitor Comparability Assessments" webpage which facilitates comparisons between collocated BAM and gravimetric



[9] Environmental Protection Agency, Office of Research and Development (2008). "Ambient Air Monitoring Reference and Equivalent Methods: Designation of One New Equivalent Method," 73 Fed. Reg. 13224, March 12, 2008. Available online at https://www.govinfo.gov/content/pkg/FR-2008-03-12/pdf/E8-4905.pdf.
[10] These are unpublished data. The BAM data are from the regulatory instrument at the site, and the gravimetric samples were collected with a Rupprecht & Pataschnick Partisol-FRM Model 2025i. Gravimetry was performed by the Bay Area Air Quality Management District according to the FRM method.

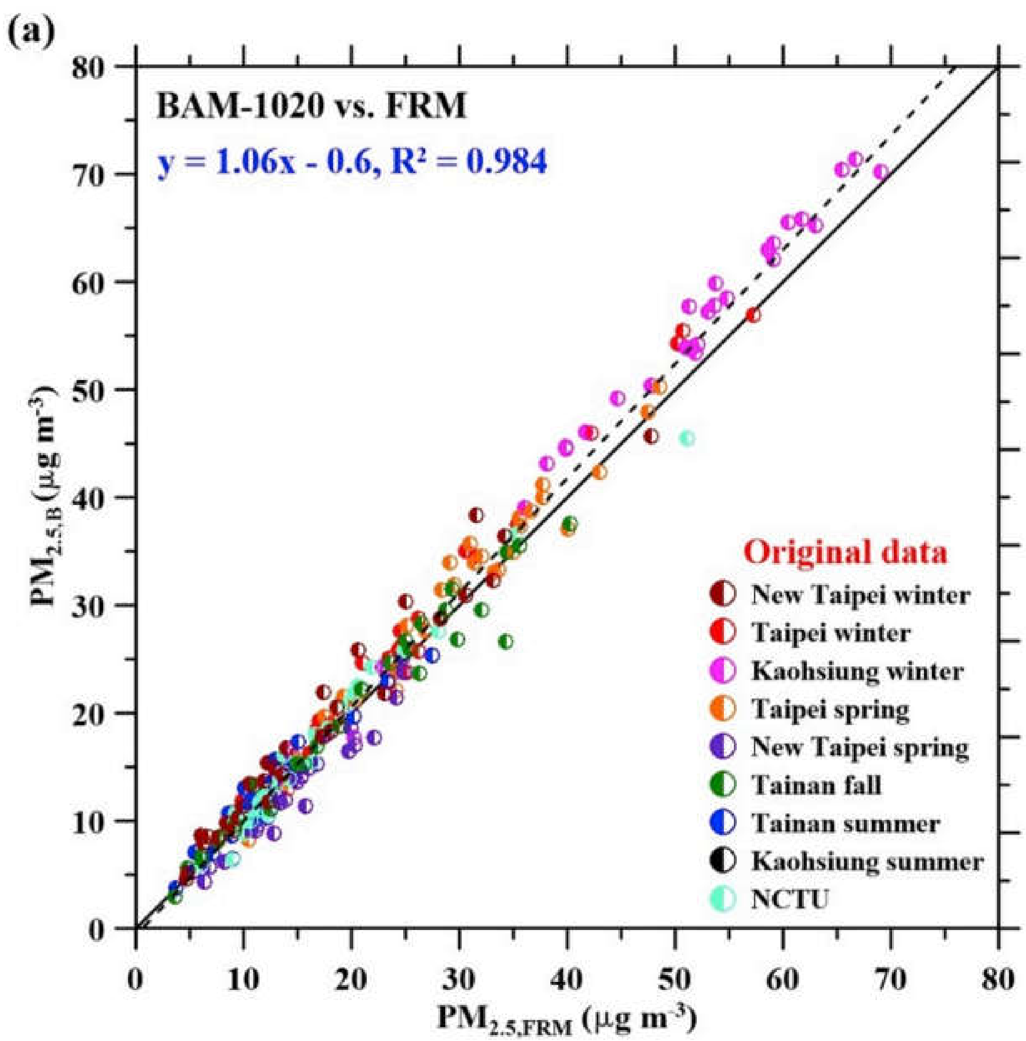
monitors.[11] Shown below are plots comparing $PM_{2.5}$ results from collocated BAM and gravimetric samplers in San Diego and Redwood City. These sites were chosen because like CDF they are coastal California sites hosting BAM monitors using VSCC cyclones (the same method used at CDF); however, unlike CDF they were operated independently of the District. The most recent year with available data is shown for each. Note that the axes are switched in these plots compared to how the data are presented in the figure above and Figure 2 of the Scripps report. These examples also show much better correlation and less bias than the Scripps results.





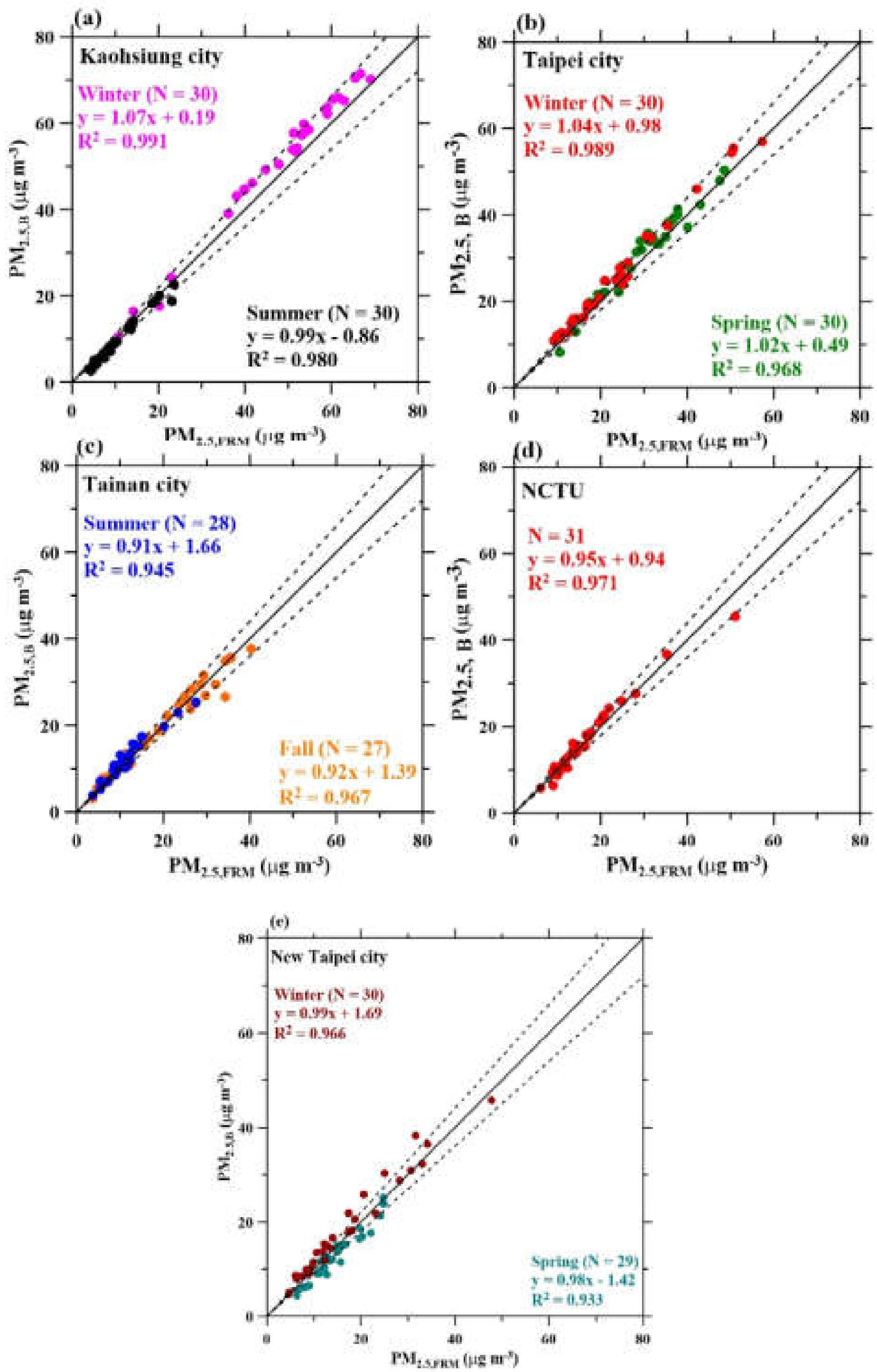
[11] Online at https://www.epa.gov/outdoor-air-quality-data/pm25-continuous-monitor-comparability-assessments. In browsing these assessments, care should be taken to ensure that the continuous monitor being assessed is a BAM-1020 with a VSCC rather than SCC.

A recent academic study, Le 2020,[12] investigated the differences between BAM and gravimetric $PM_{2.5}$ measurements in Taiwan. While the researchers did find systematic differences between collocated BAM and gravimetric measurements, which they attributed "mainly … to the aerosol water content," the bias they observed was much smaller than that reported by Scripps and more in line with the collocation studies mentioned above. Figure 2a from the study is shown below. It plots 24-hr $PM_{2.5}$ BAM concentrations from all sites in the study against the corresponding collocated gravimetric concentrations. As shown in the figure, the R^2 was 0.984, the slope was close to one and the intercept close to zero.



[12] T.-C. Le, K. K. Shukla, Y.-T. Chen, *et al.*, (2020). "On the concentration differences between PM2.5 FEM monitors and FRM samplers," Atmospheric Environment, 222, 117138. Available online at https://doi.org/10.1016/j.atmosenv.2019.117138.

Le 2020 found that differences between the BAM and gravimetric concentrations were influenced by ambient temperature and relative humidity, and that some sites had greater average differences than others. This is depicted in Figure S3 of the study's supplemental information, shown below. Even breaking the data down by site and season, all the individual correlations (as indicated by the R^2 values) and biases (as indicated by the slopes and intercepts) are much better than those reported by Scripps.



Finally, if evaporative loss was the primary cause of the mass discrepancy, then we would expect the BAM masses to always exceed the gravimetric masses, or at least to only observe BAM masses less than gravimetric masses on days when the ambient relative humidity was less than 35% (the humidity level that the Scripps samples were equilibrated at prior to weighing). This is not what is observed. According to Figure 1of the Scripps Report, there are at least 5 samples where the gravimetric mass exceeds the BAM measurement, but ambient relatively humidity did not vary much during the sampling campaign, and hourly average relative humidity was never less than 40%.

In summary, while evaporative loss is a known source of bias between BAM and gravimetric methods, this cannot explain the large difference between the Scripps gravimetric masses and the District's BAM measurements. Many researchers and regulators across the United States and around world have run BAMs and gravimetric methods side by side and obtained much better correlations with much less bias.

The Discrepancy in $PM_{2.5}$ Mass is Likely Due to Scripps's Sampling Methodology

If evaporative loss does not explain the discrepancy in $PM_{2.5}$ mass between the District's measurements and Scripps' samples, then what does? The District believes sampling methodology is the most likely explanation—specifically differences in the $PM_{2.5}$ size separators and flow rates used by the District and Scripps. The District operates its BAM 1020 at CDF in full accordance with state and federal requirements, including the use if a BGI VSCC as the $PM_{2.5}$ size separator,[13] operated at a flow of 16.7 L/min. In contrast, Scripps employed a BGI SCC 2.229 operated at 7.5 L/min as their $PM_{2.5}$ size separator.[14] The SCC 2.229 was designed for sampling PM_1 at a flow rate of 16.7; while it can achieve a nominal 2.5 micron cut point when operated at 7.5 L/min,[15] it was not designed for $PM_{2.5}$ sampling and it not a part of any EPA-approved $PM_{2.5}$ measurement method.[16]

As we wrote in our critique of the previous Scripps report, "These differences in methodology are not mere technicalities. While many cyclones can achieve a 2.5 micron cut point, only the VSCC operated at 16.7 lpm has been approved for regulatory sampling since other parameters in addition to the cut point are important. … [P]articulate sampling can be biased in windy conditions, but the EPA-approved methods have been shown to be unbiased in high wind conditions like those seen at CDF." The District suspects that Scripps method is under sampling particulates from the ambient air,

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[13] BGI, Inc. (2014). "VERY SHARP CUT CYCLONE VSCC® INSTRUCTIONS FOR USE AND MAINTENANCE." Available online at https://bgi.mesalabs.com/wp-content/uploads/sites/35/2014/10/vscc_manual.pdf.
[14] BGI, Inc. (2001). "SHARP CUT CYCLONE - SCC-2.229 FOR PM1 NSTRUCTIONS FOR USE AND MAINTENANCE." Available online at https://bgi.mesalabs.com/wp-content/uploads/sites/35/2014/10/SCC-2.229_PM1_MANUAL.pdf.
[15] BGI, Inc. (2014). "BGI Cyclone Selector Chart." Available online at https://bgi.mesalabs.com/wp-content/uploads/sites/35/2014/12/BGI_CycloneSelectorChart_2.pdf
[16] EPA (2020). "LIST OF DESIGNATED REFERENCE AND EQUIVALENT METHODS," June 15, 2020. Available online at https://www.epa.gov/sites/production/files/2019-08/documents/designated_reference_and-equivalent_methods.pdf.

particularly when winds are high, and that this effect is much important than evaporative loss in explaining why the gravimetric masses are consistently lower than the BAM masses. This is consistent with Scripps's observation that "[t]he gravimetric fraction of BAM PM2.5 is lower at 62% on high PM10 afternoons [i.e. when winds are high] compared to 74% for all samples measured."

The $PM_{2.5}$ method employed by the District is used at hundreds of regulatory sites across the United States and even more around the world. In contrast, we know of no examples of the use of the SCC 2.229 at 7.5 L/min for $PM_{2.5}$ sampling, other than the recent Scripps studies at CDF. The District has requested the author to provide other examples, but we have not yet received any such examples.

Inconsistencies in the Scripps Report

In reviewing the Scripps Report, the District has noticed several inconsistencies in the figures:

- **Figures 1 & 3: Sample Dates of Gravimetric Masses.** Figure 1 is a timeseries plotting Scripps's gravimetric masses and EBAM results along with the District's BAM measurements. Figure 3 is a timeseries plotting those same gravimetric masses along with the speciation results for "dust" and "salt". In both, the gravimetric masses are shown in green. Figure 1 shows data for 24 sampling periods, while Figure 3 shows data for 26, and each figure

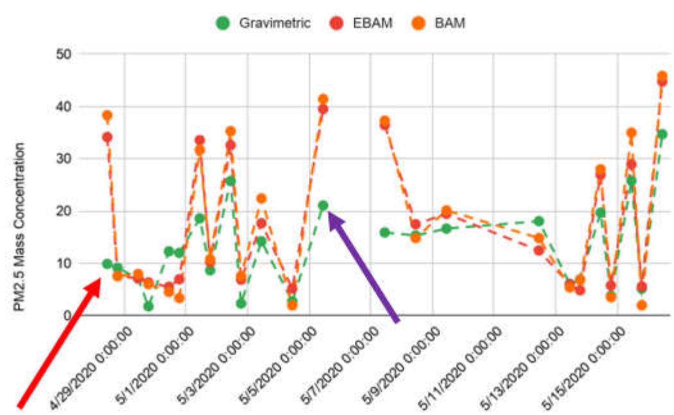

Figure 1. Time series of PM2.5 mass concentrations [μg m^{-3}] by Gravimetric, EBAM, and BAM methods at CDF for sampling from 27 April to 17 May 2020.

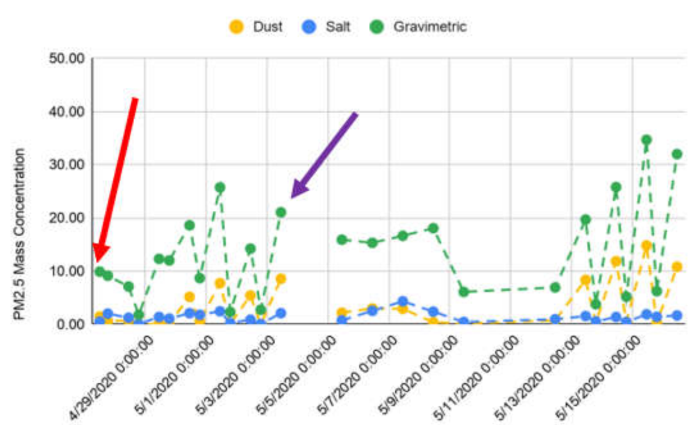

Figure 3. Time series of PM2.5 mass concentrations [μg m^{-3}] for Dust, Salt and Gravimetric (total) concentrations at CDF for sampling from 27 April to 17 May 2020.

contains at least a couple samples not included in the other. It is not explained why some samples are included in one figure but not the other. More critically, **the same samples are shown as starting at different times in the figures.** For example, the first sample in Figure 1, which has a gravimetric mass about 10 μg/m^3, is shown as starting in the afternoon of April 28th. In Figure 3, this same sample is show as starting on the afternoon of April 27th. See red arrows in the figure above. Similarly, in Figure 1 the last sample before the discontinuity in the middle of the graph has a gravimetric mass of about 21 or 22 μg/m^3 and appears to start in the afternoon of May 5th. The corresponding sample in Figure 3 is shown as starting in the afternoon of May 3rd. (Purple arrows).

- **Figure 1: BAM Masses.** Values from the District's BAM at CDF are shown in orange in this figure and presumably they were downloaded from the CARB website; however, at least some of these values are incorrect. For example, the very first BAM concentration in Figure 1 is depicted as about 38 or 39 μg/m^3, but there are not six to eight consecutive hours on April 27th or 28th which average to this value. Similarly, the figure depicts a BAM value about 36 μg/m^3 for a sample starting on the afternoon of May 3, but there are not six to eight consecutive hours on May 2nd through 5th which average to this value.

- **Figure 2: Gravimetric Masses and R^2.** Figure 2 is a scatter plot of Scripps's gravimetric masses plotted against the District's BAM masses. Figure 1 shows only one sample in which the gravimetric mass exceeded 30 μg/m^3 yet Figure 2 shows two samples with gravimetric masses greater than 30 μg/m^3. Also, according the figure legend, the R^2 of the correlation is 0.688, but the caption says it 0.687.

- **Figure 5: Sample Dates.** According to the text, "[t]he Beach site was sampled from 28 April to 16 May 2020;" however, Figure 5 shows the first sample as starting on April 30th.

In addition to these inconsistencies with certain figures, we note that the report's References section lists 29 references, but only 13 of them are cited in the report.

Reconciling the Scripps Results with Previous Studies

The Scripps Study is not the first to speciate $PM_{2.5}$ samples collected downwind of the Oceano Dunes, and its results are inconsistent with previous studies. The District's "Phase 1 Study,"[17] speciated $PM_{2.5}$ samples collected at three sites in 2004 and 2005. While none were collected at CDF, the Bendita and Mesa2 sites were nearby. On days with high wind and high PM_{10} levels, speciation of $PM_{2.5}$ samples from these sites indicated that about half of the $PM_{2.5}$ mass was from crustal materials, consistent with being derived from sand or soil. On the day with the highest $PM_{2.5}$ mass in the study (May 9, 2004), 60 to 70% of the $PM_{2.5}$ mass at these sites was from crustal materials, and

[17] SLOCAPCD (2007). "NIPOMO MESA PARTICULATE STUDY." Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/APCD%20Exhibit%201%20-%20APCD_Phase1_SouthCountyPMStudy-2007%281%29.pdf.

less than 20% was from sulfate, nitrate, and sea salt. In contrast, on non-windy days with low PM_{10} concentrations, the crustal contribution to $PM_{2.5}$ mass was low to nonexistent, and on an annual average basis, crustal materials contributed about 20 to 25% of $PM_{2.5}$ mass.

The District's "Phase 2 Study,"[18] released in 2010, found similar results: "Elemental analysis from drum sampler data … showed a preponderance of earth crustal elements during episode periods, similar to the Phase 1 analysis; sea salt was also present in the samples."

When describing their elemental analysis results, the Scripps Study uses the term "dust", while the District studies use the term "crustal." Presuming these terms refer to the same thing—namely, particulates derived from sand and/or soil—the Scripps results are inconsistent with these previous studies. As discussed in the report, they found dust contributes only 20% of $PM_{2.5}$ mass on high wind days. In fact, these results appear to be at odds even with the previous Scripps Report, which reported that "[f]or those sample collection days in May 2019, when the BAM PM2.5 exceeded 20 µg m-3, … dust [varied] from 4.1 to 14.4 µg m-3, corresponding to 26% to 46% of BAM PM2.5."[3]

Miscellaneous Issues

- The cover letter states their results show "that it is incorrect to assume that all PM2.5 measured at CDF monitors is mineral dust." The District has never assumed nor stated that 100% of $PM_{2.5}$ measured at CDF (or anywhere else) is dust. On the contrary and as discussed above, the District has published studies showing that non-crustal materials contribute to $PM_{2.5}$ mass at CDF even on windy days.

- The introduction states that "It is important to note that recreational vehicles were not allowed during this period because of COVID-19 restrictions that had been in place since March 2020." Later, in the conclusions it states, "The association of high PM10 and PM2.5 with high wind conditions, even when recreational vehicles were not allowed at Oceano Dunes, indicates that dune-derived mineral dust is more likely to be caused by natural forces (i.e. wind) rather than human activities. … [T]he high dust concentrations measured on high wind days in and downwind of Oceano Dunes are likely dominated by natural saltation processes associated with the indigenous geomorphological dune structure."

  The author appears to misunderstand how OHV activity contributes to the high PM_{10} levels measured downwind of the ODSVRA. As the District has stated elsewhere, "it is not the dust kicked up by OHV activity (i.e. 'rooster tails') that causes poor air quality downwind, nor is it their tailpipe emissions. Rather, it is the secondary effects to vegetation and dune shapes that leads to greater wind erosion and more dust when the wind blows. It is true that without wind, there would be no significant dust, but changes to key vegetation areas and

[18] SLOCAPCD (2010). "SOUTH COUNTY PHASE 2 PARTICULATE STUDY," February 2010. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/PM2-final_report_with_appendices.pdf.

dune structures caused by OHVs result in more sand movement and more dust emissions when the wind blows."[19]

The ODSVRA closed to OHV activity on March 27th, just one month before Scripps began sampling, so it unlikely that surface emissivity during their study differed significantly from when OHV activity is allowed. As the SAG noted in a letter dated April 5th, "decades of OHV activity have fundamentally altered the natural beach-dune landscape, making the dunes significantly more susceptible to PM emissions than they would be in a natural state. The SAG does not expect a few weeks or months of temporary OHV restrictions to substantially alter the balance of human versus natural contributions to PM emissions at ODSVRA."[20]

Additionally, if—as the Scripps Report seems to suggest—the dust downwind of the ODSVRA is simply a natural phenomenon unrelated to the long history of OHV activity, this does not explain the observed spatial pattern of PM_{10} in the region. Specifically, the PM_{10} levels observed downwind of the riding area of the ODSVRA (i.e. at the CDF and Mesa2 monitoring stations) are systematically higher than the levels observed downwind of non-riding areas (i.e. at the District's current Oso Flaco site or previous Morro Bay site.)[8,21] This pattern was also documented in the District's "South County Community Monitoring Project"[22] which blanketed the Nipomo Mesa in PM_{10} samplers, as well as in the previously mentioned Phase 1 and Phase 2 studies.[17,18]

- The report discusses 7 PM_{10} samples collected on at the "Beach" site, and states that the collocated gravimetric and E-BAM samples showed a moderate correlation. As discussed in the report for the South County Community Monitoring Project, E-BAMs are known to be biased when sampling PM_{10}. Therefore, both District and State Parks have always applied an empirical correction factor to PM_{10} E-BAM data. No correction factor seems to have been applied by Scripps to their E-BAM data.

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[19] SLOCAPCD (2020). "Frequently Asked Questions: Air Quality and the Temporary Closure of Oceano Dunes," June 30, 2020. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/June2020FAQ-42.pdf.

[20] Scientific Advisory Group, "Memo: SAG comments on the temporary closure of Oceano Dunes State Vehicular Recreation Area (ODSVRA) and impacts on particulate matter (PM) emissions," April 6, 2020. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/SAG%20Letter.pdf.

[21] SLOCPACD (2013). "Air Quality Trends: San Luis Obispo County: 1991-2011," March 2013. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Final%20AQ%20Trends%282%29.pdf

[22] SLOCPACD (2013). "South County Community Monitoring Project," January 2013. Available online at https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/Final%20Report.pdf.

UNIVERSITY OF CALIFORNIA, SAN DIEGO
SCRIPPS INSTITUTION OF OCEANOGRAPHY

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14 November 2020

Sarah Miggins, Deputy Director
Off-Highway Motor Vehicle Recreation Division, California Department of Parks and Recreation
1725 23rd Street, Suite 200, Sacramento, CA 95816

Dear Deputy Director Miggins,

I have received a copy of the 30 October 2020 transmittal from Gary Willey of the San Luis Obispo County Air Pollution Control District (APCD) to you regarding my 23 September 2020 report, "UCSD Supplemental Report 2020: Preliminary Results from May 2020 Aerosol Measurements." The transmittal includes reviews of my report by the APCD and the APCD's Scientific Advisory Group (SAG) that make two unsubstantiated claims: (1) that PM2.5 concentrations are not of concern because the focus of regulatory actions by the APCD is PM10; (2) that the instrument I used to segregate PM2.5, a sharp cut cyclone (SCC), is "unconventional and unproven," that the ACPD is "not aware of any other studies" using the SCC to sample PM2.5, per Mr. Willey's transmittal letter. My comments on these claims are:

1) When overall PM measurements were elevated at the APCD CDF site during our May 2020 sampling, hourly concentrations of PM2.5 averaged approximately 25% of the corresponding hourly PM10 concentrations. This 25% is a substantial fraction of overall PM10, and it included only 20% mineral dust. For example, if a PM10 reading is 100 $\mu g\ m^{-3}$, the PM2.5 reading would then be 25 $\mu g\ m^{-3}$. But based on our findings, only 20% of the PM2.5, or 5 $\mu g\ m^{-3}$, is mineral dust and the remaining 20 $\mu g\ m^{-3}$ is not mineral dust from the dunes. This means that at most 80 $\mu g\ m^{-3}$ of the PM10 value of 100 $\mu g\ m^{-3}$ was dune dust. The next priority should be quantitative chemical speciation of PM10 with corresponding gravimetric measurements to identify the mineral dust portion of the remaining 75 $\mu g\ m^{-3}$, as to date, to my knowledge, APCD has not considered it a priority to provide this.
2) There are several different cyclone designs for PM size cuts at different flow rates by different manufacturers. The APCD has not documented any measurable differences between the cyclone I used ("SCC") and the cyclone used by the APCD ("VSCC"). An APCD staff member confirmed to me that he has no documentation of the difference. Yet the APCD's primary reason for critiquing my report is that these two instruments, designed and widely used for the same purpose, operate somewhat differently. Also, contrary to Mr. Wiley's letter, the low-flow use of the SCC for PM2.5 sampling is readily documented, both in the specifications of standard PM sampling equipment (https://www3.epa.gov/ttnamti1/files/spectraining/MetOneSASSFOM.pdf) and in CARB-reviewed scientific reports (https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/13-330.pdf).

There are also a variety of other minor misinterpretations and misrepresentations of my work in these "reviews" that are too numerous to discuss here, including misreading of simple graphics, misattribution of my motives, and misdirection to cited literature. If Parks would like to contract with me to document these errors, please let me know. Please do not hesitate to contact me if you have any questions (lmrussell@ucsd.edu).

Sincerely,

Lynn M Russell

Professor Lynn M. Russell (858-534-4852)

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Oceano Dunes State Vehicular Recreation Area Dust Control Program

DRAFT 2021 Annual Report and Work Plan

ATTACHMENT 16

Preliminary Public Relations Campaign

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DRAFT Oceano Dunes SVRA Air Quality Public Relations Campaign Proposal July 2021

California State Parks (Parks) is proposing a multi-faceted public relations campaign with the intent of providing messaging to the public and park users about various aspects of the Park's air quality management program.

The following draft proposal includes the potential project, the intended audience, the desired messaging, and a short description of the project.

1. Digital Brochure

Audience: This brochure is intended for Oceano Dunes SVRA users, both long-time users and first time-users. The content would be presented at an easily understood level and focus on the main facts of the air quality issues and what Oceano Dunes SVRA is doing to improve air quality downwind of the SVRA.

Message: The digital brochure is intended to explain the basics about sand movement in a dune system, how dust is generated and mobilized, explains the Stipulated Order of Abatement in simple terms, and how it translates to management actions implemented at the SVRA.

A digital brochure is preferable to hard copies to prevent trash accumulation on the beach. Additionally, park staff feel that a digital brochure has more opportunity to reach a greater audience given it can be posted across multiple platforms, used during outreach events, and can be tied to existing and future outreach mediums. We plan to post this brochure on the Oceano Dunes SVRA website and across the multiple social media accounts managed by the unit. The digital brochure could also be converted into hard copies and distributed at events and to visitors who ask for more information on the air quality management program.

A QR code that can be scanned by a smart device with a camera containing the link to the brochure can be provided to the public in various locations throughout the Park to retrieve the brochure and review at their convenience. These locations include comfort stations, at the entrance Kiosk, on signage in the park, and at the visitor center.

The following bullets are adopted from the SAG's suggestions and are a starting point for content to be developed and included in the digital brochure.

- Sand has the potential to create dust when it is blown by the wind.
- Dust has been detected in harmful amounts inland of Oceano Dunes SVRA, and a Stipulated Order of Abatement has been issued to control and reduce dust emissions. Compliance with the Stipulated Order of Abatement is a legal requirement of the Clean Air Act.
- A coordinated effort between Oceano Dunes SVRA staff, researchers, and other agencies is underway to better understand the science around particulate matter at ODSVRA
- When emissive areas are identified, measures to reduce dust are implemented such as planting native vegetation and fencing.

• State Parks is committed to work towards compliance with the Stipulated Order of Abatement.

• Visitors to Oceano Dunes SVRA can help in the following ways:

- o Observe signage
- o Respect fences and closed areas
- o Not trampling or riding in vegetated areas
- o Educating other visitors
- o Alerting State Parks staff to possible infractions

2. Social Media Posts

Audience: All park visitors.

Message: Short, concise statements of how the park's visitors can help support Oceano Dunes air quality management program. "Help support Oceano Dunes SVRA through the following actions: Observe signage, respect fences and closed areas, do not ride on or trample vegetation, educate other visitors, and report potential infractions to State Park Peace Officers."

Direct social media posts that are synthesized from the digital brochure discussed above can be posted across multiple social media platforms managed by Parks at a given time. Content would include more direct points adapted from the digital brochure.

3. Air Quality Specific Video

Audience: The air quality specific video would be intended to reach all park visitors as well as the general public in communities around Oceano Dunes SVRA.

Message: The air quality specific video would relay key information about the Oceano Dunes' air quality management program, delivered in a short 30 second to a one-minute video.

The air quality program specific video would discuss the actions Oceano Dunes SVRA is taking to work towards compliance with the Stipulated Order of Abatement and would cover similar topics discussed in the digital brochure. The following are suggested main points of the video:

- Dust is blown downwind of the SVRA, which can impact communities.
- The park is required to reduce dust emissions over time and takes the following steps to reduce this dust [short list of projects and monitoring].
- What visitors can do to help? [relay observe signage, respect fences, do not trample or ride on vegetation, educate others, alert State Park Peace Officers of possible infractions].

Key to successful use of this video would be to keep it concise and factual. The information would be presented at a level to where all viewers could understand the content while remaining informative and accurate.

4. Frequently Asked Questions Sheet

Audience: Park visitors seeking information regarding operations at the SVRA and the public seeking answers specific to management actions aimed at improving downwind air quality.

Message: The message would be delivered in a simple question and answer format and would be intended to answer the 'why' questions that the less engaged public might ask.

A FAQ sheet can be developed with specific information about the air quality management program that the public may not have answers to. The FAQ sheet could be presented in both digital and hard copy formats. Similar to the digital brochure, the fact sheet would be accessible across online and social media platforms, available through QR codes, and available as a handout at the Kiosk and Visitor Center.

Potential Examples include:

What is the Stipulated Order of Abatement?
Why are there dust concerns?
Why is there less riding available on the dunes?
What steps are taken to reduce dust emissions?
What can the public do to help?

Answers to these questions would be developed by subject matter experts at Oceano Dunes SVRA with input from the SAG.

5. Text Message Service

Audience: The text service would be aimed at visitors who recreate at the park more frequently.

Message: The text service would be used for more specific park updates that are relevant to frequent park visitors but would include messaging relevant to the air quality management program, specifically what visitors can do to help.

Staff are exploring the possibilities of a text service that park visitors can sign up for. The system is designed to allow staff at the park to send text message updates to anyone signed up for the service. Oceano Dunes SVRA staff would use this text service to reach directly to the public to provide updates, closure information, current capacity, etc. and could include educational messaging discussed above in the digital brochure.

6. Park Signage/Interpretive Panels

Audience: The park signage and interpretive panels can reach both infrequent and frequent visitors of the park.

Message: Park signage message would be aimed at the more direct messaging of what visitors can do to help, whereas the interpretive panels could be developed to explain and relay more detailed information on specific projects, closed areas, and projects aimed at reducing dust.

Park signage and interpretive panels can be developed and placed in highly visible areas that contain messaging discussed above and developed in concert with the SAG. The signage could be reflective of, and work in tandem with, social media posts stating: “Help support Oceano Dunes SVRA through the following actions: Observe signage, respect fences, do not ride on or trample vegetation, report infractions to State Park Peace Officers.” QR codes that link to the digital brochure, the FAQ sheet, and the air quality specific video could be placed on this signage.

7. Educational Video Series

Audience: All park visitors and the general public seeking a deeper understanding of the air quality management program at Oceano Dunes SVRA.

Message: This series of videos would be used as an educational tool and would go into much more detail of all facets of the air quality management program.

The video series would complement the proposed outreach projects listed above. The projects proposed above can be developed relatively quickly and can be used effectively to relay desired messaging.

Oceano Dunes State Vehicular Recreation Area Dust Control Program

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ATTACHMENT 17

2021/2022 Planting Projects List

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FY2021/2022 Project List (subject to change)						
Project Name	**Project Acreage**	**Total Plants**	**Plants Per Acre**	**Native Seed (lbs)**	**Native Seed (lbs) per Acre**	**Large Bales**
New Planting Areas						
1. Eucalyptus Tree North	4.7	11745	2499	55.93	11.90	51.70
2. Eucalyptus Tree (western)	5.8	14494	2499	69.02	11.90	63.80
3. Eucalyptus Tree (eastern)	3.2	1632	510	27.04	8.45	
4. South Eucalyptus Tree (eastern)	2.7	1377	510	22.82	8.45	
5. APCD Area 2/LaGrille	20	51360	2568	176.60	8.83	220.00
6. Boy Scout Camp	6.4	15994	2499	56.51	8.83	70.40
7. Orion Northern	5	4900	980	44.15	8.83	
8. Orion Southern	5.6	5488	980	49.45	8.83	
Subtotal	53.40	106990		501.52	9.39	406
Supplemental Areas						
9. Boy Scout Camp (non-APCD Area)	2.0	4998	2499	17.66	8.83	22.00
10. Eucalyptus Tree North	1.0	2499	2499	8.45	8.45	11.00
11. Eucalyptus Tree	1.0	2499	2499	8.45	8.45	11.00
12. APCD Area 10	18.4			131.42	7.15	
13. APCD Area 11	4.2			29.82	7.15	
14. APCD Area 12	4.0			28.74	7.15	
Subtotal	30.6	9996		224.5	7.34	44
Totals	**84.0**	**116986**		**726**	**8.65**	**450**
Updated 24 June 2021						

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