Oceano Dunes State Vehicular Recreation Area
Dust Control Program

SECOND DRAFT 2023 Annual Report and Work Plan

September 11, 2023

State of California
Department of Parks and Recreation

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ODSVRA Dust Control Program
SECOND DRAFT 2023 Annual Report and Work Plan

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2023 Annual Report and Work Plan Attachments (Separate Documents)

Attachment 01: 2011 to 2023 Dust Control Measures

Attachment 02: 2022/2023 ODSVRA Dust Control Program Vegetation Restoration Projects (State Parks ARWP Work Product)

Attachment 03: Oceano Dunes: Status 2023 (DRI Presentation)

Attachment 04: Increments of Progress Toward Air Quality Objectives, ODSVRA Dust Control 2022 Update (Placeholder for DRI Document - Report undergoing Scientific Review Process)

Attachment 05: Computation Fluid Dynamics Modeling of the ODSVRA 48-Acre Foredune Restoration Project (DRI Document)

Attachment 06: SAG Recommendations for Establishing Emissivity Grids to be Used in the Modeling of Pre-Disturbance Conditions and Future Excess Emissions Reductions (SAG Memorandum

Attachment 07: In-Park Increments of Progress, TPM_{10}:TPWD, April to September 2022 (DRI Document)

Attachment 08: Summary of Vegetation Monitoring of Restoration Sites at ODSVRA (2022) (State Parks ARWP Work Product)

Attachment 09: Preliminary Analysis of Time-Lapse Photo Monitoring Stations at the ODSVRA Foredune Restoration Site (UCSB Document)

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- 11-04: SAG Framework for Assessing Excess Emissions of PM_{10} from the ODSVRA

Attachment 12: ODSVRA Public Relations Campaign (State Parks ARWP Work Product)

Attachment 13: 2022/2023 ODSVRA Dust Control Program Vegetation Restoration Projects (State Parks ARWP Work Product)

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List of Abbreviations	
Abbreviations	**Full Phrase or Description**
u*	shear velocity
µg/m^3	micrograms per cubic meter
µm	micrometers
ARWP	Annual Report and Work Plan
B	beach
BAM	Beta Attenuation Mass
BSNE	Big Springs Number Eight
CAAQS	California Ambient Air Quality Standards
Cal Poly	California Polytechnic State University
CARB	California Air Resources Board
CFD	computational fluid dynamics
DEM	digital elevation model
DRI	Desert Research Institute
DTM	digital terrain map
F	emissivity
FAA	Federal Aviation Administration
FAQ	Frequently Asked Questions
FD	foredune
FEM	Federal Equivalent Method
GCD	geomorphic change detection
GIS	Geographic Information System
GPS	Global Positioning System
LD	landward dune
mg/m^{2}s	milligrams per square meter per second
MP	megapixel
N	Newtons
NAAQS	National Ambient Air Quality Standards
NDRE	Normalized Difference Red-Edge Index
NDVI	Normalized Difference Vegetation Index
NIR	near-infrared
NSF	normalized sand flux
ODSVRA	Oceano Dunes State Vehicular Recreation Area
OHMVR Division	Off-Highway Motor Vehicle Recreation Division
OHV	off-highway vehicle
Pan	panchromatic

List of Abbreviations	
Abbreviations	**Full Phrase or Description**
PI-SWERL	Portable In-Situ Wind Erosion Laboratory
PM_{10}	Particulate Matter with a diameter of 10 microns or less (also referred to as respirable or coarse particulate matter)
PMRP	Particulate Matter Reduction Plan
PPK	post-processing kinematic
PST	Pacific Standard Time
RE	RedEdge
RGB	red, green, and blue
RH	relative humidity
SAG	Scientific Advisory Group
San Luis RCD	Coastal San Luis Resource Conservation District
SfM	structure-from-motion
SLOAPCD	San Luis Obispo County Air Pollution Control District
SOA	Stipulated Order of Abatement
SODAR	sonic detection and ranging
ST	straw treatment
State Parks	California Department of Parks and Recreation
SVRA	State Vehicular Recreation Area
TPM_{10}	total hourly PM_{10}
TV	temporary vehicle exclusion
TWPD	total hourly wind power density
UAS	unmanned aerial system
UCSB	University of California, Santa Barbara
USEPA	United States Environmental Protection Agency
VG	vegetation
WF	wind fencing
W/m^2	Watts per square meter
WSR	wind speed ratio

1 INTRODUCTION

The California Department of Parks and Recreation (State Parks) has prepared this 2023 Annual Report and Work Plan (ARWP) for the Oceano Dunes State Vehicular Recreation Area (ODSVRA) Dust Control Program to comply with 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 and October 2022.[1]

The SOA, as amended, requires State Parks to prepare and submit an ARWP to the SLOAPCD, and the SOA Scientific Advisory Group (SAG), by August 1 of each year, from 2019 to 2024. In general, the SOA requires the ARWP to:

- Review dust control activities implemented over the previous 12-month period and, using tracking metrics specified in State Parks' Particulate Matter Reduction Plan (PMRP), document progress towards SOA goals. For this 2023 ARWP, the previous 12-month period started on August 1, 2022, and ended on July 31, 2023.
- Identify dust control activities proposed to be undertaken or completed in the next 12-month period and, using tracking metrics specified in the PMRP, document expected outcomes and potential emission reductions for these activities. For this 2023 ARWP, the next 12-month period starts on August 1, 2023, and ends on July 31, 2024.
- Using air quality modeling, estimate the downwind benefits and anticipated reductions in respirable particulate matter (PM_{10}) concentrations associated with proposed dust control activities.[2]
- 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.

1.1 BACKGROUND INFORMATION

State Parks' 2023 ARWP is the fifth document summarizing the status and overall progress of State Parks' ODSVRA Dust Control Program in meeting SOA requirements. State Parks previously prepared, and received SLOAPCD approval of, ARWP documents in 2019, 2020, 2021,

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[1] The SOA, as amended, is available for review on the following SLOAPCD website: https://www.slocleanair.org/who/board/hearing-board/actions.php

[2] State Parks notes that, as described in more detail throughout this 2023 ARWP document, the SOA amendments adopted in October 2022 modify how State Parks, the SAG, and the SLOAPCD are to model PM_{10} emissions and evaluate the success of State Parks' Dust Control Program. This modification is neither minor nor administrative in nature. Rather, this modification resets the modeling framework and key parameters that had been applied and reported on in the past and limits the information that State Parks can publicly provide until the new modeling framework is fully developed.

and 2022.[3] Below is a summary of key information relevant to the development of State Parks' 2023 ARWP.

1.1.1 SOA Changes That Affect the 2023 ARWP

State Parks' 2019-2022 ARWP documents were prepared in accordance with the requirements of the original SOA, adopted in April 2018, and the first amendment to the SOA, adopted in November 2019.

Two important requirements of the original 2018 SOA and the 2019 SOA amendments were: 1) a 50% reduction in 24-hour PM_{10} mass emissions from the ODSVRA (as compared to modeled 2013 baseline conditions), and 2) achievement of the state and federal 24-hour PM_{10} ambient air quality standard at SLOAPCD air quality monitoring stations downwind of the ODSVRA. Accordingly, State Parks' 2019-2022 ARWP documents applied the best available scientific methods, involving both field data collection and air quality modeling, to prioritize and control PM_{10} mass emissions from approximately 740 acres of land at the ODSVRA. As documented in the 2022 ARWP, State Parks' efforts significantly reduced PM_{10} emissions from the ODSVRA, substantially improved air quality conditions on the Nipomo Mesa downwind of the ODSVRA, and made demonstrable progress towards achieving the requirements of the original SOA and 2019 SOA amendments.

The second amendment to the SOA, adopted in October 2022, modified the key mass emissions and concentration reduction requirements from the original SOA that had formed the basis for State Parks' Dust Control Program and 2019-2022 ARWP documents. Specifically, the October 2022 SOA amendments replace the requirement to reduce baseline PM_{10} emissions by 50% and achieve absolute ambient air quality standards with a new requirement that is "designed to eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal PM_{10} air quality standards."[4]

A summary of SOA changes relevant to the development of State Parks' past and present ARWP documents is provided in Table 1-1.

[3] State Parks' ARWP documents are available for review on the following SLOAPCD website (under "October 28, 2019 Update," "September 5, 2020 Update," "Fall 2021 Update," and "Fall 2022 Update"): https://www.slocleanair.org/air-quality/oceano-dunes-efforts

[4] SOA Amendment filed October 18, 2022, p. 3, lines 13-15. See footnote 1.

Table 1-1. Summary of Key SOA Dust Control Requirements		
2018 SOA Requirement	**2019 SOA Amendments**	**2022 SOA Amendments**
Initial Particulate Matter Reduction Actions		
Install 74 acres of wind fencing(A)	Install 48-acre foredune and 4.2 acres of additional long-term dust control in an area approved by the SAG(A)	No change
Install track-out control devices at Grand and Pier Avenue entrances	No change	No change
Particulate Matter Reduction Plan Goals		
Achieve state and federal PM_{10} air quality standards	No change	Eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of state and federal PM_{10} air quality standards
Initially reduce maximum 24-hour PM_{10} baseline emissions by 50%	No change	Initially reduce mass-based PM_{10} emissions within the ODSVRA to a level consistent with the pre-disturbance scenario identified by the SAG
(A) The original SOA74-acre wind fencing requirement was described as "fencing off the foredune areas with a perimeter fence . . . as shown in Map 1 of Attachment 1 . . .". the 48-acre foredune and 4.2 acres of long-term dust controls required by the 2019 SOA amendments represent additional requirements beyond the original 74-acre wind fencing requirement.		

The October 2022 SOA amendments were developed based on the latest scientific understanding of the ODSVRA PM_{10} emissions system, including a comprehensive evaluation of historical vegetation changes at the ODSVRA, modeling of 1939 "pre-disturbance" PM_{10} emissions levels prior to significant off-highway vehicle (OHV) recreation at the ODSVRA, and other scientifically defensible work conducted by the SAG, State Parks, and the SLOAPCD. [5,6]

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[5] It is recognized that human activities, including vehicular traffic, horse riding, hiking, and camping, have been a part of the Oceano Dunes landscape for many decades prior to the establishment of the ODSVRA in the 1970s. There is very limited photographic evidence of landscape configuration prior to the early 1900s when human recreational activities began to influence the natural landscape. The earliest historical aerial photography from the 1930s reflects some level of disturbance, and as such, the term 'pre-disturbance' state is somewhat of a misnomer. Nevertheless, for consistency with the language used in the SOA regarding modeling of a pre-disturbance scenario, the term pre-disturbance will continue to be used throughout.

[6] The SAG's February 7, 2022, memorandum *Scientific Basis for Possible Revision of the Stipulated Order of Abatement* provides information on modeled pre-disturbance conditions (see also Section 2.2.1). This SAG memo

The new requirements align with the goal of identifying the incremental effect of OHV recreation on ODSVRA PM_{10} emissions levels, and the objective of the Dust Control Program to reduce PM_{10} emissions to a level consistent with emissions prior to significant OHV recreation.

This 2023 ARWP builds on State Parks' 2019-2022 ARWP efforts and, where possible, summarizes key parameters of progress, such as 24-hour PM_{10} mass emissions and concentration levels, in a manner that is consistent with previous ARWP efforts; however, the October 2022 SOA amendments limit the information available for this 2023 document. For example, the development of the new framework will require State Parks and the SAG to undertake new technical analyses and work products that can be planned for, but not reported on, as part of this 2023 ARWP. State Parks' 2023 ARWP, therefore, focuses on the activities that State Parks and the SAG will undertake to develop and refine the new excess emissions framework that will form the basis for sustained implementation of the Dust Control Program.

1.1.2 State of the Science Report

As conveyed in this and prior ARWP documents, State Parks, the SAG, and the SLOAPCD have and continue to conduct substantial research to better understand the science of dust emissions, dust controls, and dune restoration at the ODSVRA. In February 2023, the SAG independently published a comprehensive report that synthesizes existing, publicly available white papers, reports, studies, publications, and other materials relevant to understanding dust generation and mitigation at the ODSVRA.[7] The report, entitled "Oceano Dunes: State of the Science," was authored by all SAG members, with input from the SLOAPCD and State Parks, and includes a four-page Executive Summary, followed by seven chapters on specific topics relating to dust control in the Oceano Dunes: 1) Geology and History of the Oceano Dunes, 2) Dust Emissions, 3) Dust Controls, 4) Vegetation Restoration, 5) Restoration of Coastal Foredunes, 6) Modeling of Particular Matter Emission and Dispersion in the Atmosphere, and 7) Air Quality. A final chapter is dedicated to a discussion of outstanding questions that are related to each of the seven, content-specific chapters and that may be relevant to filling information gaps as part of future studies at the ODSVRA. The SAG's state of the science report includes extensive citations to other documents, and it is designed for use by managers and for educating the public on dune processes and dust control strategies.

1.1.3 Scientific Review Process

The information presented in this 2023 ARWP was compiled and/or prepared in accordance with the scientific review process agreed to by State Parks and the SAG in August 2021. This

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is available for review on the following State Parks' website (see the February 17 Commission meeting link "Memo: Scientific Basis for Possible Revision of the Stipulated Order of Abatement (SOA)"): https://ohv.parks.ca.gov/?page_id=30832

[7] The SAG's state of the science report is available for review on the following SLOAPCD website (under "Winter 2023 Update"): https://www.slocleanair.org/air-quality/oceano-dunes-efforts

process establishes procedures by which the SAG, State Parks, and third parties contracted by State Parks prepare, review, and publicly release research and scientific reports related to dust/particulate matter, aeolian processes, dust controls, and/or dune restoration at the ODSVRA. This process streamlines and standardizes the documents, and ensures that they all receive the same level of expert review and are robust and as defensible as possible before they enter the public sphere. Scientific reports directly produced by the SAG, which is an independent entity established by the SOA, are not subject to this process.

Refer to State Parks' 2022 ARWP, Attachment 07, ODSVRA Dust Control Program Scientific Review Process, for the full procedures agreed upon by State Parks and the SAG.

1.1.4 CHANGES IN SAG MEMBERSHIP

State Parks acknowledges and supports changes in SAG membership that have occurred during the 2023 ARWP reporting period (August 1, 2022, to July 31, 2023).

Specifically, the following individuals retired from the SAG: Earl Withycombe of the California Air Resources Board (CARB); SAG Chair Dr. Raleigh Martin; and Dr. William Nickling, the original organizer of the SAG.

Earl Withycombe was replaced by Leah Mathews, also of CARB, who had been an active part of meetings for several months prior to Mr. Withycombe's retirement and so was well briefed on SAG activities.

The SAG coordinated an active effort to replace its other two members. Dr. Bernard Bauer was recruited to take the place of Dr. Raleigh Martin. After a brief period of overlap with Carla Scheidlinger serving as Interim Chair after Dr. Martin's retirement, Dr. Bauer assumed the Chair position of the SAG in February 2023. Dr. Bauer comes to the SAG from the University of British Columbia, where he was a full professor and Dean of Arts & Sciences before his recent retirement. His professional specialties are process geomorphology and aeolian geomorphology.

Dr. Jenny Hand was recruited to take the place of Dr. William Nickling and joined the SAG in March 2023. Dr. Hand is a senior research scientist at the Cooperative Institute for Research in the Atmosphere at Colorado State University. Dr. Hand's research interests include characterizing the physico-chemical, radiative, and hygroscopic properties of atmospheric aerosols using techniques ranging from single-particle analysis to remote sensing.

1.2 DOCUMENT ORGANIZATION AND PREPARATION

This 2023 ARWP document is organized as follows:

- **Chapter 2, Annual Report (August 1, 2022, to July 31, 2023),** describes Dust Control Program activities implemented in the previous 12 months (August 1, 2022, to July 31, 2023), including progress made towards SOA goals.
- **Chapter 3, Work Plan (August 1, 2023, to July 31, 2024),** describes the Dust Control Program activities to be undertaken in the coming 12 months (August 1, 2023, to July 31, 2024), including activities related to the new compliance framework established by the SOA.
- **Chapter 4, Budgetary Considerations,** describes the estimated budget to develop and implement the 2023/2024 Work Plan.
- **Chapter 5, Implementation Schedule,** presents schedules for the Dust Control Program activities to be initiated, undertaken, and/or completed in the coming 12 months.
- **Attachments 01 – 13** present, in their entirety, important documents summarized and/or referenced in specific ARWP discussions.

This 2023 ARWP has been prepared under the supervision of Ronnie Glick, Senior Environmental Scientist, and Jon O'Brien, Environmental Program Manager, Off-Highway Motor Vehicle Recreation Division (OHMVR Division), whom State Parks has designated as the Project Manager for the Dust Control Program pursuant to the SOA, as amended. State Parks developed the 2023 ARWP in consultation and coordination with the SAG ARWP subcommittee.

2 ANNUAL REPORT (AUGUST 1, 2022, TO JULY 31, 2023)

This chapter of the 2023 ARWP reports on Dust Control Program activities undertaken from August 1, 2022, to July 31, 2023; estimates progress towards achieving the dust control requirements of the original SOA and the first amendment to the SOA; and presents additional information on other activities related to the Dust Control Program undertaken by State Parks and/or the SAG. State Parks notes that while the SOA requires State Parks to report on activities "implemented over the previous year" by August 1, 2023, this 2023 ARWP reports on activities that were started more than one year ago (i.e., before August 1, 2022) and completed in the past year (i.e., between August 1, 2022, and July 31, 2023). It also reports on activities started in the past year, which State Parks 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, review, and report the data collected for the Dust Control Program. The year 2022 ARWP actions and results that are not available to State Parks for reporting in this 2023 ARWP will be made available upon request when they are completed.

2.1 REPORT ON DUST CONTROL MEASURES INSTALLED AT THE ODSVRA

State Parks' ODSVRA 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 the ODSVRA.

Dust control projects are control measures that State Parks puts on or into the ground, or otherwise implements, to cover the ground surface or reduce surface disturbance, break the flow of wind across the landscape, and/or reduce or halt saltation and dust generation. The Dust Control Program includes seasonal dust control measures, temporary dust control measures, vegetation dust control measures, and long-term closure of the ODSVRA Western Snowy Plover and California Least Tern nesting exclosure. A seasonal dust control measure is a project that State Parks 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 other broadcast surficial straw treatments, porous roughness elements, and other materials that can sometimes, but not always, be recovered and reused in subsequent dust control projects.[8] State Parks also excludes vehicles from areas (vehicle exclusion areas) and has

[8] Straw bales were used for specific dust control projects and are identified as such (11-SB-01, 14-SB-01, 18-SB-01, and 18-SB-02) in Attachment 01 of this ARWP. Other projects have employed a mix of straw mats, straw blankets, fiber rolls, and blown straw and are collectively referred to in this ARWP as "straw treatment" projects.

explored, in a very limited manner in 2014, the use of soil stabilizers as a form of seasonal and/or temporary dust control at the ODSVRA. In contrast to seasonal and temporary measures like wind fencing, vegetation planted by State Parks at the ODSVRA is generally considered a long-term dust control measure; however, vegetation is subject to fluctuation in growing conditions, burial from sand migration, and other conditions. Similarly, the closure of the ODSVRA's 293.3-acre nesting exclosure prohibits vehicular and non-vehicular recreation from occurring. According to the SAG, "it is known that there is a gradient toward reduced emissivity to the south, likely due to increasing grain size. In addition, the absence of OHV traffic has allowed natural vegetation to take hold and incipient foredunes to evolve. The combination of surface topography and placement of large woody debris (for habitat improvement) has the effect of reducing surface shear stress on intervening open sand surface, which may lead to dust control benefits. Thus, the areal extent and intensity of saltation are reduced (i.e., less dust emitted) and the potential for sand deposition is enhanced (i.e., burial of extant dust in surface sediments)."[9] State Parks manages the nesting exclosure area for multiple purposes, including nesting. While the closure may support the natural progression of foredune formation and reduced saltation in this area, other management activities may not support foredune progression.

Finally, State Parks also implements a track-out control program to prevent track-out of sand onto the Grand Avenue and Pier Avenue entrances to the ODSVRA.

State Parks' report on ODSVRA dust control measures as of July 31, 2023, is provided below.

2.1.1 Dust Control Measures Installed Between August 1, 2022, and July 31, 2023

From August 1, 2022, to July 31, 2023, State Parks did not install new dust control projects at ODSVRA but did:

- Convert 27.3 acres of existing, temporary wind fencing and straw treatment measures to native dune vegetation[10]
- Conduct supplemental plantings in 20.2 acres of existing vegetation plots
- Maintain 32.5 acres of existing wind fencing and 5.0 acres of straw treatments installed as part of the 2020 ARWP
- Seasonally close 34.6 acres of land inside the ODSVRA open riding and camping area
- Maintain the long-term closure of the 293.3-acre nesting exclosure, which has a dust

[9] See the SAG's comments on State Parks' August 1, 2023 Draft ARWP, available on the following SLOAPCD website (under "Summer 2023 Update, First Draft ARWP and Reviews"): https://www.slocleanair.org/air-quality/oceano-dunes-efforts

[10] As recommended by the SAG, the main body of this ARWP document and Attachment 01 to this ARWP report the size of dust control measures to the nearest tenth of an acre, with acreage values rounded up (values 0.05 and above) or down (values below 0.05) to the nearest tenth of an acre as necessary.

emissions reduction effect by way of reducing saltation and promoting deposition in developing foredunes

The dust control projects implemented by State Parks from August 1, 2022, to July 31, 2023, are listed in Table 2-1, shown in Figure 2-1, and briefly summarized below. Refer to Attachment 01, 2011 to 2023 Dust Control Measures, for additional maps showing historical dust control measure locations, the dust control measures installed between August 1, 2022, and July 31, 2023, and all dust control measures in place as of July 31, 2023.

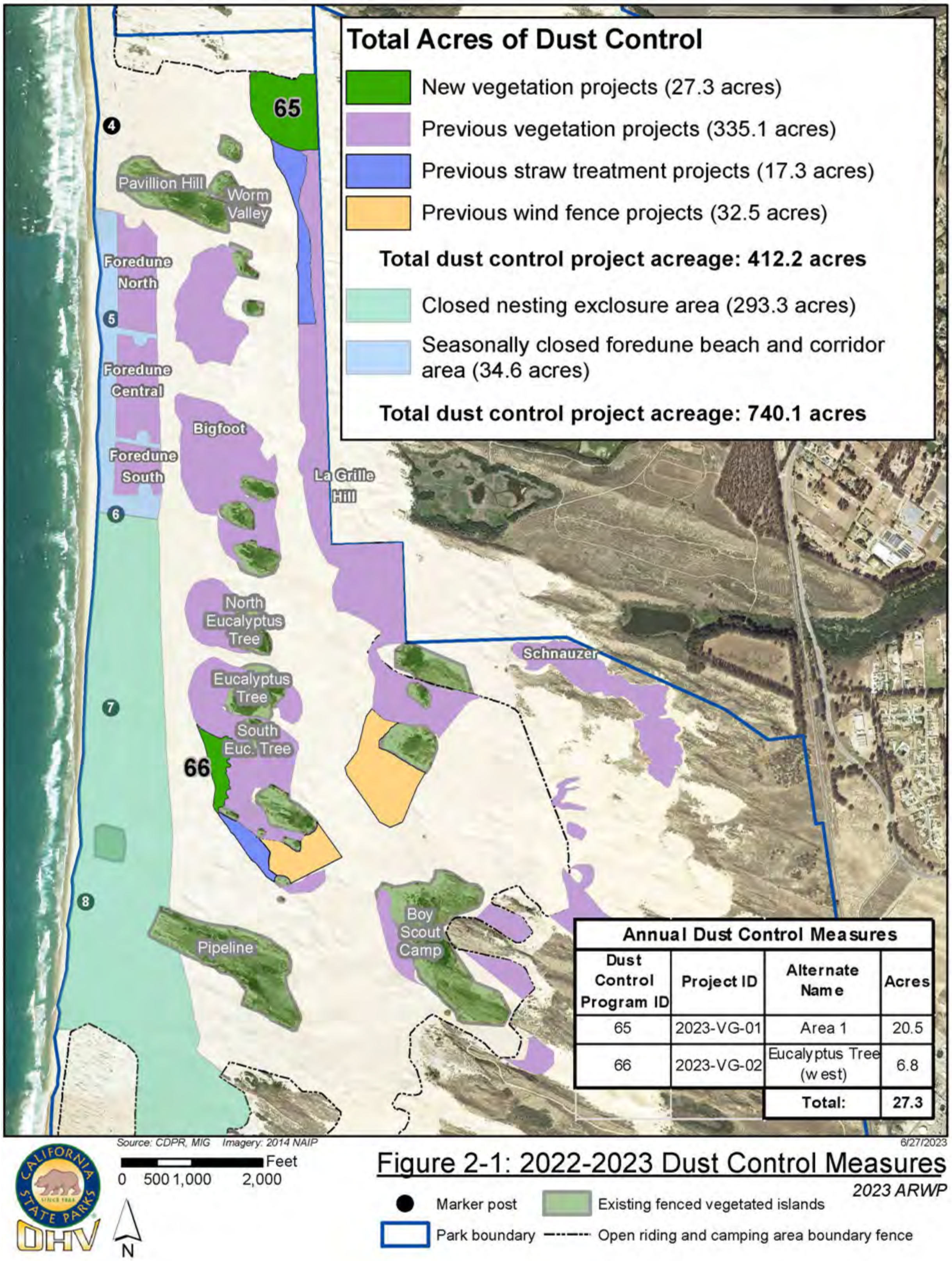
Table 2-1. Dust Control Measures Installed from August 1, 2022, to July 31, 2023

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)
Converted Dust Control Projects				
65	23-VG-01	Converted to Vegetation	Long-Term	20.5
66	23-VG-02	Converted to Vegetation	Long-Term	6.8
Subtotal, Converted Dust Control Projects				*27.3*
New Dust Control Projects				
Not Applicable				--
Subtotal, New Dust Control Projects				*0.0*
Total Dust Control Measure Acreage Installed August 1, 2022, to July 31, 2023				**27.3**

(A) State Parks has implemented a series of dust control projects at the ODSVRA 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 vegetation project in 2023 (ID #66). For projects installed in the same dust control year (defined from August 1 of one year to July 31 of the next year), 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, "22-VG-05" is the fifth vegetation treatment project installed in the 2022 dust control year (identified from north to south). "ST" refers to straw treatment, "WF" refers to wind fencing, "TV" refers to temporary vehicle exclusion area, and "VG" refers to vegetation.

Figure 2-1. 2022-2023 Dust Control Measures



Annual Dust Control Measures

Dust Control Program ID	Project ID	Alternate Name	Acres
65	2023-VG-01	Area 1	20.5
66	2023-VG-02	Eucalyptus Tree (west)	6.8
		Total:	**27.3**

2.1.1.1 New Vegetation/Temporary Dust Control Measures

Consistent with State Parks' Primary Work Plan from the approved 2022 ARWP, no new vegetation measures were planted and no new temporary straw treatment, wind fence, or vehicle exclusion measures were installed at the ODSVRA between August 1, 2022, and July 31, 2023.[11]

2.1.1.2 Conversion of Existing Temporary Measures to Long-Term Vegetation

In fall 2022 and winter 2023, State Parks converted 27.3 acres of temporary wind fencing and straw treatment measures to long-term vegetation dust control measures, as follows:

- Vegetation measure 23-VG-01 (20.5 acres) is located in the northeast corner of the open riding and camping area. This measure replaced 20.5 acres of wind fencing installed in 2020 (20-WF-01; see Attachment 01, Figure A01-11).
- Vegetation measure 23-VG-02 (6.8 acres) is located west of the South Eucalyptus Tree and Tabletop vegetation islands, in the center of the ODSVRA open riding and camping area, between marker posts 7 and 8. This measure replaced 6.8 acres of an 11.8-acre straw treatment installed in 2021 (22-ST-02; see Attachment 01, Figure A01-12).

In total, State Parks planted 70,641 plants and spread 302 pounds of native dune seed and 1,350 pounds of sterile seed in the two converted vegetation projects identified above. Refer to Attachment 02, 2022/2023 ODSVRA Dust Control Program Vegetation Restoration Projects, for a detailed breakdown of converted vegetation areas, the type of species planted, and the amount of native and non-native seeding (pounds applied) and planting (number of seedlings planted) activity in each treatment area.

2.1.1.3 Supplemental Vegetation Plantings

From fall 2022 to spring 2023, State Parks planted 51,083 plants and spread approximately 215 pounds of native dune seed and 1,000 pounds of sterile seed in areas previously treated with native vegetation. In total, these supplemental planting and seeding activities covered approximately 20.2 acres of previously treated areas. Supplemental planting and seeding activities often focus on the west-facing portions of vegetation installations where direct wind and sand activity bury or undermine treatments. Some supplemental planting and seeding areas require straw, while others do not. The areas that received supplemental planting and seeding during the 2022/2023 planting season included 2.8 acres at the North Eucalyptus Tree vegetation island (22-VG-04), 14.9 acres at the Eucalyptus Tree Center vegetation island (22-

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[11] For the period August 1, 2022, to July 31, 2023, State Parks did not plant new vegetation in areas that were previously managed for dust control purposes. In previous ARWP documents the vegetation planted in areas previously controlled with temporary or seasonal dust control measures was identified as "new" vegetation for mapping purposes because it did previously exist in the dunes. Thus, Figure 2-1 shows 27.3 acres of new vegetation, even though this acreage was already managed for dust control purposes.

VG-09, previously only seed treatment), 1.5 acres at Eucalyptus Tree vegetation island (22-VG-05), and 1.1 acres east of the North Eucalyptus Tree vegetation island and south of La Grille Hill (perpendicular to marker post 6;22-VG-03; see Attachment 01, Figures A01-13).

Refer to Attachment 02 for a detailed breakdown of the supplemental planting and seeding 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.

While State Parks' supplemental vegetation planting and seeding activities may be necessary to support the establishment and success of a vegetation project, such activities (in terms of acres of supplemental plantings) are not reported in this section or Table 2-1 because these activities take place in project areas that have already been reported on in prior ARWP documents and counted as vegetation dust control projects (see Section 2.1.2).

2.1.1.4 Maintenance of Existing Temporary Dust Control Measures

State Parks maintained 32.5 acres of existing wind fencing projects and 5.0 acres of existing straw treatment projects installed at the ODSVRA before August 1, 2022. These include projects 21-WF-01 (21.7 acres) in the center of the open riding and camping area (perpendicular to marker post 7); 21-WF-02 (10.8 acres) south of the Tabletop vegetation island, also in the center of the open riding and camping area; and 22-ST-02 (5.0 remaining acres from an 11.8-acre project), located west of the South Eucalyptus Tree and Tabletop vegetation islands, in the center of the ODSVRA open riding and camping area, between marker posts 7 and 8 (see Attachment 01, A01-12 and A01-13). Maintenance activities were limited to repositioning fallen fencing material to maintain historical design control values for wind fencing arrays.

2.1.1.5 Seasonal Closure of Foredune Beach and Transportation Corridor Areas

State Parks installation of a 48-acre foredune at the end of 2019 resulted in a narrow beach area to the west of the foredune project and transportation corridors in between different foredune treatment areas, as well as a small corridor to the south of the foredune project, between the foredune project and the nesting exclosure (see Figure 2-1). These areas are potentially subject to Western Snowy Plover and California Least Tern nesting activity during the breeding season. Consistent with management activities since 2020, State Parks installed temporary fencing around these areas to protect potential nest sites. Thus, foredune, beach and corridor areas were seasonally closed for approximately seven months from March 1, 2022, to September 30, 2022. The foredune, beach and corridor areas were again seasonally closed on March 1, 2023.

2.1.1.6 Western Snowy Plover Exclosure

In October 2021, State Parks closed the 293.3-acre nesting exclosure area to vehicular and non-vehicular recreation.[12] Since then, State Parks has installed more permanent metal fencing in the southeast part of the exclosure. State Parks also actively maintains the perimeter fencing.

2.1.2 Cumulative Dust Control Measures Installed As of July 31, 2023

As of July 31, 2023, 40 dust control projects are in the ground at the ODSVRA. State Parks actively manages and maintains each of these projects. In total, the 40 dust control projects plus the closed nesting exclosure area and seasonally closed foredune beach and corridor area occupy 740.1 acres of land at the ODSVRA. The dust control measures in the ground at the ODSVRA as of July 31, 2023, are summarized 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 July 31, 2023.

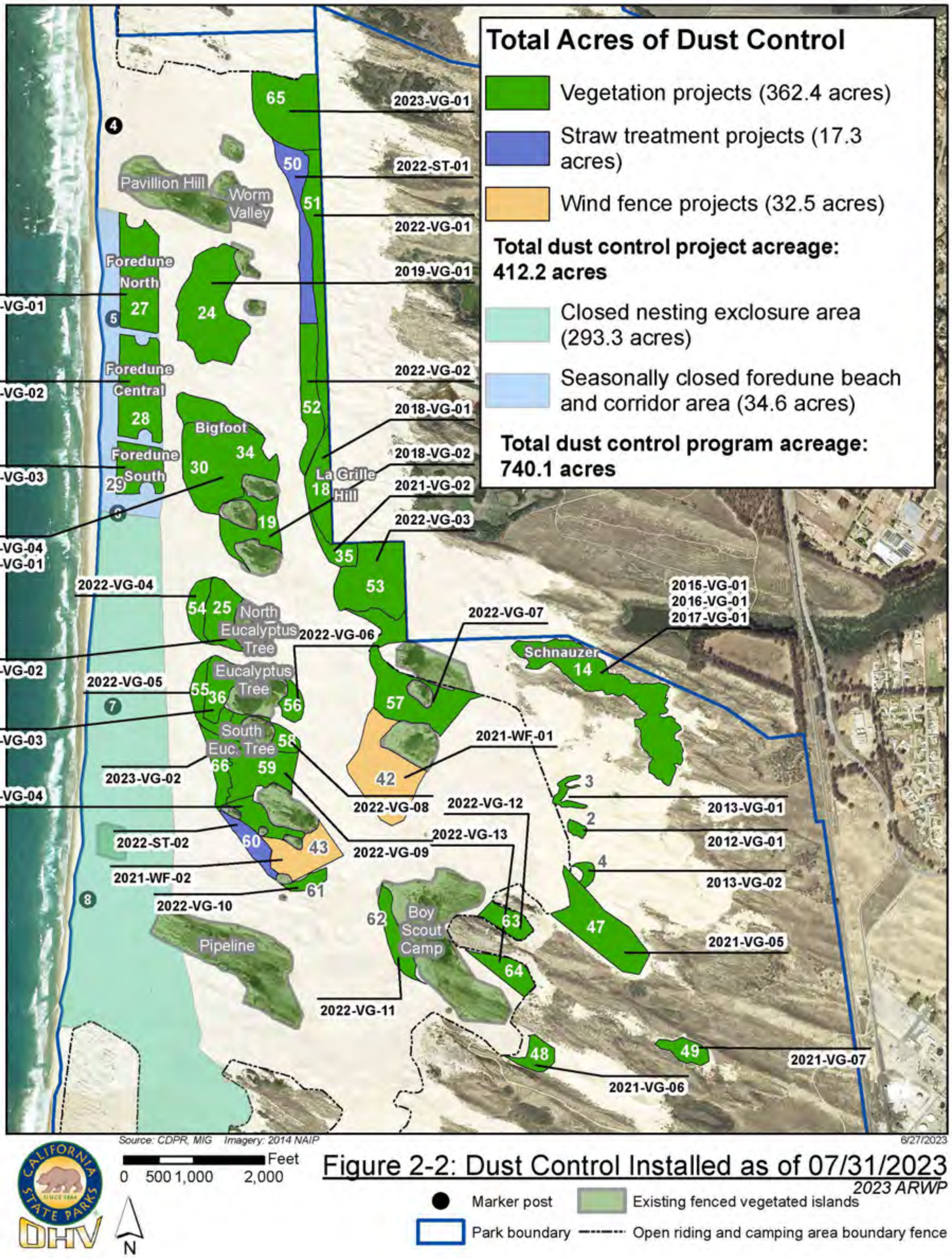
Table 2-2. Cumulative Dust Control Measures Installed as of July 31, 2023

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	ODSVRA Total
Vegetation Dust Control Measures				
Foredune	3	48.0	0.0	48.0
Backdune	33	238.5	75.9	314.4
Subtotal	*36*	*286.5*	*75.9*	*362.4*
Seasonal and/or Temporary Dust Control Measures				
Straw treatment	2	17.3	0.0	17.3
Wind fencing	2	32.5	0.0	32.5
Temporary vehicle exclosure	0	0.0	0.0	0.0
Other(B)	0	0.0	0.0	0.0
Subtotal	*4*	*49.8*	*0.0*	*49.8*
Other Operational Activity				
Closed nesting exclosure area	-	293.3	0.0	293.3
Seasonally closed foredune beach and corridor area	-	34.6	0.0	34.6
Subtotal	-	*327.9*	*0.0*	*327.9*
Totals(C)	**40**	**664.2**	**75.9**	**740.1**

(A) Value reflects the number of projects in the ground as of July 31, 2023, 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.
(C) Without the nesting exclosure and foredune beach and corridors, there are 336.3 acres of dust control inside the open riding and camping area and 412.2 total acres of dust control at the ODSVRA.

[12] The decision to close this area was an operational choice. If State Parks elects to reopen this area in the future, State Parks would, in coordination with the SAG and the SLOAPCD, simultaneously identify and close other areas for dust control that equal the credited mass emissions reductions occurring from the 293.3-acre exclosure area.

Figure 2-2. Dust Control Measures Installed as of July 31, 2023



2.2 REPORT ON PROGRESS TOWARDS SOA GOALS

The SOA, as amended, establishes project, emission reduction, and air quality standard requirements that have changed over time, as follows:

- Condition 1.a of the original SOA required State Parks to fence off a foredune area (identified in Map 1 of Attachment 1 of the original SOA) and install 74 acres of wind fencing projects by September 15, 2018 (referred to as initial particulate matter reduction actions, or "Initial SOA" dust control measures). In addition, the November 2019 amendments to the SOA required State Parks to finish installing perimeter fencing for a 48-acre foredune area and complete an additional 4.2 acres of vegetation in an area approved by the SAG. The October 2022 amendments to the SOA did not modify these requirements. As of August 1, 2022, State Parks has complied with all SOA project-specific requirements, such as the installation of a 48-acre foredune, and continues to maintain all installed projects. Compliance with project-specific requirements is described in detail in State Parks' 2022 ARWP and is not discussed further in this 2023 ARWP.[13]
- Condition 1.c of the original SOA required State Parks to install SLOAPCD-approved sand track-out control devices at the Grand and Pier Avenue entrances to the ODSVRA. This requirement was not modified by the November 2019 or October 2022 SOA amendments. State Parks' track-out control activities are discussed in Section 2.2.5.
- Condition 2.b of the original SOA required State Parks' PMRP to be designed to achieve the state and federal ambient air quality standards for PM_{10}. These standards are typically referred to as the California Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Standards (NAAQS) and are mass concentration-based standards that require measurement and analysis of ambient air to determine compliance with the standard. In California, the state has set 24-hour average and annual arithmetic mean standards of 50 micrograms per cubic meter ($\mu g/m^3$) and 20 $\mu g/m^3$, respectively. The United States Environmental Protection Agency (USEPA) has set a 24-hour average standard of 150 $\mu g/m^3$ but does not maintain an annual arithmetic mean for PM_{10}. Progress towards compliance with original SOA Condition 2.b is measured by evaluating modeled and actual measured concentrations of PM_{10} concentrations at the SLOAPCD's CDF and Mesa2 air quality monitoring stations. To provide continuity with past ARWP documents, progress towards meeting the state and federal ambient air quality standards is discussed in Section 2.2.3. The November 2019 SOA amendments did not modify this original SOA requirement; however, the October 2022 SOA amendments replaced absolute compliance with these standards with a

[13] See State Parks' 2022 ARWP, Section 2.2.2

requirement to eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal ambient air quality standards.[14]

- Condition 2.c of the original SOA required the PMRP to reduce maximum 24-hour PM_{10} baseline emissions by 50%. This requirement is assessed through air quality modeling to define the baseline emissions conditions from May 1, 2013, through August 31, 2013, before any major dust controls were implemented. After the issuance of the original SOA, baseline emissions conditions were defined as the PM_{10} mass emissions occurring within the ODSVRA open riding and camping area, as averaged over the 10 most emissive days from May 1, 2013, to August 31, 2013. In contrast to the CAAQS and NAAQS, which are mass concentration-based standards, this requirement is a mass emissions-based standard. Progress towards compliance with original SOA Condition 2.c is measured by modeling and identifying the maximum amount of PM_{10} mass (e.g., metric tons per day) emitted by the ODSVRA open riding and camping area during the 2013 baseline period, inputting dust control measures into the model, and determining the total reduction in PM_{10} mass achieved by the dust control measures based on the use of the air quality model. To provide continuity with past ARWP documents, progress towards achieving baseline emissions reductions is discussed in Section 2.2.2. The November 2019 SOA amendments did not modify this original SOA requirement; however, the October 2022 SOA amendments replaced the requirement to reduce baseline emissions by 50% (as compared to 2013 conditions) with a requirement to reduce PM_{10} mass emissions to a level consistent with the pre-disturbance scenario identified by the SAG (see Section 2.2.1).

2.2.1 SAG-Recommended Pre-Disturbance Scenario

State Parks' 2022 ARWP summarized the results of a SAG-led effort to identify potential scientifically informed refinements to the original SOA target of reducing PM_{10} emissions from the ODSVRA open riding and camping area by 50% relative to 2013 modeled baseline conditions. The proposed refinements, which were informed by improved understanding and modeling of historical and current PM_{10} emissions from the ODSVRA, were based on a comprehensive determination of the difference in PM_{10} emissions between the SOA 2013 baseline scenario and a historical pre-disturbance scenario identified to simulate conditions prior to significant OHV recreation (referred to in this 2023 ARWP as the "original" pre-

[14] The SOA's requirement to eliminate emissions in excess of naturally occurring emissions is not related to the Federal Clean Air Act's "exceptional" events provisions. An exceptional event is an unusual or naturally occurring event that can affect air quality but cannot be reasonably controlled by an air agency, such as wildfires, high wind dust events, volcanic activities, and other exceptional events. Emissions of dust and PM_{10} from ODSVRA are not considered exceptional events.

disturbance model or modeling scenario). Refer to State Parks' 2022 ARWP for more detailed information on the SAG-recommended original pre-disturbance modeling scenario.[15]

The SLOAPCD has indicated that the emissions reporting and comparison provided in State Parks' 2022 ARWP was not "apples to apples" because the original pre-disturbance model relied on an emissivity grid that was different from the emissivity grid incorporated into the model used to evaluate the effectiveness of the ODSVRA Dust Control Program in the 2022 ARWP. [16,17] Accordingly, State Parks, in coordination with the SAG, asked the Desert Research Institute (DRI) to model a 1939 pre-disturbance scenario using land cover conditions (i.e., vegetation mask) at that time coupled with the same emissivity grid incorporated into the model used by DRI to evaluate the effectiveness of the Dust Control Program. This updated pre-disturbance modeling scenario is referred to in this 2023 ARWP as the "revised" pre-disturbance model or modeling scenario. This modeling approach results in both 1939 pre-disturbance mass emissions estimates and Dust Control Program mass emissions estimates that are based on the same emissivity grid (derived from Portable In-Situ Wind Erosion Laboratory [PI-SWERL] data).

To provide continuity with the 2022 ARWP, this 2023 ARWP compares the Dust Control Program status against the original SOA requirements, the original pre-disturbance modeling scenario, and the revised pre-disturbance modeling scenarios. For ease of reference, the baseline and pre-disturbance modeling scenario results are summarized in Table 2-3, Table 2-4, and Table 2-5.

[15] See State Parks' 2022 ARWP, Section 2.2.1.
[16] In general, emissivity refers to how emissive or how much dust and PM_{10} are emitted from ODSVRA sand surfaces, as determined through Portable In-Situ Wind Erosion Laboratory (PI-SWERL) testing. Emissivity varies throughout the ODSVRA, and the air quality modeling conducted in accordance with the SOA incorporates a spatial grid into the modeling domain that accounts for changes in emissivity in different areas of the ODSVRA.
[17] While, in general, there are several differences between the model used to estimated pre-disturbance emission and the model used to evaluate the Dust Control Program. Both the SAG and the SLOAPCD, in their comments on State Parks' 2022 ARWP, identified the different emissivity grids used in the different models as key limit to the direct comparison of the respective result for each model.

Table 2-3. Modeled Baseline and Pre-Disturbance PM_{10} Mass Emissions

Variable	Previous SOA Baseline and Target Metrics(A)		1939 Pre-Disturbance Modeling Scenarios(B)		
	2013 Modeled Baseline	SOA Target	Original (2013 through 2019 PI-SWERL Data)	Revised Scenario 1 (2013 PI-SWERL Data)	Revised Scenario 2 (2019 PI-SWERL Data)
PM_{10} mass emissions (metric tons per day)	182.8	91.4	108.4	130.4	83.2
Percent reduction relative to 2013 baseline	--	50.0%	40.7%	28.7%	54.5%

(A) The original SOA and November 2019 SOA amendments set a requirement to achieve a 50% reduction in maximum modeled PM_{10} baseline mass emissions, as averaged over the 10 highest emission days as determined by the DRI model from May 1, 2013, to August 1, 2013. The October 2022 SOA amendments replaced this requirement with a new excess emissions requirement (see fourth bullet under Section 2.2).

(B) The primary difference between the original pre-disturbance modeling scenario presented in the 2022 ARWP and the revised pre-disturbance modeling scenarios presented in this 2023 ARWP is the emissivity grid. Whereas the original pre-disturbance modeling scenario emissivity grid was based on 2013 through 2019 PI-SWERL data, the revised scenarios are based on only either the 2013 PI-SWERL data (scenario 1) or the 2019 PI-SWERL data (scenario 2).

Table 2-4. Modeled Baseline and Pre-Disturbance 24-Hour Average PM_{10} Concentrations (CDF)

Variable	Previous SOA Baseline and Target Metrics(A)		1939 Pre-Disturbance Modeling Scenarios		
	2013 Modeled Baseline	SOA Target	Original (2013 through 2019 PI-SWERL Data)	Revised Scenario 1 (2013 PI-SWERL Data)	Revised Scenario 2 (2019 PI-SWERL Data)
24-hour average PM_{10} concentration ($\mu g/m^3$)	124.7	50.0	88.0	Results not available(B)	
Percent reduction relative to 2013 baseline	--	59.9%	29.4%	Results not available(B)	

(A) The original SOA and November 2019 SOA amendments set a requirement to achieve ambient air quality standards. The October 2022 SOA amendments replaced this requirement with a new excess emissions requirement (see third bullet under Section 2.2).

(B) State Parks does not plan to commission this modeling work because the October 2022 SOA amendments focus on reducing excess emissions instead of compliance with absolute air quality standards.

Table 2-5. Modeled Baseline and Pre-Disturbance 24-Hour Average PM_{10} Concentrations (Mesa2)					
Variable	**Previous SOA Baseline and Target Metrics**[(A)]		**1939 Pre-Disturbance Modeling Scenarios**		
	2013 Modeled Baseline	**SOA Target**	**Original (2013 through 2019 PI-SWERL Data)**	**Revised Scenario 1 (2013 PI-SWERL Data)**	**Revised Scenario 2 (2019 PI-SWERL Data)**
24-hour average PM_{10} concentration ($\mu g/m^3$)	97.5	50.0	71.2	Results not available[(B)]	
Percent reduction relative to 2013 baseline	--	48.7%	27.0%	Results not available[(B)]	

(A) The original SOA and November 2019 SOA amendments set a requirement to achieve ambient air quality standards. The October 2022 SOA amendments replaced this requirement with a new excess emissions requirement (see third bullet under Section 2.2).
(B) State Parks does not plan to commission this modeling work because the October 2022 SOA amendments focus on reducing excess emissions instead of complying with absolute air quality standards.

2.2.1.1 DRI Model Assumptions

State Parks' 2022 ARWP summarized SAG recommendations for changing the "current" DRI air quality model to more accurately estimate and account for PM_{10} emissions reductions from State Parks' Dust Control Program and presented results using both the current and a "revised" DRI model.[18]

This 2023 ARWP uses only the revised DRI model, which has been further updated since approval of the 2022 ARWP to incorporate the SAG's latest, scientifically defensible information, as well as conditions stipulated by the SLOAPCD as part of its 2022 ARWP approval.[19] The revised DRI models used in the 2022 ARWP and 2023 ARWP are different with respect to three key parameters:

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[18] See State Parks' 2022 ARWP, Sections 2.2.1.2 and 2.2.1.3. The "DRI air quality model" is the model used to evaluate the effectiveness of the Dust Control Program. The DRI air quality model is similar to, but separate from, the baseline and pre-disturbance modeling scenarios against which the effectiveness of the Dust Control Program is compared.

[19] The SLOAPCD's 2022 ARWP conditional approval letter is available on the following SLOAPCD website (under "Fall 2022 Update, Second Draft and Reviews"): https://www.slocleanair.org/air-quality/oceano-dunes-efforts

- **Nesting exclosure area emissivity:** The revised DRI model now incorporates actual 2022 PI-SWERL emissivity observations measured in the nesting exclosure area (see Section 2.3.5.2).[20,21]
- **Foredune restoration area emissivity:** The revised DRI model now incorporates actual 2022 PI-SWERL emissivity observations measured in the primary foredune restoration area (i.e., not including the seasonally closed foredune beach and corridor area (see Section 2.3.5.2).[22]
- **Seasonal foredune beach and transportation corridor emissivity:** The revised DRI model now incorporates a weighted average emissivity relation based on PI-SWERL measurements made on the beach to the west of the 48-acre foredune restoration area and in transportation corridor areas during periods of time when these areas were open to vehicular recreation (58 PI-SWERL tests between 2013 and 2022) and closed to vehicular recreation (45 PI-SWERL tests from 2022). The emissivity relation is defined as the average of the two emissivity values (open and closed to vehicular recreation) and the resulting best fit power relation for the collected PI-SWERL data (see Section 2.3.5.2).[23]

The key model assumptions used in the baseline (per the original SOA), original and revised DRI pre-disturbance scenarios, and 2022 and 2023 ARWP dust control scenarios are summarized in Table 2-6.

[20] DRI's best fit power emissivity relations for the nesting exclosure, foredune restoration area, and seasonal foredune beach and transportation corridors were estimated using the regression algorithm in Microsoft Excel for the mean values of the emissivity for u_* or revolutions per minute in the PI-SWERL testing sequence.
[21] The emissivity (F), in terms of milligrams per square meter per second (mg/m^2s), as a function of shear velocity (u_*), in terms of meters per second, for the nesting exclosure area is $F=7.847\ u_*^{7.1084}$.
[22] The emissivity as a function of shear velocity for the foredune restoration area (all 48 acres) is $F=10.286\ u_*^{7.1924}$.
[23] The weighted average emissivity as a function of shear velocity for the seasonal foredune beach and corridor area (all 34.6 acres) is $F=10.096\ u_*^{5.3521}$.

Table 2-6. Comparison of Key Assumptions Used in DRI Models

Variable	2013 Modeled Baseline	2022 ARWP		2023 ARWP	
		Original 1939 Pre-Disturbance Scenario	Dust Control Scenario	Revised 1939 Pre-Disturbance Scenarios	Dust Control Scenario
PI-SWERL emissivity grid	2013 emissivity grid	Three latitudinal zones of the riding area are defined using 2013-2019 PI-SWERL non-riding area data for the same three zones	2019 emissivity grid	Three latitudinal zones of the riding area are defined using 2013 (scenario 1) or 2019 (scenario 2) PI-SWERL non-riding area data for the same three zones	2013 or 2019 emissivity grid (unless otherwise indicated)[(A)]
Vegetation mask	2013	1939	2013	1939	2013
PM_{10} emissions inside of wind fence arrays	2013 emissivity grid	2013-2019 zonal emissivity grid	100% effective	2013 (scenario 1) or 2019 (scenario 2) zonal emissivity grid	72% effective
PM_{10} emissions inside the 48-acre foredune project	2013 emissivity grid	2013-2019 zonal emissivity grid	Mean emissivity of all non-riding areas	2013 (scenario 1) or 2019 (scenario 2) zonal emissivity grid	Actual 2022 PI-SWERL measurements
PM_{10} emissions inside the closed nesting exclosure	2013 emissivity grid	2013-2019 zonal emissivity grid	50% of mean emissivity inside nesting exclosure based on amalgamating PI-SWERL non-riding data available from 2013 through 2019	2013 (scenario 1) or 2019 (scenario 2) zonal emissivity grid	Actual 2022 PI-SWERL measurements
PM_{10} emissions downwind of the 48-acre foredune project and closed nesting exclosure	No credit applied	No credit applied	Emissivity reduction based on computational fluid dynamics modeling	No credit applied	Emissivity reduction based on computational fluid dynamics modeling
PM_{10} emissions from seasonally closed foredune beach and transportation corridors	2013 emissivity grid	2013-2019 zonal emissivity grid	Mean emissivity of all non-riding areas	2013 (scenario 1) or 2019 (scenario 2) zonal emissivity grid	2013-2022 PI-SWERL (weighted average)

(A) As described in this table, certain specific areas were modeled using actual 2022 measurements or weighted average emissivity data

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2.2.2 Report on Progress Towards Mass Emissions Reductions

The current DRI air quality model estimates the maximum amount of PM_{10} mass (e.g., metric tons per day) emitted by the dune surfaces in the ODSVRA open riding and camping area during the stipulated 2013 baseline period to be 182.8 metric tons per day.[24] As explained in Section 2.2.1.1, for this 2023 ARWP, State Parks' progress in reducing modeled baseline PM_{10} mass emissions is estimated using the latest version of the revised DRI air quality model. See Attachment 03 for DRI model estimates of baseline mass emission reductions.

2.2.2.1 Mass Emissions Reductions

This 2023 ARWP summarizes State Parks' progress in reducing modeled PM_{10} mass emissions as of July 31, 2023, for four different modeling scenarios. Progress is compared against 1) the SOA's previous baseline requirement (reduce mass emission by 50% compared to 2013 baseline conditions), 2) the original pre-disturbance modeling scenario, 3) the revised pre-disturbance modeling scenario (2013 PI-SWERL emissivity grid), and 4) the revised pre-disturbance modeling scenario 2 (2019 PI-SWERL emissivity grid. The results of the modeling are summarized as follows:

- Table 2-7 compares the Dust Control Program against the previous SOA baseline and original 1939 pre-disturbance modeling scenario. As shown in this table, the ODSVRA Dust Control Program has, as of July 31, 2023, reduced baseline PM_{10} mass emissions from 182.8 metric tons per day to 100.9 metric tons per day, a reduction of 81.9 metric tons per day (182.8 – 100.9 = 81.9) or a 44.8% reduction in modeled baseline mass emissions (compared to the 50% reduction previously required by the SOA). The total modeled PM_{10} mass emissions estimate of 100.9 metric tons per day is below the estimated PM_{10} mass emissions from the ODSVRA open riding and camping area as modeled under the original pre-disturbance scenario (108.4 metric tons per day).
- Table 2-8 compares the Dust Control Program against the revised 1939 pre-disturbance modeling scenario 1, which incorporates only the 2013 PI-SWERL emissivity grid into the pre-disturbance and Dust Control Program model runs. As shown in this table, the ODSVRA's total modeled PM_{10} mass emissions estimate is 112.3 metric tons per day as of July 31, 2023. This value is below the estimated PM_{10} mass emissions from the ODSVRA open riding and camping area occurring under the revised pre-disturbance modeling using the 2013 PI-SWERL emissivity grid (130.4 metric tons per day).
- Table 2-9 compares the Dust Control Program against the revised 1939 pre-disturbance modeling scenario 2, which incorporates only the 2019 PI-SWERL emissivity grid into the

[24] One metric ton is equal to 1.1 short tons (U.S. tons). One metric ton is approximately 2,204.6 pounds, while one U.S. ton is 2,000 pounds.

pre-disturbance and Dust Control Program model runs. As shown in this table, the ODSVRA's total modeled PM_{10} mass emissions estimate is 100.9 metric tons per day as of July 31, 2023. This value is above the estimated PM_{10} mass emissions from the ODSVRA open riding and camping area occurring under the revised pre-disturbance modeling using the 2019 PI-SWERL emissivity grid (83.2 metric tons per day).

Table 2-7. Modeled PM_{10} Mass Emissions at ODSVRA through July 31, 2023 – Comparison to Previous SOA Baseline and Original 1939 Pre-Disturbance Modeling Scenarios

Model Scenario/Evaluation	Acres Controlled	PM_{10} Mass Emissions (metric tons per day)	Percent Reduction in PM_{10} Mass Emissions from 2013 Baseline
2013 baseline emissions from open riding and camping area (no dust control measures in place)(A)	0	182.8	0.0%
Total emissions reported from cumulative dust control measures in place as of July 31, 2022(B)	740.1	103.8	-43.2%
Dust control measures converted between August 1, 2022, and July 31, 2023, and emissions reporting changes resulting from 2023 DRI model updates(C)	--	*-2.9*	*-1.6%*
Dust Control Program status as of July 31, 2023(D)	**740.1**	**100.9**	**-44.8 %**
Original 1939 pre-disturbance scenario(E)	**-**	**108.4**	**-40.7%**
Original SOA Condition 2.c goal(F)	**--**	**91.4**	**-50.0%**

Source: DRI, 2023 (see Attachment 03)

(A) Pursuant to the SOA, the 2013 modeled baseline for mass emissions is based on emissions from the ODSVRA open riding and camping area only; however, the mass emissions reductions needed to comply with the SOA, as amended, may occur from both inside and outside the open riding and camping area.

(B) State Parks' 2022 ARWP, Table 2-11, reported that the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2022, reduced 2013 modeled baseline mass emission from 182.8 metric tons per day to 100.4 metric tons per day, a reduction of 82.4 metric tons per day. This equals a 45.1% reduction in 2013 modeled baseline emissions (82.4/182.8 = 45.1%). The 100.4 value reported inadvertently double-counted 3.4 metric tons of emissions reductions from the 48-acre foredune project. The revised estimate of cumulative mass emissions reductions is therefore 100.4 + 3.4 = 103.8 metric tons per day, a reduction of 79.0 metric tons per day, or a 43.2% reduction in 2013 modeled baseline emissions (79.0/182.8 = 43.2%).

(C) State Parks converted 27.3 acres of temporary dust control measures to vegetation during the reporting period of August 1, 2022, to July 31, 2023 (see Section 2.1.1.2). This activity did not increase the acres of land managed for dust control purposes. The changes to the DRI modeling incorporated into this 2023 ARWP (see Section 2.2.1.1) result in a net decrease in PM_{10} emissions equal to 2.9 metric tons per day, as compared to the modeling reported in the 2022 ARWP. This equals a 1.6% decrease in 2013 modeled baseline emissions (2.9/182.8 = 1.6%).

(D) The DRI modeling conducted for this 2023 ARWP estimates that the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2023, have reduced 2013 modeled baseline mass emissions from 182.8 metric tons per day to 100.9 metric tons per day, a reduction of 81.9 metric tons per day. This equals a 44.8% reduction in 2013 modeled baseline emissions (81.9/182.8 = 44.8%).

(E) The original 1939 pre-disturbance modeling scenario is based on 2013-2019 PI-SWERL emissivity data (refer to Section 2.2.1 for pre-disturbance model details).

(F) A 50% reduction in 2013 baseline mass emissions (182.8 metric tons per day) equals 91.4 metric tons per day.

Table 2-8. Modeled PM_{10} Mass Emissions at ODSVRA through July 31, 2023 – Comparison to Revised 1939 Pre-Disturbance Modeling Scenario 1 (2013 PI-SWERL Data)			
Model Scenario/Evaluation	**Acres Controlled**	**PM_{10} Mass Emissions (metric tons per day)**	**Pre-Disturbance Emissions Exceeded?**
Dust Control Program status as of July 31, 2023	**740.1**	**112.3**	**No**
Revised 1939 pre-disturbance scenario 1	**-**	**130.4**	**-**
Source: DRI, 2023 (see Attachment 03)			

Table 2-9. Modeled PM_{10} Mass Emissions at ODSVRA through July 31, 2023 – Comparison to Revised 1939 Pre-Disturbance Modeling Scenario 2 (2019 PI-SWERL Data)			
Model Scenario/Evaluation	**Acres Controlled**	**PM_{10} Mass Emissions (metric tons per day)**	**Pre-Disturbance Emissions Exceeded?**
Dust Control Program status as of July 31, 2023	**740.1**	**100.9**	**Yes**
Revised 1939 pre-disturbance scenario 2	**-**	**83.2**	**-**
Source: DRI, 2023 (see Attachment 03)			

2.2.3 Report On Progress Towards Meeting Ambient Air Quality Standards

The current DRI model estimates the 24-hour average PM_{10} concentration at CDF and Mesa2 during the stipulated 2013 baseline period to be 124.7 and 97.5 μg/m^3, respectively. As explained in Section 2.2.1.1, for this 2023 ARWP, State Parks' progress in reducing modeled baseline PM_{10} concentrations is estimated using the latest version of the revised DRI model.

Refer to Attachment 03 for DRI model estimates of PM_{10} concentration reductions downwind of the ODSVRA.

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 2-10, which compares the Dust Control Program modeled PM_{10} concentration reductions against the original SOA requirements (achieve state and federal ambient air quality standards for PM_{10}) and the original 1939 pre-disturbance scenario. As of September 11, 2023, there are no concentration results for the revised pre-disturbance modeling scenarios because the October 2022 SOA amendments focus on reducing excess emissions instead of compliance with absolute air quality standards (i.e., the specific concentration target to be met, if any, will be changing as part of the excess emissions framework).

Table 2-10. Revised DRI Model 24-Hour Average PM_{10} Concentrations at CDF

Model Scenario/Evaluation	Acres Controlled	24-Hour Average PM_{10} Concentration ($\mu g/m^3$) at CDF	Percent Reduction in PM_{10} Concentration from 2013 Baseline
2013 baseline concentration (no dust control measures in place)[(A)]	0	124.7	0.0%
Reported concentration from cumulative dust control measures in place as of July 31, 2022[(B)]	740.1	61.9	-50.4%
Dust control measures converted between August 1, 2022, and July 31, 2023, including changes resulting from 2023 DRI model updates[(C)]	--	*-1.0[(D)]*	*-0.8%*
Dust Control Program status as of July 31, 2023[(E)]	**740.1**	**60.9**	**-51.2%**
Original 1939 pre-disturbance scenario[(F)]	**-**	**88.0**	**-29.7%**
Original SOA Condition 2.b goal[(G)]	**--**	**50.0**	**-59.9%**

Source: DRI, 2023 (see Attachment 03)

(A) Pursuant to the SOA, the 2013 modeled baseline for PM_{10} concentration ($\mu g/m^3$) is based on emissions from riding and non-riding areas at the ODSVRA.

(B) Refer to State Parks' 2022 ARWP, Table 2-13. As reported in the 2022 ARWP, the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2022, reduced 2013 modeled 24-hour average PM_{10} concentrations at CDF from 124.7 $\mu g/m^3$ to 61.9 $\mu g/m^3$, a reduction of 62.8 $\mu g/m^3$. This equals a 50.4% reduction in 2013 modeled baseline concentrations (62.8/124.7 = 50.4%)

(C) State Parks converted 27.3 acres of temporary dust control measures to vegetation during the reporting period August 1, 2022, to July 31, 2023 (see Section 2.1.1.2). This activity did not increase the acreage managed for dust control purposes. The changes to the DRI modeling incorporated into this 2023 ARWP (see Section 2.2.1.1) result in a net decrease in 24-hour average PM_{10} concentrations equal to 1.0 $\mu g/m^3$, as compared to the modeling reported in the 2022 ARWP. This equals a 0.8% decrease in 2013 modeled baseline concentrations (1.0/124.7 = 0.80%).

(D) This value is a concentration change, not a 24-hour average concentration value.

(E) The DRI modeling conducted for this 2023 ARWP estimates that the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2023, reduced 2013 modeled 24-hour average PM_{10} concentrations from 124.7 $\mu g/m^3$ to 60.9 $\mu g/m^3$, a reduction of 63.8 $\mu g/m^3$. This equals a 51.2% reduction in 2013 modeled baseline concentrations (63.8/124.7 = 51.2%).

(F) The original SOA goal was based on the CAAQS of 50 $\mu g/m^3$ (see Section 2.2). In contrast, he original 1939 pre-disturbance modeling scenario, which is based on 2013-2019 PI-SWERL emissivity data (refer to Section 2.2.1 for pre-disturbance model details), indicates 24-hour average pre-disturbance PM_{10} concentrations at CDF would be 88.0 $\mu g/m^3$, which is 36.7 $\mu g/m^3$ less than modeled baseline conditions (124.7 $\mu g/m^3$), or a 29.7% reduction in 2013 modeled baseline concentrations (88/124.7 = 29.7%).

(G) The original SOA goal was based on the CAAQS of 50 $\mu g/m^3$ (see third bullet under Section 2.2), which is 74.7 $\mu g/m^3$ less than modeled baseline conditions (124.7 $\mu g/m^3$), or a 59.9% reduction in 2013 modeled baseline concentrations (50/124.7 = 59.9%).

In total, as of July 31, 2023, the revised DRI model estimates that the cumulative reduction in 24-hour PM_{10} concentrations at the CDF station from the 740.1 acres of dust control measures in the ground at the ODSVRA is 60.9 μg/m^3, which equals a 51.2% reduction in baseline modeled 24-hour PM_{10} concentrations. This 51.2% cumulative reduction in 24-hour PM_{10} concentrations at the CDF station represents continued progress towards achieving the CAAQS (50 μg/m^3) as originally required by the SOA. The resulting modeled 24-hour average PM_{10} concentration of 60.9 μg/m^3 at the CDF station is also lower than the 24-hour average PM_{10} concentration levels that the original pre-disturbance model estimates would have occurred at the CDF station under the land cover conditions present in 1939 (88.0 μg/m^3).

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, as estimated using the revised DRI model, is summarized in Table 2-11, which compares the Dust Control Program modeled PM_{10} concentration reductions against the original requirement SOA requirements (achieve state and federal ambient air quality standards for PM_{10}) and the original 1939 pre-disturbance scenario.

In total, as of July 31, 2023, the revised DRI model estimates that the cumulative reduction in 24-hour PM_{10} concentrations at the Mesa2 station from the 740.1 acres of dust control measures in the ground at the ODSVRA is 62.5 ug/m^3, which equals a 35.9% reduction in modeled baseline 24-hour PM_{10} concentrations. This 35.9% 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 originally required by the SOA. The resulting modeled 24-hour average PM_{10} concentration of 62.5 μg/m^3 at the Mesa2 station is also lower than the 24-hour average PM_{10} concentration levels that the original pre-disturbance model estimates would have occurred at the Mesa2 station under the land cover conditions present in 1939 (71.2 μg/m^3).

Table 2-11. Revised DRI Model 24-Hour Average PM_{10} Concentrations at Mesa2

Model Scenario/Evaluation	Acres Controlled	24-Hour Average PM_{10} Concentration (µg/m^3)at Mesa2	Percent Reduction in PM_{10} Concentration from 2013 Baseline
2013 baseline concentration (no dust control measures in place)[(A)]	0	97.5	0.0%
Reported concentration from cumulative dust control measures in place as of July 31, 2022[(B)]	*740.1*	*63.6*	*-34.8%*
Dust control measures converted between August 1, 2022, and July 31, 2023, and concentration reporting changes resulting from 2023 DRI model updates€	--	*-1.1[(D)]*	*-1.1%*
Dust Control Program status as of July 31, 2023[(E)]	**740.1**	**62.5**	**-35.9%**
Original 1939 pre-disturbance scenario[(F)]	**-**	**71.2**	**-27.0%**
Original SOA Condition 2.b goal[(G)]	**--**	**50.0**	**-48.7%**

Source: DRI, 2023 (see Attachment 03)

(A) Pursuant to the SOA, the 2013 modeled baseline for PM_{10} concentration in micrograms per cubic meter (µg/m^3) is based on emissions from riding and non-riding areas at the ODSVRA.

(B) Refer to State Parks' 2022 ARWP, Table 2-15. As reported in the 2022 ARWP, the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2022, reduced 2013 modeled 24-hour average PM_{10} concentrations at Mesa2 from 97.5 µg/m^3 to 63.6 µg/m^3, a reduction of 33.9 µg/m^3. This equals a 34.8% reduction in 2013 modeled baseline concentrations (33.9/97.5 = 34.8%).

(C) State Parks converted 27.3 acres of temporary dust control measures to vegetation during the reporting period of August 1, 2022, to July 31, 2023 (see Section 2.1.1.2). This activity did not increase the acreage managed for dust control purposes. The changes to the DRI modeling incorporated into this 2023 ARWP (see Section 2.2.1.1) result in a net decrease in 24-hour average PM_{10} concentrations equal to 1.1 µg/m^3, as compared to the modeling reported in the 2022 ARWP. This equals a 1.1% decrease in 2013 modeled baseline concentrations (1.1/97.5 = 1.1%).

(D) This value is a concentration change, not a 24-hour average concentration value.

(E) The DRI modeling conducted for this 2023 ARWP estimates that the cumulative dust control measures in place throughout the ODSVRA as of July 31, 2023, reduced 2013 modeled 24-hour average PM_{10} concentrations from 97.5 µg/m^3 to 62.5 µg/m^3, a reduction of 35.0 µg/m^3. This equals a 35.9% reduction in 2013 modeled baseline concentrations (35.0/97.5 = 35.9%).

(F) The original SOA goal was based on the CAAQS of 50 µg/m^3 (see Section 2.2). In contrast, the original 1939 pre-disturbance modeling scenario, which is based on 2013-2019 PI-SWERL emissivity data (refer to Section 2.2.1 for pre-disturbance model details), indicates 24-hour average pre-disturbance PM_{10} concentrations at Mesa2 would be 71.2 µg/m^3, which is 26.3 µg/m^3 less than modeled baseline conditions (97.5 µg/m^3), or a 27.0% reduction in 2013 modeled baseline concentrations (26.3/97.5 = 27.0%).

(G) The original SOA goal was based on the CAAQS of 50 µg/m^3 (see third bullet under Section 2.2), which is 47.5 µg/m^3 less than modeled baseline conditions (97.5 µg/m^3), or a 48.7% reduction in 2013 modeled baseline concentrations (50/97.5 = 48.7%).

2.2.4 Increments of Progress Towards Meeting Air Quality Objectives, 2013 to 2022

As described in Section 2.1, dust control measures such as temporary wind fencing, straw treatments, and vegetation projects have been used within the ODSVRA to reduce PM_{10} emissions originating from the ODSVRA and to lower the regional PM_{10} burden on the Nipomo Mesa. Since 2013, when there were effectively no dust control measures in place at the ODSVRA, the amount of acreage managed for dust control purposes has increased to 412.2 acres of engineered dust control projects and 740.1 acres of total dust control program area (including acres removed from seasonal OHV activity, i.e., the nesting exclosure) as of July 31, 2022 (see Figure 2-1).

The PM_{10} data measured at the CDF and Mesa2 stations and the wind data measured at State Parks' S1 meteorological tower, or at other suitable meteorological network monitoring stations (see Section 2.3.1), can be used to demonstrate that the dust emission system in the ODSVRA produces less PM_{10} now than it did prior to the emplacement of dust controls and that this reduction in PM_{10} scales with the increase in acres of dust control. The metric used to evaluate the production of PM_{10} from the ODSVRA is the ratio of total hourly PM_{10} (TPM_{10}, $\mu g/m^3$) and total hourly wind power density (TWPD, in terms of Watts per square meter, or W/m^2) during a set time period. This ratio serves as a metric to evaluate how the dust emission system is changed by modifications to or in the landscape. With no changes to the surface from which the emissions originate, 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 and should remain stable if the environmental conditions remain stable. If, however, the surface from which the emissions are originating 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 emitting PM_{10} dust. Conversely, if the ratio increases through time, it indicates that the source area is producing greater amounts of PM_{10} for similar conditions of TWPD.[25]

[25] According to DRI, 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. Thus, the values of the ratio become unreliable at diminished wind speed.

DRI has prepared an analysis of the relation between the TPM_{10}:TWPD ratio and acres of dust control using data from April to September 2022 from the SLOAPCD's CDF and Mesa2 air quality monitoring stations and State Parks' S1 meteorological tower. Below is a summary of DRI's latest increments of progress report. DRI's ODSVRA Dust Control 2022 Update is currently undergoing the scientific review process. Attachment 04, Increments of Progress Toward Air Quality Objectives, ODSVRA Dust Control 2022 Update, is a placeholder for DRI's full report on increments of progress over the 2013-2022 period.

2.2.4.1 TPM_{10} and TWPD, April to September 2022 (CDF and Mesa2)

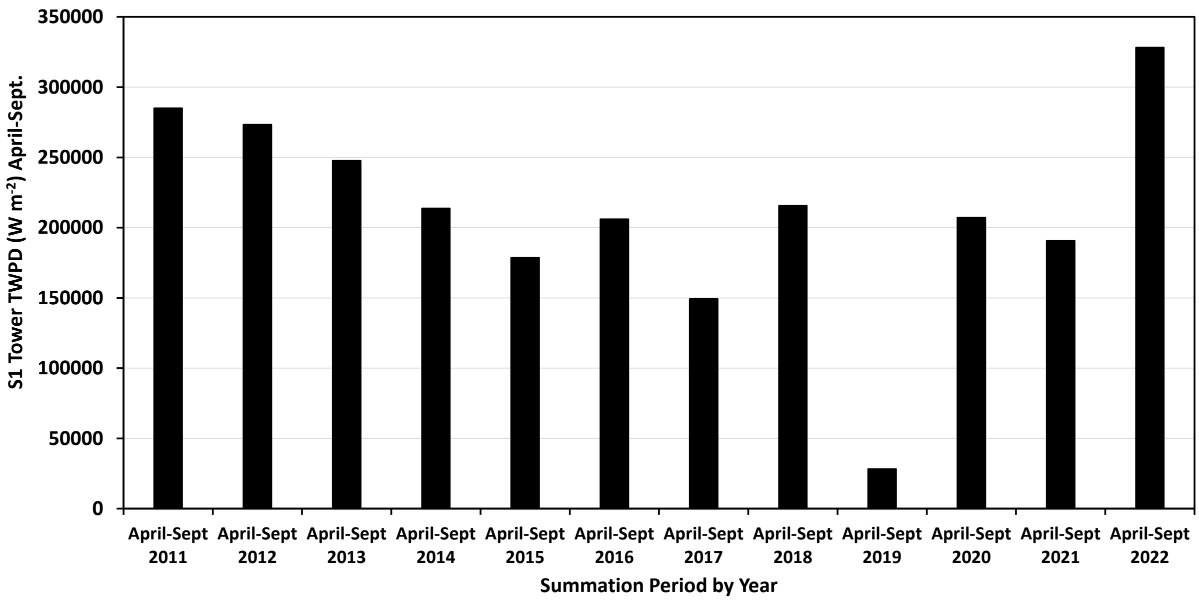
DRI applied the following constraints to the available environmental data:

- A wind direction filter was applied to screen for the conditions that were most likely to result in the generation of PM_{10} by saltation within the ODSVRA reaching the SLOAPCD's CDF and Mesa2 air quality monitoring stations. Winds from 248° to 326° were used to ensure, conservatively, that the air flow that reached CDF and Mesa2 had most likely traveled from the ODSVRA.
- The threshold wind speeds and TWPD for CDF and Mesa2 were determined from data that relates PM_{10} to wind speed at each of the sites.
- A precipitation filter was applied to screen out any hourly observations where precipitation had occurred in the previous 72 hours (3 days).

To calculate TPM_{10} and TWPD, a lower limit of wind speed over which the summation is carried out needs to be established and remain consistent when results among different time periods are compared. Similar to previous reporting by DRI this limit is set at 3.5 meters per second (or 26 Watts per square meter if expressed in wind power density) as measured at CDF and Mesa2. At this wind speed, i.e., 3.5 meters per second at 10 meters above ground level at CDF and Mesa2 a correlation between increasing PM_{10} and increasing wind speed is observed at both monitoring stations. The value of 3.5 meters per second measured at CDF and Mesa2 corresponds to the threshold wind speed for dust emissions within the ODSVRA of approximately 8.5 meters per second (measured at 10 meters above ground level) at the S1 tower as reported in Mejia et al. (2019). TWPD is the summation of the hourly mean wind speed measured at the S1 tower for the hours identified at CDF or Mesa2 that correspond to hourly mean wind speed equal to or greater than 3.5 meters per second (after screening for the wind direction and precipitation criteria) measured at these locations.

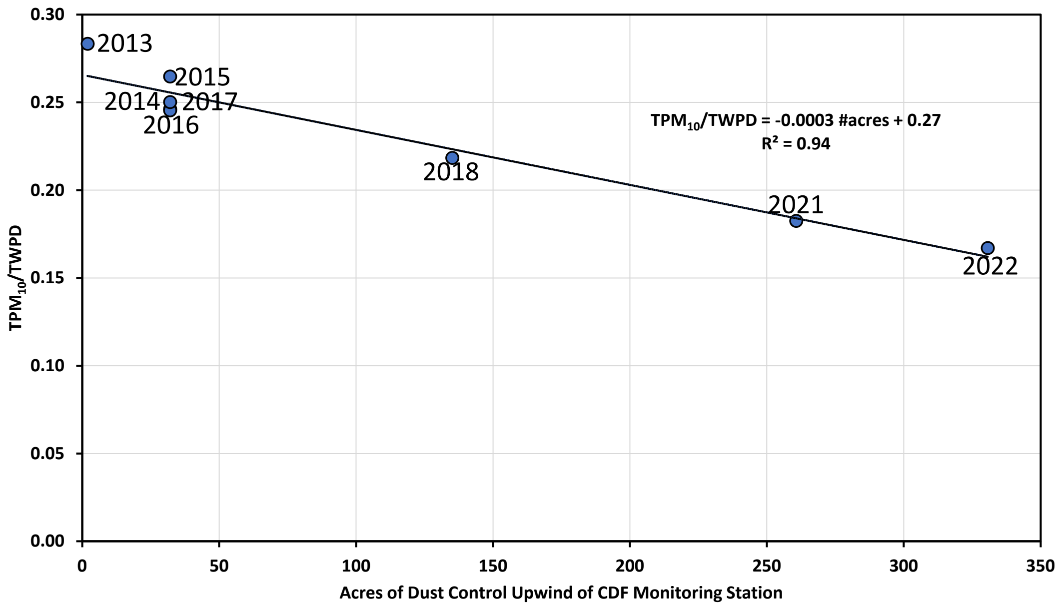
The wind speed record at the S1 tower, measured at 10 meters above ground level, for the period from April to September 2022 had values that were higher than observed in 2021. To place the wind conditions into context across the available S1 tower data record (2011 to 2022), DRI calculated the TWPD for the period from April to September in each year. The TWPD at the S1 tower is shown Figure 2-3.

Figure 2-3. 2011-2022 TWPD at S1 Tower (April-September Period)



As shown in Figure 2-3, the TWPD in 2022 as measured at the S1 tower is the highest observed for the data record, which suggests that the potential for wind-driven sand transport and dust emissions within the ODSVRA was also at its highest level; however, as shown in Figure 2-4, the downward trend in the TPM_{10}:TPWD ratio at CDF that DRI has previously observed with increasing amount of dust control at the ODSVRA continued in 2022. That the downward trend continued even as the TWPD reached a level greater than in the years 2011-2021 suggests that the dust control management strategies continue to work as intended. The acres of dust control in Figure 2-4 represent the summation for acres that were placed within the directional range of 270° to 325° referenced to the CDF monitoring station for the period 2013-2022.

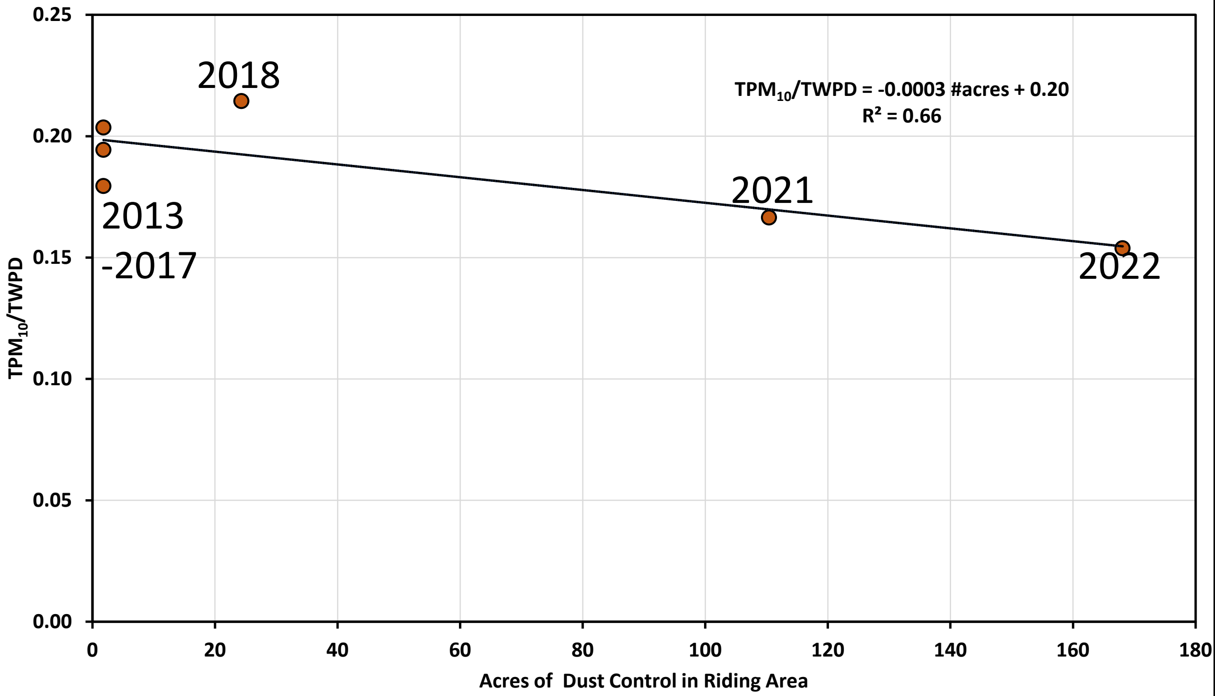
Figure 2-4. ODSVRA Dust Control Acreage and TPM_{10}:TPWD Ratio at CDF (2013-2022)



The relation between the TPM_{10}:TWPD ratio at the CDF monitoring station and the acreage of dust control measures at the ODSVRA upwind of CDF in the direction range 270° to 325° for the period from April to September, 2013 to 2022. The dates for the amounts of acres of dust control are shown beside the symbols. The data for 2019 were excluded because the wind speeds measured at the S1 tower in 2019 created the condition whereby the ratio becomes unreliable at diminished wind speed (see footnote 25). The data for 2020 were excluded because there was an extended closure of the ODSVRA riding area due to COVID-19 restrictions during that year.

The TPM_{10}:TPWD ratio for Mesa2 for the period from April to September, 2011 to 2022, as a function of acres of dust control is shown in Figure 2-5. Similar to CDF, the downward trend in the TPM_{10}:TPWD ratio that DRI has previously observed with the increasing amount of dust control at the ODSVRA since 2018 continued in 2022 at Mesa2. Prior to 2018, there was no clear trend in the TPM_{10}:TPWD ratio data as there were few acres of dust control upwind of the Mesa2 air quality monitoring station. The acres of dust control in Figure 2-5 represent the summation for acres that were placed within the direction range 270° to 305° referenced to the Mesa2 monitoring station for the period 2013-2022.

Figure 2-5. ODSVRA Dust Control Acreage and TPM_{10}:TPWD Ratio at Mesa2 (2013-2022)



The relation between the TPM_{10}:TWPD ratio at Mesa2 monitoring station and the acreage of dust control measures at the ODSVRA upwind of Mesa2 in the direction range 270° to 305°for the period from April to September, 2013 to 2022. The dates for the amounts of acres of dust control are shown beside the symbols. The data for 2019 were excluded because the wind speeds measured at the S1 tower in 2019 created the conditions whereby the ratio becomes unreliable at diminished wind speed (see footnote 25). The data for 2020 were excluded because there was an extended closure of the ODSVRA riding area due to COVID-19 restrictions during that year.

DRI's analysis of TWPD and TPM_{10} indicates that the approximately 412 acres of engineered dust control measures have reduced the PM_{10} originating from the ODSVRA by approximately 41% at CDF in 2022 (for equivalent wind power density conditions compared with the baseline year of 2013). Beginning in 2018 when the first large scale dust emission projects upwind of Mesa2 were installed (approximately 24 acres), the TPM_{10}:TPWD ratio has been less than the 2018 value and the years prior to that as well (i.e., 2013-2017).

It is noted that the TPM_{10}:TWPD ratio indicates the production potential of PM_{10} as a function of WPD. An increase in TWPD can result in more exceedances of the state or federal ambient air quality standards even in the presence of increased amounts of dust controls because the PM_{10} is produced from the uncontrolled areas and it increases as a power function of wind speed, while the efficiency of the dust control does not. Under the higher TWPD conditions of April to September 2022, however, the established dust controls appear to be functioning at sufficient efficiencies to modulate the dust emission processes to reduce the production of PM_{10} as a function of TWPD to a greater degree than in all previous years.

2.2.5 Report on Progress Towards Track-Out Control

State Parks finalized engineered drawings for permanent track-out control at Grand and Pier Avenues in 2020.[26] Construction of the Grand Avenue project was completed by November 2022; however, State Parks continues to use temporary rubber track-out mats installed in 2019 at the Pier Avenue entrance due to the uncertain future of this entrance. The temporary mats are regularly cleaned when the beach is open to public vehicle activity. State Parks also continues to conduct ongoing street sweeping activities on Pier and Grand Avenues at a minimum of three times per week.

2.3 REPORT ON FIELD MONITORING AND AIR QUALITY MODELING

Chapter 3 of State Parks' 2019 Draft PMRP provides a basic overview of dispersion modeling and presents the methodology, key inputs, data sources, and assumptions that experts from DRI, the SAG, CARB, the SLOAPCD, the University of California, Santa Barbara (UCSB), and State Parks have incorporated into the air quality modeling conducted for the SOA.[27] 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 document 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. 'Reducible' uncertainties are caused by 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 the ODSVRA 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 results.

For example, State Parks' meteorological and PM_{10} monitoring network (see Section 2.3.1) provides data on meteorological and PM_{10} conditions across the spatial domain of the ODSVRA and at locations external to the ODSVRA. These data are important for modeling the dispersion of PM_{10} for the time frame beginning with the establishment of the network (effectively 2017

[26] Refer to State Parks' 2021 ARWP, Attachment 05 (Sediment Track-out Prevention Measures), for detailed plans for track-out control at Grand Avenue.
[27] State Parks PMRP is available for review on the following SLOAPCD website (under "June 11, 2019 Update"): https://www.slocleanair.org/air-quality/oceano-dunes-efforts

to the present).[28] For the baseline year, the stations set up in 2013, at different locations, provided wind speed and wind direction data and PM_{10} measurements across the spatial domain as input into the current and revised DRI model. These data are used to calibrate and verify the model. 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_{10} MONITORING

State Parks has installed seasonal and temporary meteorological and PM_{10} monitoring sites at the ODSVRA since the SLOAPCD first began evaluating PM_{10} emissions on the Nipomo Mesa as part of its Phase 1 and Phase 2 studies. The purpose of these instruments is to help assess individual project effectiveness and update and refine meteorological inputs needed for air quality modeling.

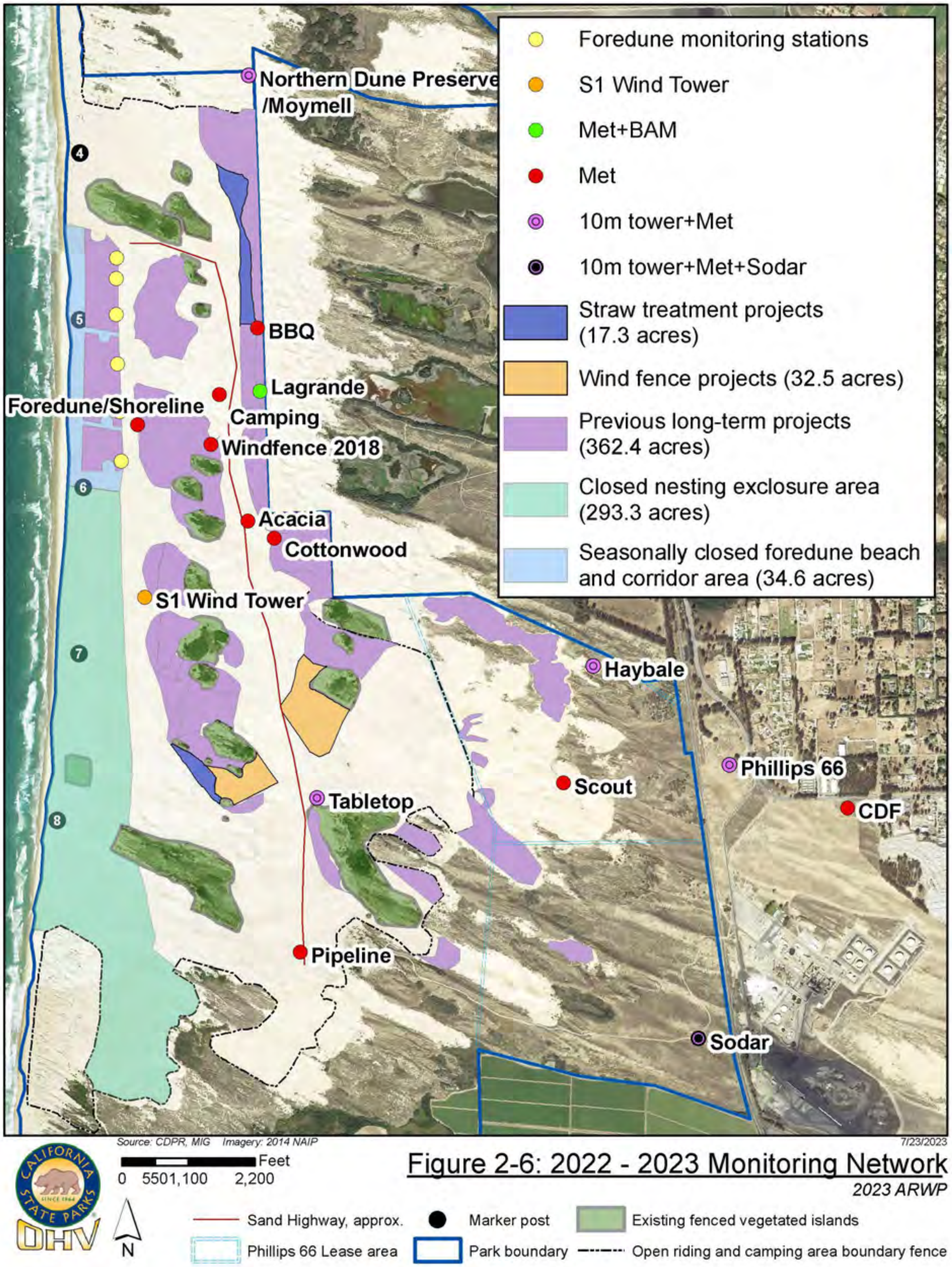
State Parks' S1 meteorological tower (located near marker post 6) was installed in June 2010 and continues to operate and support Dust Control Program activities. In 2013, State Parks deployed a temporary network of meteorological and PM_{10} monitoring equipment throughout the ODSVRA. This temporary network, mostly removed in 2013, has generally informed the basis and need for subsequent meteorological and PM_{10} data collection efforts and monitoring locations in subsequent years.

State Parks' meteorological and PM_{10} monitoring network varies slightly from year to year depending on specific goals, objectives, and dust control measures identified in the ARWP cycle. From approximately April 1, 2022, to October 31, 2022, State Parks maintained the monitoring network shown in Figure 2-6, including:

- Six foredune meteorological and PM monitoring sites.
- Fifteen other meteorological and PM monitoring sites located throughout and downwind of the ODSVRA.
- One sonic detection and ranging (SODAR) instrument station.

[28] Wind and PM monitoring began in 2013 but the network of monitoring stations that is installed annually with MetOne 212-2 Particle Profilers began in 2017 and reached the current compliment of stations in 2019.

Figure 2-6. 2022-2023 Monitoring Network



State Parks installed the same monitoring network beginning in April 2023 and will maintain this network through approximately October 2023. Typically, the 15 monitoring sites each consist of a suite of instruments affixed to a tripod, platform, or tower located 3.5 to 10 meters above ground level (see Figure 2-7). Instruments collect wind speed and wind direction (using two-dimensional sonic anemometry), ambient temperature, relative humidity (RH), and barometric pressure. A Sensit instrument is also deployed at or near the ground level to measure saltation activity in active sand transport areas. The SODAR instrument station (originally installed in May 2019 and removed from operation in February 2023) recorded three-dimensional velocity vector data from approximately 40 meters to 200 meters above ground level. Foredune monitoring is described in Section 2.3.2.2.

The particulate matter at each station is measured using a MetOne 212-2 Particle Profiler that measures particle counts in eight size (geometric mean diameter in micrometers, or µm) bins (0.39 µm, 0.59 µm, 0.84 µm, 1.41 µm, 2.24 µm, 3.53 µm, 7.07 µm, and 10+ µm) 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-calibrated relations between particle count data collected by the Particle Profiler and mass-based PM_{10} concentration data collected by a USEPA Federal Equivalent Method (FEM) Beta Attenuation Mass (BAM) PM_{10} monitor.[29] This calibration ensures that each MetOne 212-2 Particle Profiler instrument provides an accurate and representative estimate of PM_{10} during deployment at the ODSVRA.

The MetOne 212-2 units deployed in 2022 and 2023 were calibrated by DRI using the same methodology employed for previous monitoring efforts. The calibration procedures ensure that each MetOne 212-2 Particle Profiler instrument provides an accurate and representative estimate of PM_{10} during deployment. The key purpose of the monitoring network is to collect PM_{10} and meteorological data to provide a means to evaluate the relation between wind conditions and PM_{10} during the primary dust season (April-September). This annual characterization allows for the assessment of changes in the PM_{10} levels interior and downwind of the ODSVRA open riding and camping area as it relates to meteorology and dust control projects.

[29] DRI conducted initial, environmentally controlled calibration procedures in 2020 and concluded the consistency of the calibration settings 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 that were experienced during the collocation. In April 2021 and 2022, DRI repeated the environmentally controlled calibration procedures with similar results. The same calibration procedure was repeated by DRI in April 2023. Refer to State Parks' 2021 ARWP, Attachment 06, for a detailed summary of DRI's MetOne 212-2 Particle Profiler PM_{10} calibration procedures.

Figure 2-7. Typical Meteorological and PM Monitoring Station at ODSVRA

2.3.2 Saltation Monitoring

In addition to meteorological and airborne PM_{10} measurements, State Parks 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 saltation monitoring also informs understanding of the mean threshold wind speed for the saltation process. Based on Sensit data for the monitoring sites that had operational Sensit instruments in 2021 (Northern Dune Preserve, BBQ, Camping, Lagrande, Foredune, Acacia, and Tabletop sites; see Figure 2-6), DRI reports the mean threshold wind speed for saltation in 2021 was 6.4 meters per second (±0.7 meters per second).[30] This mean threshold is based on wind speeds measured 3.5 meters above ground level, which corresponds to the 10 meter above ground level threshold wind

[30] The reported 2021 threshold for saltation is not affected by variations across the ODSVRA, such as increasing grain size and threshold wind speed from north to south. DRI previously reported (in 2013) that the threshold wind speed at the ODSVRA varied from north to south (https://storage.googleapis.com/slocleanair-org/images/cms/upload/files/DRI_Oceano-Dune-Wind%20-PM-Conditions_09-22-2014%281%29.pdf). This finding was based on transects with instrumentation that covered a north to south distance of more than 7,000 meters (4.3 miles) and extended into the southern dune preserve (Oso Flaco), while the 2021 network stations spanned a north-to-south distance of approximately 4,500 meters (2.8 miles) with all stations except the northern Pismo Dunes Natural Preserve located in the ODSVRA open riding and camping area. Using the threshold wind speed as a function of horizontal distance from DRI's 2013 report (Figure 19), the change in threshold wind speed predicted for moving from 4,500 meters from north to south in the riding area is 0.5 meters per second. This supports the finding from 2021 that for the threshold wind speed for the stations cited (i.e., Northern Dune Preserve, BBQ, Camping, Lagrande, Foredune, Acacia, and Tabletop) a change in threshold wind speed would not be observed based on the uncertainty stated (±0.7 meters per second) and the predicted change of 0.5 meters per second.

speed of 8.5 meters per second reported by Meija et al. (2019).[31] The estimate of the 10 meter above ground level wind speed was accomplished using the "law of the wall" and an aerodynamic roughness length (z_0) for bare sand.[32] State Parks did not conduct any new saltation monitoring during the 2023 ARWP reporting period.

2.3.2.1 Wind Fence Array Saltation Flux Measurements

The control effectiveness of a 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. As reported in prior ARWPs, the mean percent reduction in sand flux across the width of the wind fence array has been approximately 72%. From August 1, 2022, to July 31, 2023, no new saltation monitoring occurred within installed wind fence arrays.

2.3.2.2 Foredune Restoration Area Saltation Flux Measurements

State Parks initiated the 48-acre foredune restoration treatment in late 2019. The rationale for this was to re-establish a vegetated foredune ecosystem, akin to that present prior to significant vehicular disturbance, that could naturally disrupt incoming boundary layer flow from the ocean, reduce surface shear stress, and decrease sand flux across its width and for some distance downwind. As a mitigation strategy, the foredune will reduce saltation-driven dust emissions and contribute to improved air quality downwind. The restoration treatment is based on a SAG design in which the 48-acre treatment area is subdivided into six different treatment areas, as shown in Figure 2-8. The treatment areas include:

- Plot 1 – Foredune North (18.6 acres, 20-VG-01):
  - Treatment 1 (T1, 4.0 acres): No treatment other than sheep's foot surface texturing to create divots for seeds and low-level aerodynamic roughness
  - Treatment 2 (T2, 5.2 acres): Native seed mix with sheep's foot surface texturing
  - Treatment 3 (T3, 9.6 acres): Native seed mix and sterile ryegrass seeds with sheep's foot surface texturing

[31] Mejia, J.F., J.A. Gillies, V. Etyemezian, R. Glick. 2019. A very-high resolution (20 m) measurement-based dust emissions and dispersion modeling approach for the Oceano Dunes, California. Atmospheric Environment, 218, 116977, doi: 10.1016/j.atmosenv.2019.116977.

[32] The "law of the wall" describes the general form of the relation between wind speed and height above the surface, which can be used to estimate the change in wind speed between different elevations.

- Plot 2 – Foredune Central (18.8 acres, 20-VG-02):
  - Treatment 4 (T4, 9.1 acres): Low-density random planting nodes (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 (T5, 9.7 acres): High-density random planting nodes with the same planting and straw protection strategy
- Plot 3 – Foredune South (9.9 acres 20-VG-03):
  - Treatment 6 (T6, 9.9 acres): "Parks' classic" restoration consisting of sheep's foot surface texturing, spreading straw over the entire area, planting foredune-specific species, and seeding the area with native seed

From March 13, 2022, to May 31, 2023, State Parks, the Coastal San Luis Resource Conservation District (San Luis RCD), DRI, and UCSB conducted meteorological and saltation flux measurements in 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 3-meter tower on a platform deployed near the eastern edge of each treatment plot, approximately 10 meters west of the eastern fence line and halfway along the north-south length of the treatment area. The foredune monitoring stations have almost the same configuration as those deployed across and exterior to the ODSVRA to measure temperature, RH, wind speed and direction, and pressure (see Section 2.3.1 and Figure 2-7); however, the foredune monitoring stations do not measure PM_{10}. 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 (see Section 2.3.6.3), and three tipping bucket rain gauges are deployed across the restoration area (north, middle, south) to provide data on precipitation across the foredune restoration zone.

The Sensit instrument was used to monitor saltation on the downwind (i.e., eastern) edges of the six foredune restoration areas. The mean threshold wind speed at a height of 3.5 meters above ground level for each treatment area and the total number of hours in which saltation was observed at each treatment area are shown in Figure 2-9 (from April 2022 to May 2023).

Figure 2-8. Foredune Treatment Areas

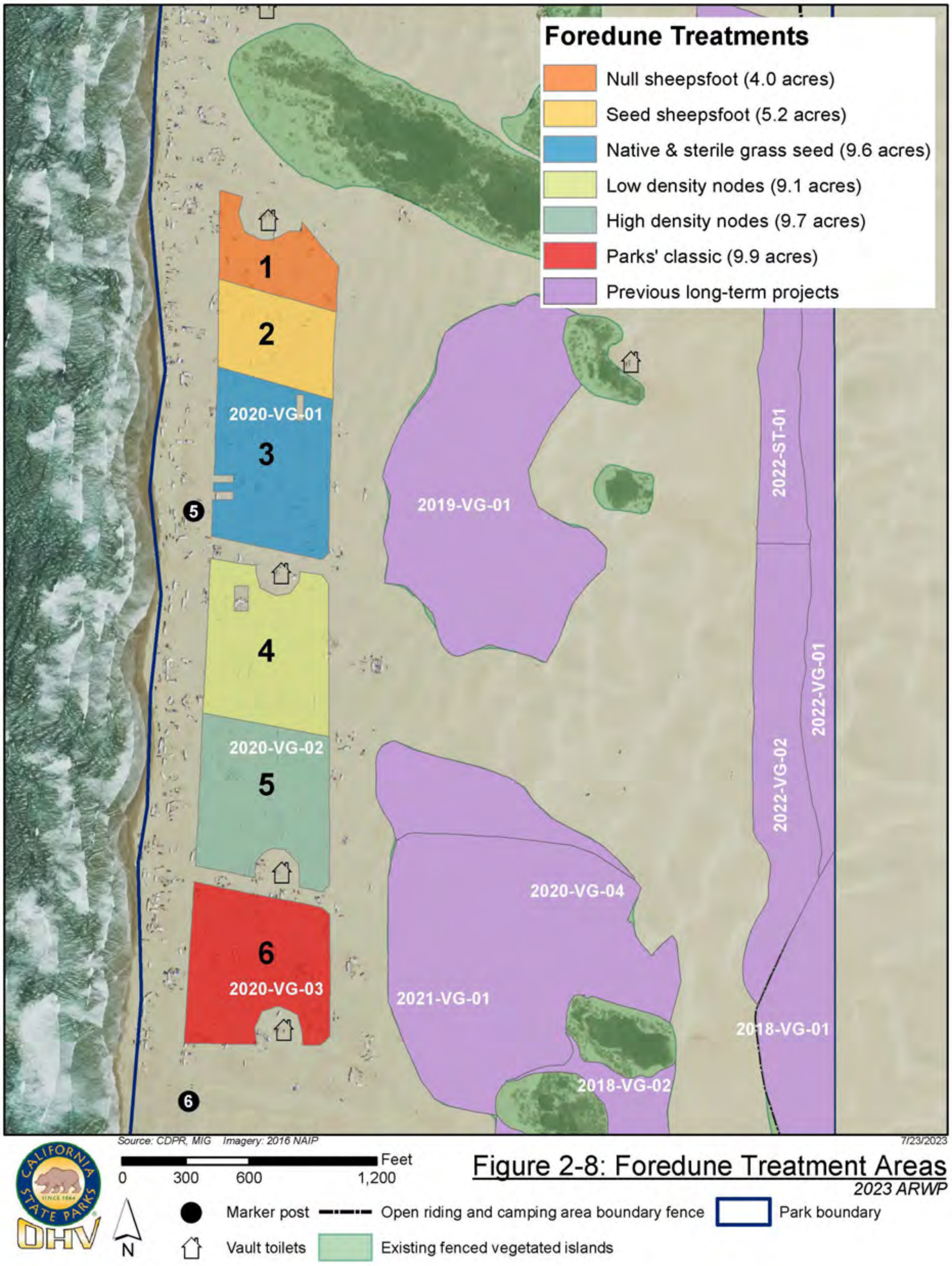
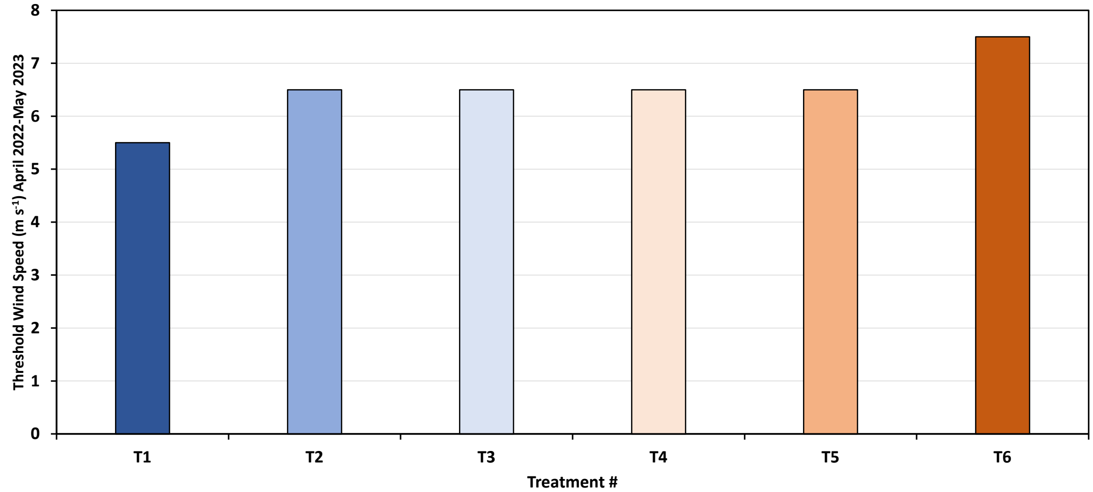
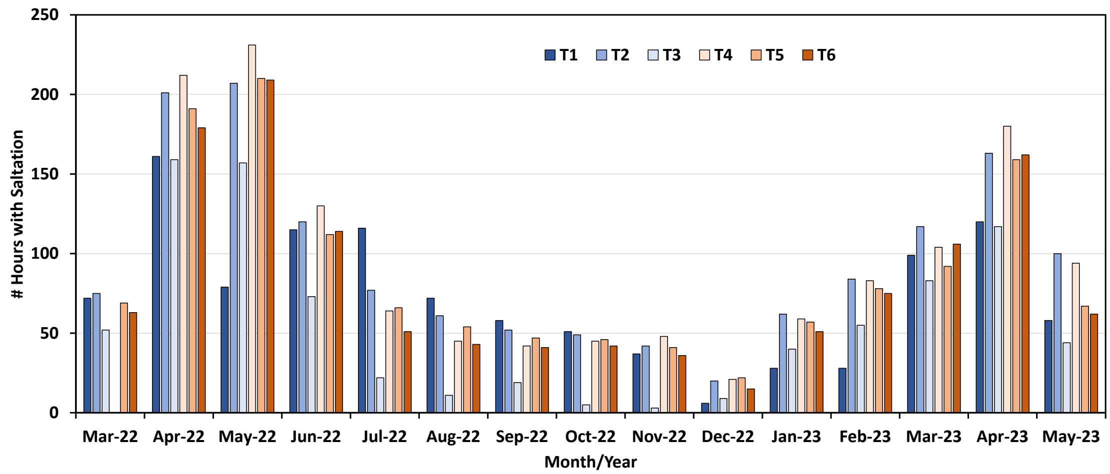


Figure 2-9. Foredune Treatments – Mean Threshold Wind Speed and Observed Saltation



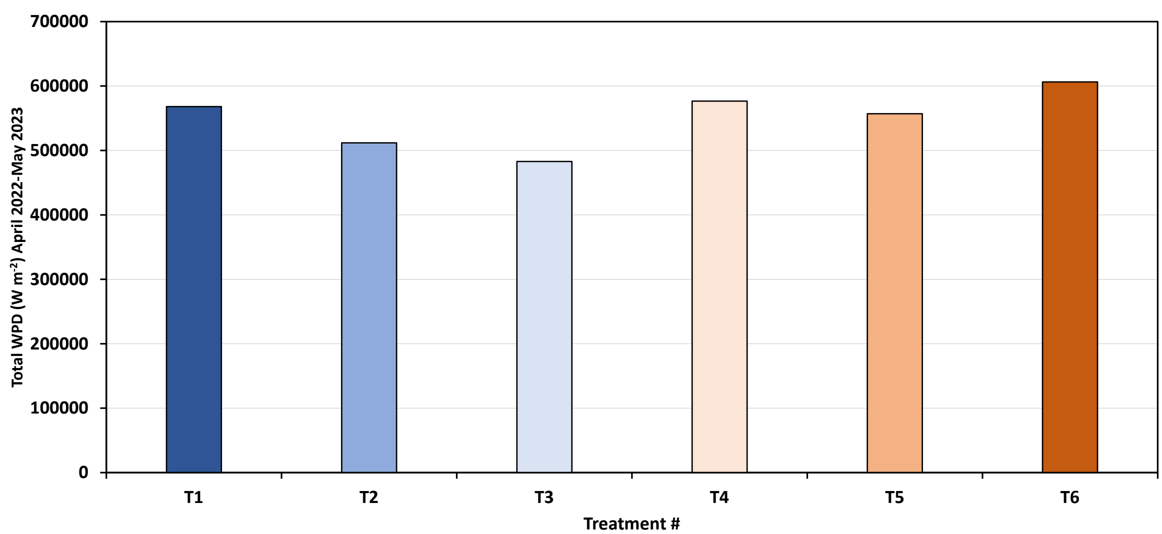


Top: The mean threshold wind speed, as measured at 3.5 meters above ground level, for each of the treatment areas for the period April 2022 to May 2023 for wind direction range 247° to 337°. (March 2022 was a partial month of observation and excluded.) Bottom: Monthly summation of hours with observed saltation for each treatment area from March 2022 to May 2023 for wind direction range 247° to 337° (March 2022 was only a partial month of observation.)

As shown in Figure 2-9, the mean threshold wind speed was lowest in T1 (5.5 meters per second). T2 through T5 had threshold wind speeds of 6.5 meters per second, while T6 had the highest threshold wind speed (7.5 meters per second). This is most likely due to the fact that T1 (the control site) has minimal plant and no straw coverage, while T2, T3, T4, and T5 all have lower levels of plant cover than T6 (see Section 2.3.6). Saltation occurred most frequently in the spring months, with more saltation in March through May 2022 than in March through May 2023. The treatment area with the least number of hours of saltation during the April to June period in both years was T3. It is noted that the saltation thresholds identified in Figure 2-9 are not a precise measurement, i.e., saltation may or may not occur each time the hourly wind speed exceeds the threshold value, and there may also be saltation activity within the treatment areas that occurs below the threshold value. Data were filtered for the wind direction range 247° to 337°. This wind direction assumes that sand is moving from the beach area into the foredune restoration area and then has the potential to traverse the plot area to be recorded by the Sensits on the eastern edge of the treatment area including sand mobilization from within a foredune restoration area.

The TWPD for the March 2022 to May 2023 period when wind direction was 247° to 337° is shown in Figure 2-10. The data suggest T3 has a TWPD value that is 20% lower than the treatment with the highest TWPD, T6, which indicates a lower potential for sand transport for T3. The lower TWPD measured at T3 may be due to the increased range of elevation because of dune topography that is developing for this treatment. As surface topography becomes better developed, it increases its elevation range (i.e., surface roughness), the wind speed measured at the same height above ground level will become lower compared to a smoother surface. Measurements made in 2021 at the upwind and downwind edges of the foredune showed an increase in wind speed at the measurement height of 3.5 meters above ground level between T1 (farthest north) and T6 (farthest south), but this may now be changing on the downwind side as the flow adjusts to the effect of the evolving roughness of each treatment area. DRI recommends the physical roughness of each treatment be quantified using the most recent uncrewed aerial system (UAS) survey measurements from 2023 to explain how the flow over the treatments may be influenced by the topography.

Figure 2-10. Foredune Treatments Total Wind Power Density, March 2022 to May 2023

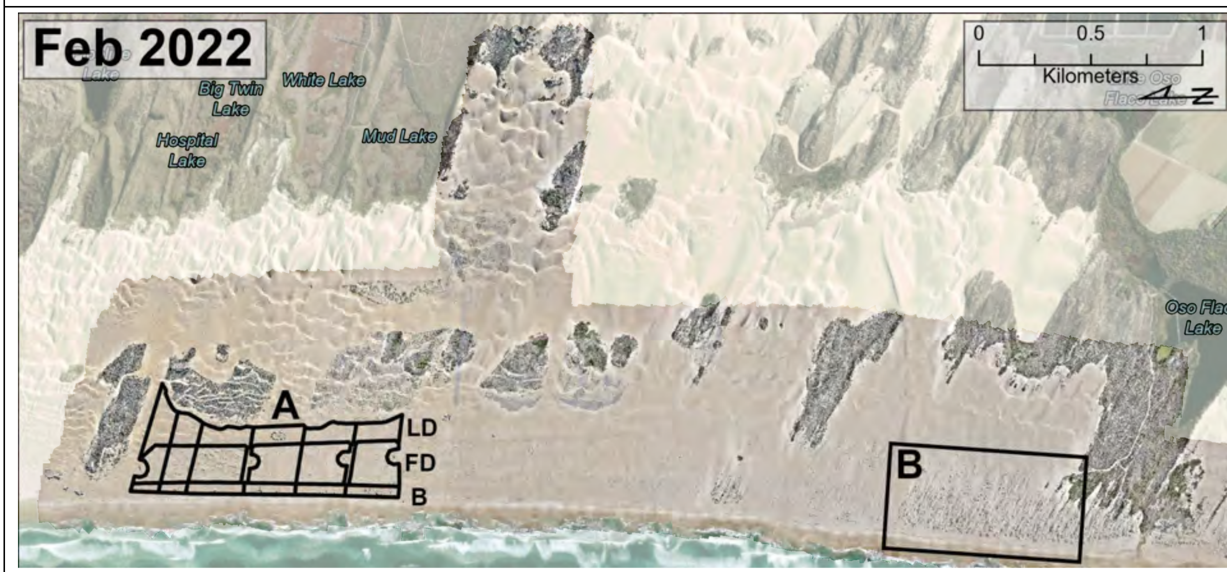


TWPD, in Watts per square meter, for each foredune treatment area for the period April 2022 through May 2023 for wind direction range 247° to 337° (March 2022 was a partial month of observation and excluded.)

2.3.3 Uncrewed Aerial System (UAS) Surveys

Since October 2019, State Parks, in collaboration with a team from UCSB and, formerly, Arizona State University, has conducted bi-annual UAS surveys using a Wingtra One fixed-wing UAS (also known as a drone) to survey and monitor changes in dune morphodynamics, vegetation cover, and sediment budgets (volumetric change) at the ODSVRA. The Wingtra One UAS is a fully autonomous drone. Flight paths are pre-programmed into the drone and monitored by a Federal Aviation Administration (FAA)-certified pilot. The drone is typically flown at altitudes between 100 and 150 meters 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 millimeter-scale accuracy. The UAS surveys occur each February and October to avoid the Western Snowy Plover nesting season. Flights are coordinated with State Parks staff and wildlife monitors to ensure safety and minimal disturbance to birds and wildlife during the flight campaigns. The typical coverage of the UAS imagery captured at the ODSVRA is shown in Figure 2-11.

Figure 2-11. Typical Coverage of UAS Imagery at ODSVRA Since 2019



UAS orthophoto mosaic from February 2022 (shown as a brighter layer atop paler satellite imagery) showing the typical extent of the UAS mapping campaigns. North is oriented to the left of the image. Box A shows the location of the six foredune treatment areas (FD), as well as their adjoining landward (LD) and beach (B) polygons. Box B shows the location of the North Oso Flaco restoration reference site, north of Oso Flaco Lake.

The multispectral imagery captured by the UAS surveys allow for improved detection of vegetation at the ODSVRA. One visual and two multispectral sensors have been used to capture high-resolution digital imagery to date: 1) a Sony RX1RII 42-megapixel (MP) full-frame red, green, and blue (RGB) camera at approximately 1.5- to 2-centimeter resolution; 2) a Micasense

RedEdge-MX sensor (October 2020 to February 2022) that provides multispectral (RGB, RedEdge [RE], and near-infrared [NIR]) imagery at a resolution of approximately 7 to 9 centimeters; and 3) a Micasense RedEdge P sensor (October 2022 to present) that captures the same data as the Micasense RedEdge-MX sensor plus a panchromatic (Pan) band that improves the resolution of the data set from approximately 7 centimeters per pixel to approximately 3.5 centimeters per pixel. The multispectral imagery allows for improved detection of vegetation in the dunes 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 used to create four main data products:

- Georeferenced, orthorectified aerial photo mosaics of the study site in the visual (RGB) bands
- Georeferenced, orthorectified multispectral maps of vegetation cover using (NDVI) and other spectral methods
- Three-dimensional digital elevation models (DEMs) derived from structure-from-motion (SfM) photogrammetry
- Geomorphic change detection (GCD) maps derived from sequential DEMS used to identify patterns of surface elevation change and related volumes of sediment erosion and/or deposition across the foredune restoration area

The resulting data are then used to identify and interpret dune development, sediment budget responses, and vegetation establishment, and assess the performance of the different vegetation restoration treatments.

As of July 31, 2023, eight UAS survey campaigns have been flown at the ODSVRA (see Table 2-12). Initial UAS survey efforts in October 2019 focused on mapping an area of 588 acres along the shoreline of the ODSVRA, including 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, State Parks and the SAG decided to expand UAS surveys to include the full extent of the ODSVRA open riding and camping area (approximately 1,500 acres), including 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. As shown in Table 2-12, the ODSVRA UAS surveys conducted to date have captured baseline (pre-restoration) conditions from October 2019 to February 2020 and responses from three plant growth and wind seasons (February to October) and three winter seasons (October to February).

The UCSB 2022-2023 ODSVRA Foredune Restoration UAS Survey Report is currently undergoing the scientific review process, but a summary of the most recent UAS vegetation analysis conducted by UCSB is provided below.

Table 2-12. Summary of UAS Surveys at ODSVRA					
UAS Survey Campaigns	**Survey Dates**	**Sensor Payload (spectral bands)**	**Coverage Area (square kilometers)**	**Resolution (centimeters per pixel**	**Total Uncertainty (meters)**
1: Baseline pre-restoration survey	October 1-2, 2019	Sony RX1R II (42 MP, RGB)	3.83	1.45	0.038
2: Initial treatment installations	February 10-11, 2020	Sony RX1R II (42 MP, RGB)	5.41	1.56	0.033
3: First post-treatment survey	October 13-15, 2020	Sony RX1R II (42 MP, RGB)	5.98	1.54	0.037
	October 16, 2020	Micasense RedEdge-MX (RGB, RE, NIR)	4.63	7.53	—
4: First year of treatment response	February 17-18, 2021	Sony RX1R II (42 MP, RGB)	5.95	1.52	0.030
	February 18-21, 2021	Micasense RedEdge-MX (RGB, RE, NIR)	5.79	7.89	—
5: Second growing season	October 4-5, 2021	Sony RX1R II (42 Megapixel, RGB)	5.98	1.54	0.025
	October 5-7, 2021	Micasense RedEdge-MX (RGB, RE, NIR)	6.95	7.82	—
6: Second year of treatment response	February 23-25, 2022	Sony RX1R II (42 Megapixel, RGB)	7.56	1.42	0.043
	February 25-26, 2022	Micasense RedEdge-MX (RGB, RE, NIR)	5.91	7.71	—
7: Third growing season	October 17-18, 2022	Sony RX1R II (42 Megapixel, RGB)	7.45	1.66	0.026
	October 19-21, 2022	Micasense RedEdge-P (RGB, RE, NIR, Pan)	8.59	3.67	—
8: Third year of treatment response	February 23, 2023	Sony RX1R II (42 MP, RGB)	4.64	1.59	0.034
	February 20-21, 2023	Micasense RedEdge-P (RGB, RE, NIR, Pan)	7.38	3.97	—

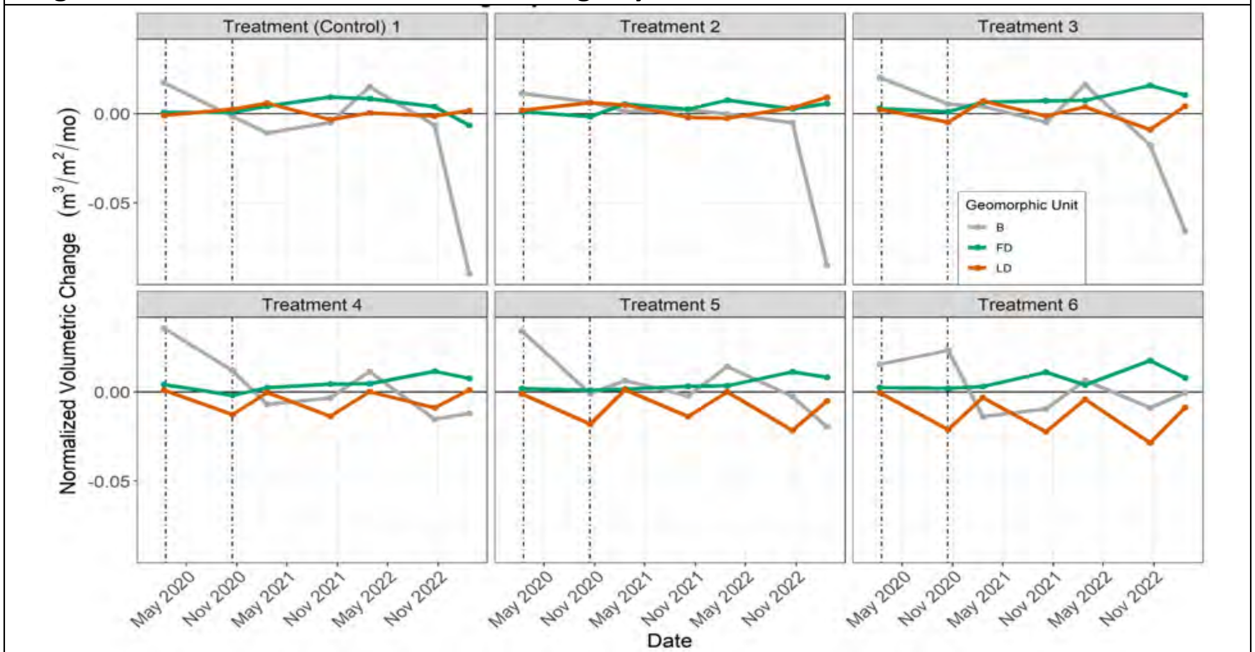
2.3.3.1 UAS Survey Results

All foredune restoration treatments (T2 through T6) continue to show net positive sediment gains (see Figure 2-12). For the first time, however, the control plot (T1) shifted to a negative (erosional) budget that relates partly to a lack of vegetation to promote accretion and dune development, as well as notable beach erosion in the winter of 2022-2023. This said, beach erosion was greater fronting T2 and T3, yet they maintained appreciable accretion in the presence of vegetation. Generally, sediment budgets continued to increase in the vegetated treatment plots where nebkha dune development is enhancing sediment capture and providing downwind sheltering to the surface.

The absolute volumes of sand inputs to the beach, which provides supply to the restoration plots, differ and have generally declined to negative values in recent observation intervals (see Figure 2-12). Amounts were variable but comparable across the treatment sites until this most recent winter interval (October 2022 to February 2023), during which the beach saw increasing erosion from south to north. As of February 2023, T1 through T3 had significant deficits in sand supply to the beach, which could reduce future sand inputs to the adjoined foredune treatments. Despite this, all adjoining foredune restoration treatments (T2 through T6) have maintained net positive sediment budgets, while the control site (T1) switched to a deficit in this most recent interval.

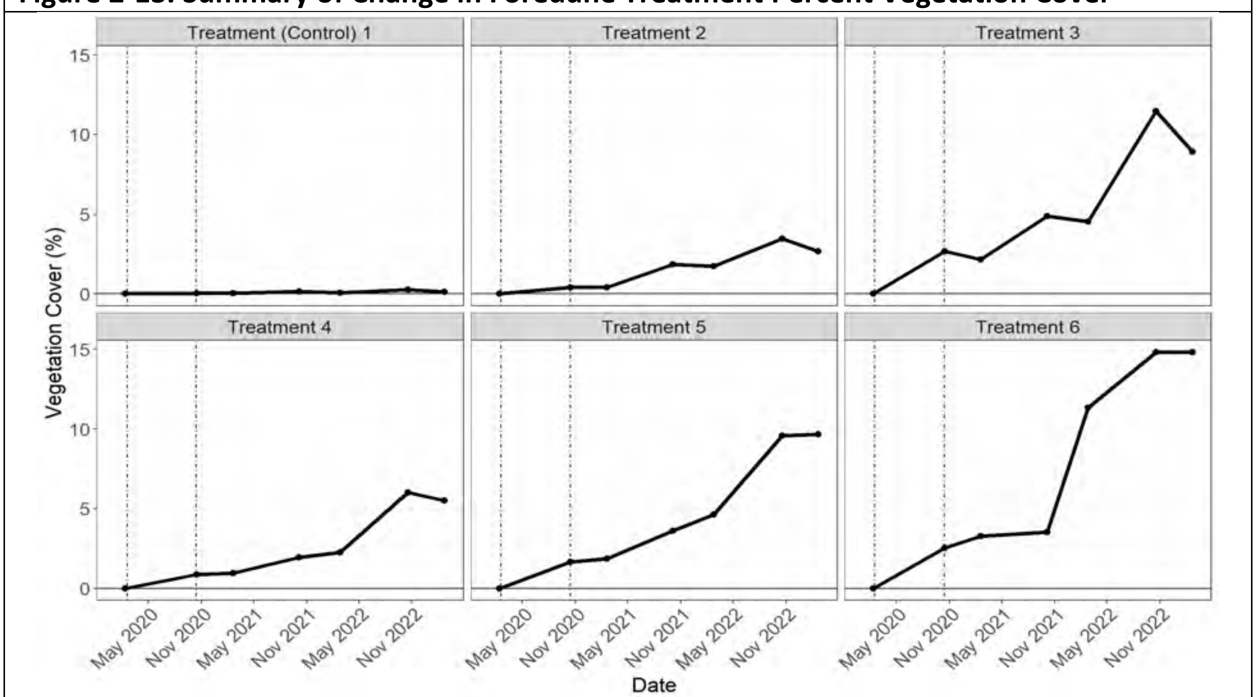
Plant cover continues an increasing trend in all treatment plots except for the control site (T1), which continues to show negligible vegetation. Although the three-year trend since installation is positive, plant cover declined in most plots during this past observation period — markedly in T3 and slightly in plots T2, T4, and T6 — and remained similar in T5 (see Figure 2-13). The cause of this decline is unknown but could relate to an unusually wet and stormy winter and/or erosion along the seaward margins of the plots. It is unclear if this downturn in plant cover reflects a plateauing of the ecosystem or just natural variability as the system continues to evolve. The UAS surveys indicate that, since the 48-acre foredune restoration was initiated in February 2020, there has been a general increase in the percent cover of plants within each treatment plot relative to the total plot area.

Figure 2-12. Normalized Volumetric Change by Month for Foredune Restoration Treatments



Normalized volumetric changes (total volumetric change divided by total plot area divided by months between collections) for each restoration treatment plot. Responses are shown for the foredune (FD), adjacent beach (B), and landward dune (LD) landscape units. Each point on the plot represents net results of volumetric change for the preceding interval (e.g., the first point represents net change between October 2019 and February 2020, etc.). Dashed lines delimit the COVID-19 closure period (March 2020 through October 2020).

Figure 2-13. Summary of Change in Foredune Treatment Percent Vegetation Cover



Line graphs showing the changes in percent vegetation cover in each of the six foredune treatment areas from February 2020 to February 2023.

The treatment with the highest plant cover change to date is T6 (14.8%), followed by T5 (9.7%), T3 (8.9%), T4 (5.5%), and T2 (2.7%) with negligible vegetation change in the T1 control plot. Historical levels of vegetation cover observed in aerial imagery for the 48-acre foredune restoration project reached a maximum of 3.3% in 1949, then declined to essentially zero cover by 1985, with no subsequent detectable increase in plant cover as of 2020.[33] Since 2020, however, plant cover in the 48-acre foredune project has increased from essentially zero to just over 8% as of February 2023. This amount of plant cover remains significantly below that of the North Oso Flaco reference site (~24%), which is a fully developed foredune ecosystem that has experienced no OHV activity since the ODSVRA was founded in 1982. Further details on plant community responses and species richness derived from State Parks line intercept method is provided in Section2.3.6.

2.3.4 Computational Fluid Dynamics (CFD)

CFD is the science of producing fluid flow simulations using large computational resources. The CFD model (openFOAM) calculates very localized shear stresses. Near the ground, the flow quantities are calculated over finite volumes that are centimeter scale, so the wakes and shelter zones behind surface roughness or topographic undulations are resolved. This resolution can be used to quantify and compare the differences in the shear generated on surfaces with varied topography and vegetation cover. Quantification of shear stress generation can be used to evaluate the effectiveness of each foredune restoration treatment to modulate the surface shear stress and estimate how this modulation affects potential dust emissions as they develop and evolve through time.

2.3.4.1 Foredune CFD Modeling

As described in Section 2.3.2.2, State Parks initiated a 48-acre foredune restoration treatment in 2019. Currently, foredunes are absent across much of the north-south extent of the beach area at the ODSVRA, but they are established in the south of the park where OHV activity is not permitted. Historical aerial photography of the site indicates that hummocky foredunes did exist at the ODSVRA in the 1930s. A well-developed foredune system could disrupt incoming boundary layer flow from the ocean, reduce surface shear stress, and decrease sand flux across its width and for some distance on the lee side, thereby reducing saltation-driven dust emissions and contributing to improved air quality downwind.

Quantifying the benefit of the presence of a foredune on modulating sand transport and dust emissions is a challenge. DRI previously applied a CFD approach to characterize the value of foredunes, typified by those in the south Oso Flaco area of the ODSVRA, at reducing surface shear stress responsible for saltation and dust emissions, including simulations that isolated the

[33] Refer to State Parks' 2022 ARWP, Section 2.3.6.3 and Attachment 06-04, for information on the historical vegetation cover analysis by UCSB.

downwind effects of the foredune on shear stress and dust emissions. The revised DRI model incorporates the results of this CFD modeling to provide a more accurate assessment of the effectiveness of mitigation treatments by accounting for flow changes downwind of foredune treatment areas and the nesting exclosure.[34]

In 2022, DRI performed CFD simulations of airflow over each of the six distinct foredune treatment areas using high-spatial resolution topographic data received from UCSB and high-temporal resolution velocity measurements to create incoming boundary wind conditions. The simulations were performed for approximately equal-sized areas within each treatment area as they existed in February 2022, approximately 24 months after the foredune treatments were initially established. An area smaller than the actual foredune restoration treatment area was used due to the computational limits at the time of analysis and to avoid edge effects between treatment areas. The modeled area along the west-to-east direction was centered north to south on the position of the monitoring station on the eastern edge and aligned with the dominant sand transporting wind direction.

Measurements of wind speed upwind and downwind of the treatment areas were also used to compare measured winds speeds with model predicted wind speeds to verify the veracity of model outputs following established procedures. The relation between the upwind and downwind wind speed for each treatment area (measured and modeled) was defined as the wind speed ratio, which was calculated based on measured and modeled wind speeds at 3.26 meters above ground level (WSR equals modeled wind speed [downwind side]/measured wind speed [downwind side]). Measurements within the restoration treatments themselves during the wind season are not possible as the sites are exclosed for the nesting season of the Western Snowy Plover .

Below is a summary of the results of the CFD simulations. Refer to Attachment 05, Computation Fluid Dynamics Modeling of the ODSVRA 48-Acre Foredune Restoration Project, for a detailed description of CFD modeling of the foredune treatment areas conducted by DRI.

As summarized in Table 2-13, DRI's simulation results closely matched actual measured wind speeds on the leeward side of the six different foredune treatment areas, which provides confidence that the model effectively reproduced the wind flow conditions across the modeling domain.

[34] Refer to State Parks' 2021 ARWP, Attachment 09, DRI 2021/2022 CFD Report, for a detailed description of CFD modeling inputs, methodology, and benefits.

Table 2-13. Comparison of Measured and Simulated Foredune Wind Speed Ratios							
Wind Speed Ratio (WSR)[(A)]	**Foredune Treatment**						
	T0[(B)]	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Measured WSR	not applicable	1.004	0.989	0.905	1.015	1.036	not applicable
Simulated WSR	0.972	0.97	0.983	0.9767	1.019	1.017	1.029
Percent difference	--	3.4	0.6	-6.2	-0.4	1.9	-

Source: DRI (see Attachment 05), modified by State Parks.

(A) Wind speed ratio for the measured and simulated velocity at 3.26 meters above the ground at the location of the towers on the eastern edges of the treatment areas. Field data do not exist for T0 (a hypothetical flat sloping surface) or T6 (no access permitted due to Western Snowy Plover restrictions).

(B) The surface identified as T0 was a hypothetical surface created to represent a smooth, sloping beach, for comparing shear stress production and emission potential with the developing restoration areas and their individual topographies and vegetation covers.

Recent PI-SWERL measurements were not available for the time period represented by the topographic and vegetation coverage data (February 2022). To compare the effect of the different surface topography and vegetation within each foredune treatment area on PM_{10} emissions, DRI applied the mean PM_{10} emissivity of the ODSVRA riding area to each foredune treatment area and assigned a threshold shear stress for sand movement in each treatment area based on an assumed mean grain size of 350 µm and application of the Bagnold threshold equation. The use of uniform emissivity relation and threshold shear stress values isolates the effect of shear stress on topography and vegetation to generate dust emissions but is not representative of actual emissivity conditions.

For each modeled foredune restoration treatment area, DRI performed surface integrals to compute the vegetation area, total surface area, total shear stress (Newtons [N]), and area-normalized total shear stress (N per square meter^2). These quantities are summarized in Table 2-14. The integrals were only performed over a distance of 100 meters upwind from the location of the meteorological towers. Separate integrals were computed for vegetated areas and bare sand areas.

Table 2-14. Simulated Shear Stress – Foredune Treatment Area Surface Integral Data							
Wind Speed Ratio (WSR)(A)	**Foredune Treatment**						
	T0(B)	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Vegetation area (square meters)	0	5	20.7	234.7	77.8	117.3	177.4
Total surface area (square meters)	5,001.4	5,009.7	5,009.3	5,048.7	5,033.1	5,030.1	5,026.4
Total shear (N)	926.8	789.1	762.4	636.5	703.3	712.4	699.3
Total shear on bare ground/sand (N)	926.8	788.6	759.9	608.8	694.7	699.4	676.1
Surface area normalized shear (N per square meter)(A)	0.185	0.156	0.152	0.126	0.14	0.142	0.139

Source: DRI (see Attachment 05), modified by State Parks

(A) Area normalization calculations were computed using the total surface area accounting for the complexity of the topography in each treatment.

(B) The surface identified as T0 was a hypothetical surface created to represent a smooth, sloping beach, for comparing shear stress production and emission potential with the developing restoration areas and their individual topographies and vegetation covers.

As shown in Table 2-14, T3 and T6 have the largest vegetated areas and the lowest total shear stress on the bare sand surface among the vegetation elements (31.9% and 24.9% lower than the hypothetical smooth sloping surface, T0, respectively). T4 (24.6% lower than T0) and T5 (23.6% lower than T0) have less vegetated area but still resulted in a similar shear stress reduction as T6. T1 (15.0% less than T0) and T2 (17.8% less than T0) also show a reduction in shear stress due to the influence of dune topography from the creation of bedforms by the wind and sediments transport processes. DRI calculated the potential PM_{10} emissions from each foredune treatment surface for the wind condition investigated by integrating the emissivity relation over the shear surface data. Specifically, potential emissions were integrated over bare sand surfaces where the calculated shear stress was above the assigned threshold value. The resulting PM_{10} emissions for each treatment area, as well as the PM_{10} that would be emitted by vegetated areas if the vegetation was removed (i.e., a vegetation deficit), and the total surface area below the threshold shear velocity, are summarized in Table 2-15. The amount of surface area below the threshold shear velocity represents how much of the modeled area is, under the modeled flow conditions, not being actively eroded. A value of zero square meters indicates that the entire surface is above the threshold shear velocity, so saltation is occurring across the entire surface. The greater this value, the greater the amount of area where saltation is not occurring under the modeled wind flow. It is noted that the vegetation deficit correlates with the total area of vegetation cover, and that the surface area below the threshold for transport is effectively a function of the amount of shelter in the lee of the roughness elements such as individual nebkha, plants, and small sand dunes and hummocks.

Table 2-15. Predicted PM_{10} Emissions from Foredune Treatment CFD Simulations

Variable	T0(B)	T1	T2	T3	T4	T5	T6
PM_{10} emissions bare sand (milligrams per second)(A)	603.5	408.0	369.3	244.2	323.5	325.7	296.7
PM_{10} emissions bare sand (milligrams per square meter per second)(A)	0.121	0.082	0.074	0.048	0.064	0.065	0.059
PM_{10} emissions, vegetation deficit (milligrams per second(B)	0.00	0.15	1.14	15.00	4.59	6.53	9.25
Area below threshold shear velocity (square meters)	0.00	57.7	90.5	719.5	282.2	255.8	195.4

Source: DRI (see Attachment 05), modified by State Parks

(A) Emission values are calculated using only the surface area at the intersection of the shear values above threshold and bare ground surfaces.

(B) Vegetation deficit emissions are the amount of predicted emissions from vegetated surface area, which is not included in the bare sand calculations.

The vegetation deficit emission value (milligrams per second) represents the amount of emissions that would be generated from the space covered by the plants if they were absent. In T3 the value of 15 milligrams per second indicates that the vegetation cover is providing a means to remove this emission rate to the air stream and hence the T3 vegetation cover is the most effective in modulating the emissions on a mass per unit time basis for the modeled flow condition.

DRI's CFD simulations of flow over the six foredune restoration treatment areas provide a means to characterize how topography and vegetation cover modulate sand transport and dust emissions. As the foredune restoration areas evolve, simulations using updated digital terrain maps (DTMs) created by UCSB two times per year, and the established boundary wind condition can be used to update the metrics in Table 2-14 and evaluate how potential sand transport and dust emissions change as a function of changes in foredune topography and vegetation and inform adaptive management decisions. In turn, these values can be used to quantify one of the six assessment indicators (dust emission control potential) used to cumulatively assess and rank the performance of the restoration treatments over time (Walker et al., 2022).[35] CFD simulations may also provide information on how foredune emissions modulate PM_{10} emissions within the DRI air quality model, although such evaluations would be complex.

2.3.5 PI-SWERL/Emissivity Monitoring

Since 2013, DRI has undertaken PI-SWERL measurements of PM_{10} emissivity across the ODSVRA in riding and non-riding areas. Some measurements have been repeated over time by revisiting the 2013 sampling locations, while others have been made in areas deemed critical to understanding changes in emissivity throughout the ODSVRA. In total, between 2013 and 2022, DRI has conducted more than 1,000 individual PI-SWERL emissivity tests within the ODSVRA riding area and more than 500 individual PI-SWERL emissivity tests outside the riding area. Below is a summary of PI-SWERL testing and analyses undertaken by DRI during the 2023 ARWP reporting period (August 1, 2022, to July 31, 2023).

2.3.5.1 May 2022 ODSVRA Riding and Non-Riding Areas

In May 2022, DRI completed a PI-SWERL campaign consisting of 216 tests from both inside and outside of the ODSVRA open riding and camping area (see Figure 2-14).[36] This sampling repeated measurements at 100 locations previously sampled in 2013 and 2019. Due to topographic changes in the dune environment, specifically in non-riding areas that limited safe access, new measurement locations were established during the May 2022 campaign. In addition, some previously measured locations in the open riding and camping areas, as well as the foredune restoration sites, were also moved due to nesting bird restrictions, plant growth and/or dune development. When repeat sample locations were not accessible, new sampling locations were selected in areas as close to the previously sampled location as feasible. The mean relations between emissivity (F), in terms of milligrams per square meter per second (mg/m^2s), and shear velocity (u_*) in terms of meters per second for riding and non-riding areas are summarized in Figure 2-15.

[35] Walker, I. J., Hilgendorf, Z., Gillies, J. A., Turner, C. M., Furtak-Cole, E., & Nikolich, G. (2023). Assessing performance of a "nature-based" foredune restoration project, Oceano Dunes, California, USA. *Earth Surface Processes and Landforms*, *48*(1), 143-162.

[36] Although the May 2022 sampling occurred during the2022 ARWP reporting period (August 1, 2021, to July 31, 2022), the analysis of this data was not completed in time to include in the 2022 ARWP. Accordingly, State Parks is reporting on this information in this 2023 ARWP.

Figure 2-14. 2022 PI-SWERL Measurement Locations

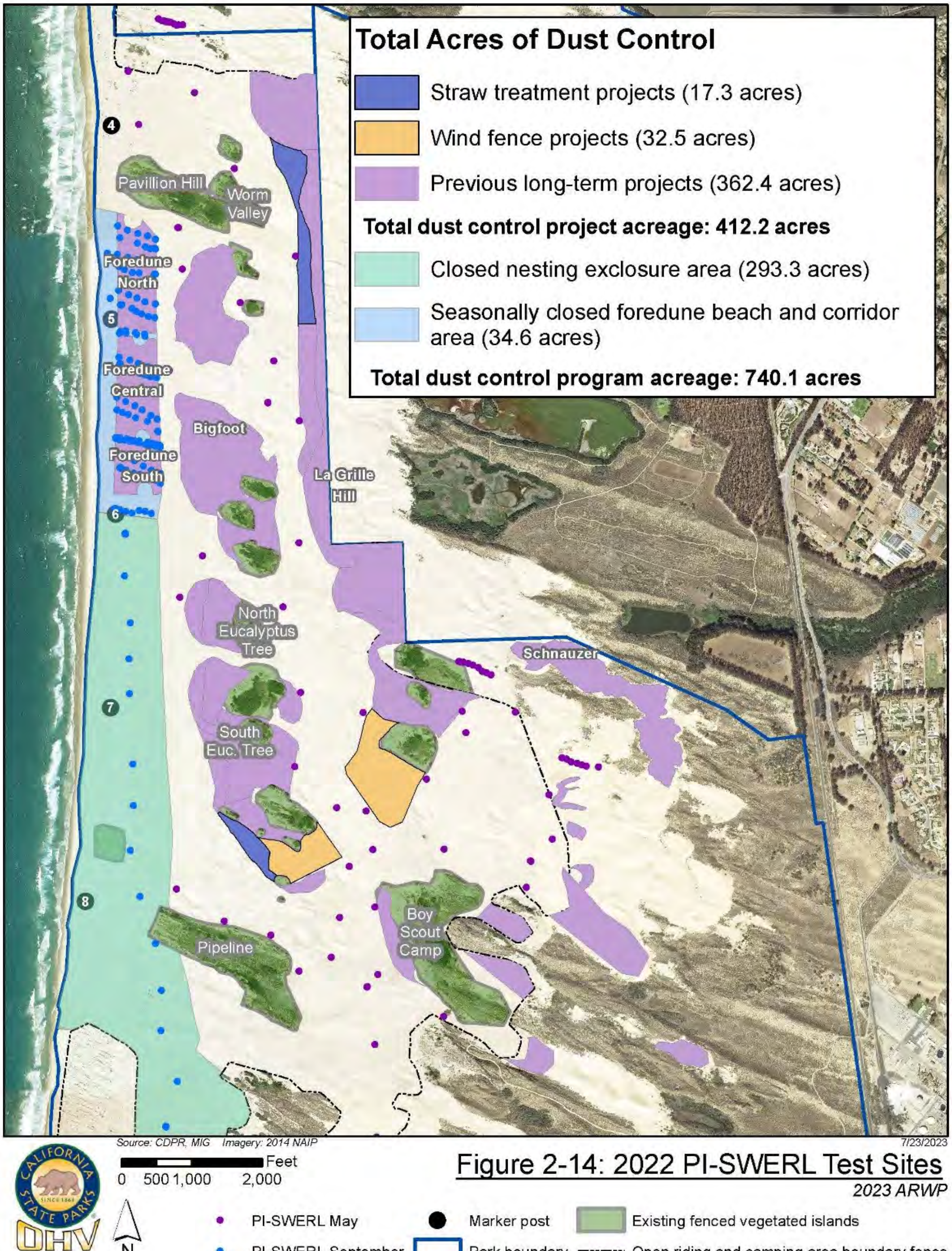
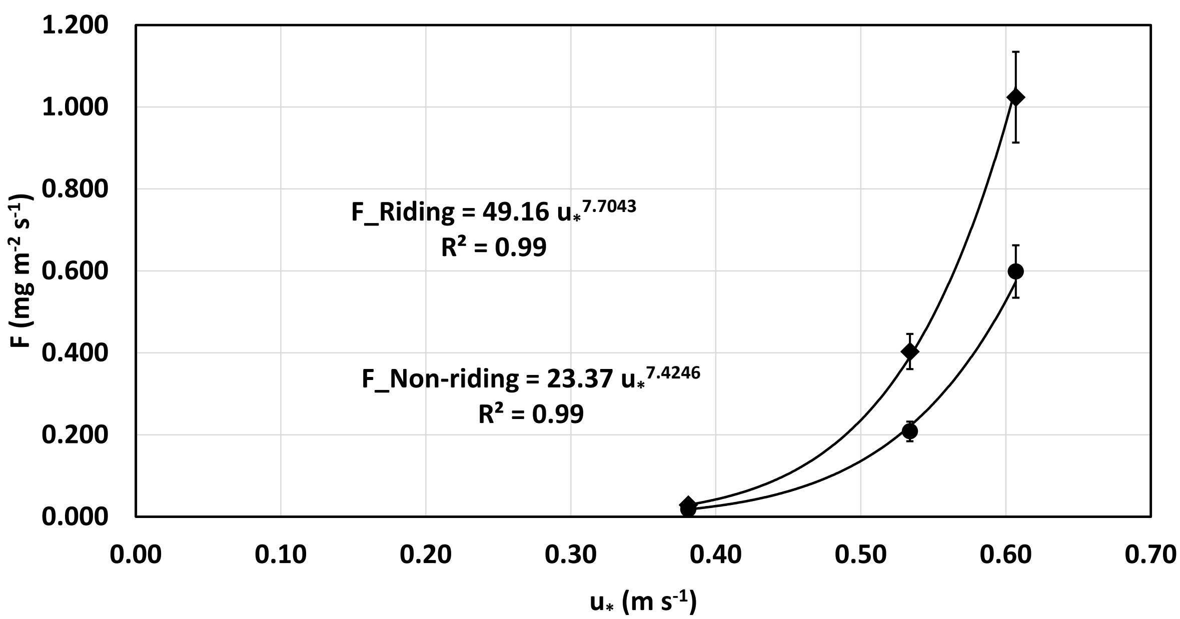


Figure 2-15. Mean Emissivity as a Function of Shear Velocity (Riding and Non-Riding Areas)



The May 2022 mean emissivity (F, in terms of milligrams per square meter per second) as a function of shear velocity (u_*, meters per second) relations for riding (black diamonds) and non-riding areas (black circles). Error bars represent the standard error of the estimate (standard deviation/(number of observations-1)$^{0.5}$).

As shown in Figure 2-15, in May 2022 the mean riding area emissivity was greater than the mean non-riding area emissivity by approximately a factor of 1.73 for equivalent values of u_*. This finding is consistent with observations from previous PI-SWERL campaigns conducted by DRI.

2.3.5.2 September 2022 Nesting Exclosure and Foredune Beach and Transportation Corridor Areas

In September 2022, DRI conducted focused PI-SWERL testing in the six foredune treatment areas (see Section 2.3.2.2), the transportation corridor areas at the foredune restoration site (see Section 2.1.1.5), the nesting exclosure, and the beach to the west of the nesting exclosure (above the high tide line).[37] These areas had either not been measured following a major change to the area (e.g., foredune treatment areas) or had not been measured recently (e.g., nesting exclosure). The surveys were timed to occur prior to the seasonal opening to vehicular recreation (October 1, 2022) of the beach area to the west of the 48-acre foredune and the corridor between the foredune restoration site and the nesting exclosure (see Figure 2-14). Permission to access for PI-SWERL testing was provided daily based on State Parks personnel's assessment of Western Snowy Plover activity and proximity to the PI-SWERL test locations. At the time of the campaign, it was anticipated that the western half of the foredune corridors

[37] PI-SWERL measurements were made between T3 and T4, between T5 and T6, and between T6 and the nesting exclosure.

would be undisturbed since these areas were closed to vehicular recreation starting in April 2022; however, DRI observed that these corridors had been disturbed by sand-moving operations shortly before the measurements were taken. In contrast, the eastern half of the corridors were continually disturbed by vehicular recreation as they provide access to public restrooms.

DRI's September 2022 PI-SWERL measurements were used to develop key emissivity relations in the DRI model applied to this 2023 ARWP, such as the emissivity for the nesting exclosure used in the latest DRI air quality model (see Section 2.2.1.1). The September 2022 measurements indicates the mean emissivity of the 48-acre foredune area, nesting exclosure, and beach area west of the foredune ranged from approximately 12% to 38% lower than the mean non-riding area emissivity for the period 2013 through 2019 and approximately 16% to 50% lower than the mean non-riding area emissivity for just 2019[38]. The September 2022 measurements also indicated that mean emissivity of the foredune transportation corridors, which occupy a small area, was similar to the mean non-riding area emissivity for 2019. Refer to Attachment 11-03, PI-SWERL September 2022 Results and Implications for Emissivity/Dispersion Modeling, for detailed PI-SWERL testing information and results, as well as the SAG's review of DRI's PI-SWERL testing.

2.3.5.3 Analysis of Annual Variability in Riding Area Emissivity

State Parks' 2022 ARWP includes a summary of a preliminary analysis of annual PI-SWERL data conducted by DRI that compared the relation between mean emissivity and shear velocity for years when PI-SWERL surveys were conducted at ODSVRA (2013, 2014, 2015, 2016, 2019, and through May 2022). This preliminary analysis demonstrated that emissivity in the riding area has generally declined from 2013 to 2022.

In June 2023, the SAG completed a comprehensive analysis of the existing PI-SWERL data collected to date to make recommendations for creating an emissivity grid that could be incorporated into future DRI modeling efforts designed to evaluate potential excess emissions of PM_{10} from the ODSVRA (see Section 3.3). Refer to Attachment 06, SAG Recommendations for Establishing Emissivity Grids to be Used in the Modeling of Pre-Disturbance Conditions and Future Excess Emissions Reductions, for the SAG's analysis. State Parks is currently reviewing the SAG's analysis and recommendations. This review is anticipated to be complete by fall 2023.

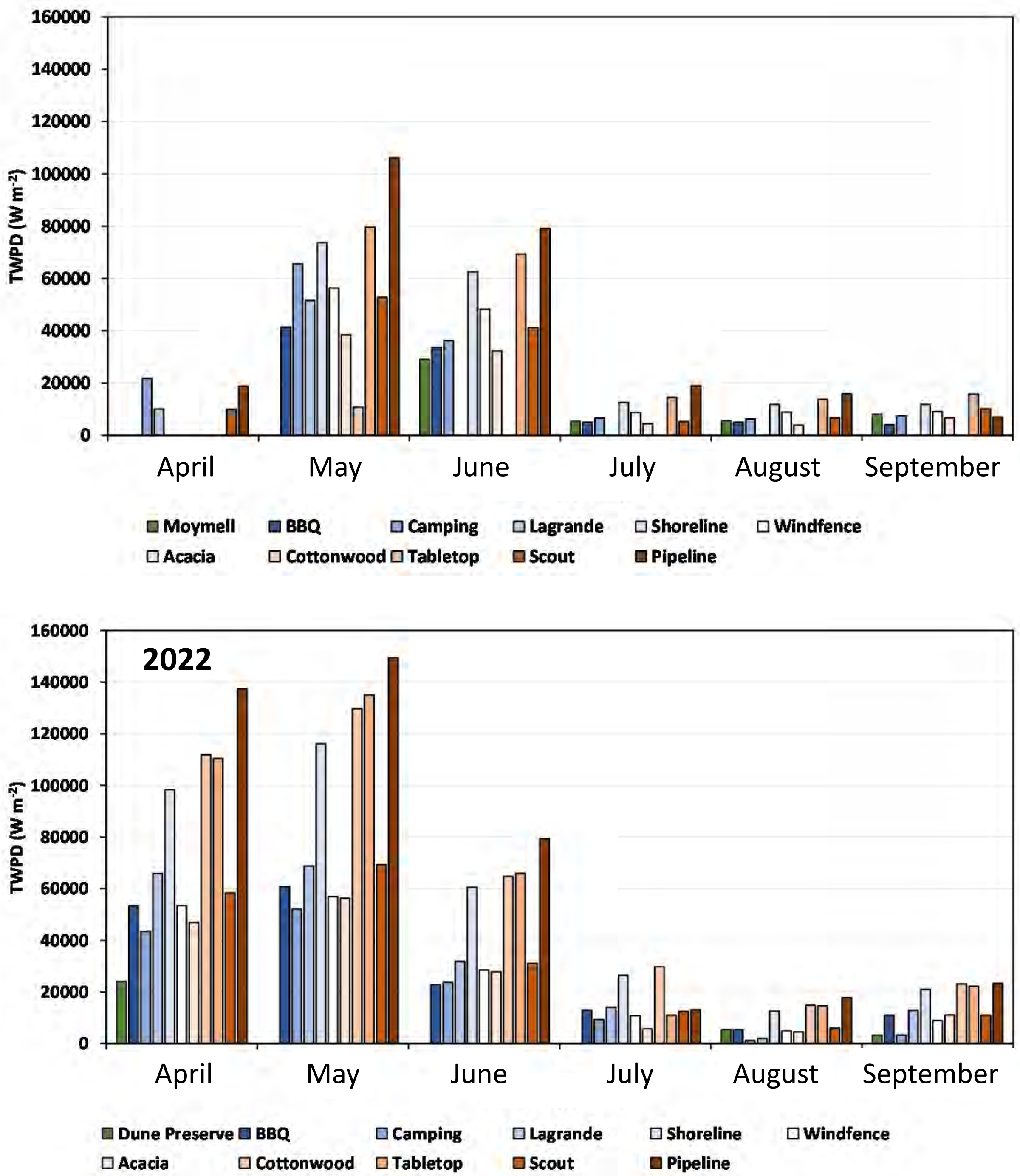
[38] These comparisons do not include any comparisons with just non-riding area data for 2013; the 2022 PI-SWERL data are consistently lower than the amalgamated non-riding area data for 2013 through 2019 as well as just the 2019 data.

2.3.5.4 Total PM_{10} and Total WPD, April to September 2022 (In-Park Stations)

DRI has used the PM_{10} data measured at CDF and Mesa2 and the wind data measured at State Parks' S1 meteorological tower, or at other suitable meteorological network monitoring stations (see Section 2.3.1), to demonstrate that the dust emission system in the ODSVRA produces less PM_{10} now than it did prior to the emplacement of dust controls and that this reduction in PM_{10} scales with the increase in acres of dust control. The metric used to evaluate the production of PM_{10} from the ODSVRA is the ratio of TPM_{10}:TPWD. DRI's analysis of the TPM_{10}:TPWD ratio as a function of the amount of dust control measures installed at the ODSVRA for the SLOAPCD's CDF and Mesa2 air quality monitoring stations is summarized in Section 2.2.4.1. DRI has also analyzed the TMP_{10}:TWPD ratio as a function of dust control acreage for the in-park PM_{10} monitoring stations described in Section 2.3.1 and shown in Figure 2-6. Below is a summary of this analysis. Refer to Attachment 07, In-Park Increments of Progress, TPM_{10}:TPWD, April to September 2022, for DRI's report on increments of progress for in-park monitoring stations for the 2021-2022 period.

The TWPD by month for the period from April to September in 2021 and 2022 for each in-park monitoring station is shown in Figure 2-16. The total WPD and PM_{10} at each monitoring location is quantified by summing the hourly mean values for the hours when Met One 212 BAM PM_{10} concentrations are paired with the station-measured wind speed. The threshold for summation was determined by DRI by first examining the relation between average PM_{10} and mean wind speed for monitoring stations spanning the ODSVRA from north to south (Dune Preserve, Cottonwood, and Pipeline; see Figure 2-6). In 2022, similar to 2021, DRI observed that concentrations of PM_{10} began to increase at most stations when the wind speeds measured at approximately 3.5 meters above ground level exceeded 6.5 meters per second (equivalent to approximately 8.5 meters per second at 10 meters above ground level) and used as the lower limit for mean hourly wind speed and PM_{10} concentration summations. DRI did not apply a wind directional filter to in-park measurement locations as these stations are surrounded by sand that can be mobilized from any direction. In contrast, for stations located downwind of the ODSVRA open riding and camping area (i.e., CDF, Phillips 66, SODAR, and Haybale), DRI filtered data by direction (236°to 325°) to ensure PM_{10} was originating from the direction of the ODSVRA, as the PM_{10} at these stations is being dispersed by the wind over mostly vegetation-covered surfaces and there is likely no additional contribution of PM_{10} from local saltation processes near these stations.

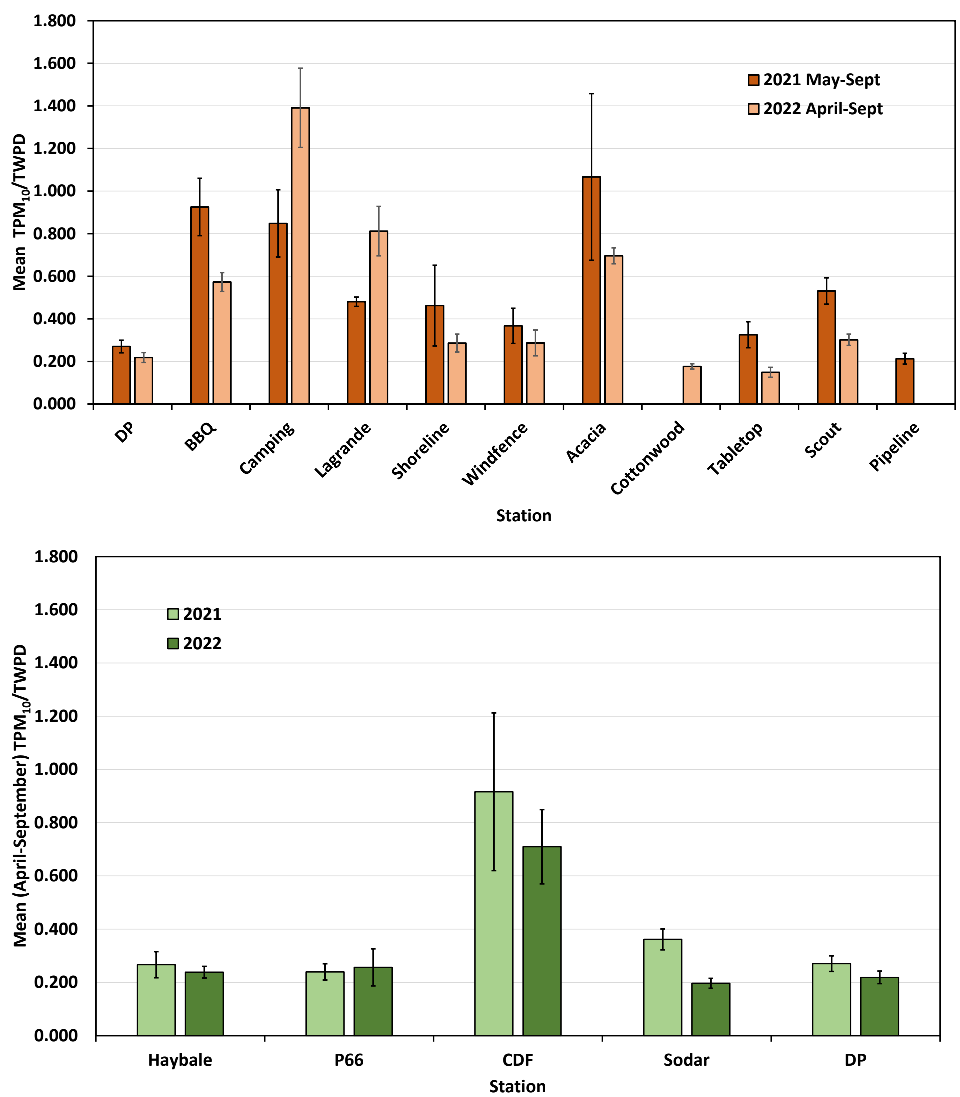
Figure 2-16. Total Wind Power Density, April to September 2021 and 2022 (In-Park Stations)



TWPD for the in-park stations for available data from April to September 2021 (top) and April to September 2022 (bottom). At some stations, TWPD reached greater values in 2022 than in 2021. Note the abrupt change in TWPD transitioning from spring (April to June) to summer (July to September) in 2021 and 2022.

The change in the TPM_{10}:TWPD ratio for the in-park and out-of-park stations for available data from April to September in 2021 and 2022 is shown in Figure 2-17. As shown in Figure 2-17, for the period from April to September in 2021 and from April to September in 2022, the mean seasonal TPM_{10}:TWPD ratio for the in-park stations decreased for six of the stations (Dune Preserve, BBQ, Shoreline, Windfence, Tabletop, and Scout) and increased for two of the stations (Camping and Lagrande); data are missing for Cottonwood in 2021 and Pipeline in 2022 due to instrument failures. The out-of-park stations (Haybale, CDF, and Philips 66) do not appear to have changed between 2021 and 2022 based on the overlap of the standard deviation of the mean values, with only SODAR being lower in 2022 than in 2021.

Figure 2-17. Mean TPM_{10}:TWPD Values, April to September 2021 and 2022



Mean seasonal TPM_{10}:TWPD values for available data from April to September 2021 and 2022 for in-park (top) and out-of-park (bottom) stations.

The results of DRI's latest increments of progress evaluation indicate that even though the TWPD values were much greater in 2022 than in 2021, the production of PM_{10} during the April to September 2022 period was lower than in 2021. These data further support the observation that the trend of a decreasing TPM_{10}:TWPD ratio is a function of increasing acres of dust control, as the majority of stations within the ODSVRA riding area also show a reduction in their TPM_{10}:TWPD ratio from 2021 to 2022 (see also Section 2.2.4 and Figure 2-4 and Figure 2-5).

2.3.6 VEGETATION MONITORING

From August 1, 2022, to July 31, 2023, State Parks developed and reported the vegetation sampling methods described below in consultation with the SAG's vegetation working group.

2.3.6.1 Line Intercept Transect Sampling Method

The line intercept method was used to estimate the percent cover of species within the 48-acre foredune project, backdune areas, and three reference sites that had been closed to vehicular activity for at least 20 years and not subject to restoration plantings in the past. Within each foredune area and reference site, a total of four 30-meter transects were sampled. Within each backdune area and reference site, a total of three 30-meter transects were sampled. Backdune sampling includes early seral and late seral reference sites.

State Parks sampled the following areas in 2022:[39]

- The 48-acre foredune area (20-VG-01, 20-VG-02, and 20-VG-03, planted in February 2020). This area was also surveyed in 2020 and 2021. The same transect lines were surveyed in 2020, 2021, and 2022.
- Three backdune vegetation projects perpendicular to marker post 6, one planted in 2018 (18-VG-02, 9.3 acres), one planted in January 2020 (20-VG-04, 20.4 acres), and one planted in February 2021 (21-VG-01, 14.8 acres).

The starting points for the transect lines were randomly selected within each project area using Geographic Information System (GIS) software. Three transect lines in each project area were randomly selected from the eight cardinal and intermediate directions (i.e., north, northeast, east, southeast, etc.). For the foredune site, a fourth transect line was included that was parallel to the prevailing wind direction. 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

[39] New reference site sampling was not conducted in winter 2022 or winter, spring, or summer 2023. A foredune reference site in the North Oso Flaco area of the ODSVRA was sampled in 2022. An early seral reference site in the South Oso Flaco backdunes was sampled in summer 2022. A late seral reference site in the Pipeline/Maidenform vegetation islands was sampled in fall 2021.

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 the seasonal dieback of a perennial plant that was still viable. Once each 30-meter transect was surveyed, a reconnaissance-level survey was conducted of the project area and any additional species present were noted.

The results of State Parks' 2022 line intercept transect sampling are summarized below. Refer to Attachment 08, Summary of Vegetation Monitoring of Restoration Sites at ODSVRA (2022), for detailed information on State Parks line intercept sampling methodology and results.

48-Acre Foredune Project Results

As expected in the first growing season (2020), none of the foredune treatment areas approached the vegetation of the North Oso Flaco reference site (23.0%); however, three of the six treatment areas (T4, T5, and T6) did have species richness (i.e., number of different species) similar to the North Oso Flaco reference site.[40] In 2021, after the second growing season, an increase in vegetation cover was observed in each of the foredune treatment areas, excepting the control area; however, none of the treatment areas met the vegetation cover of the North Oso Flaco reference site. In addition, only one of the six foredune treatment areas (T5) met the species richness of the North Oso Flaco reference site with at least 10 species represented.

In 2022, after the third growing season, none of the treatment areas met the vegetation cover of the North Oso Flaco reference site (23.0%) and only one of the six treatment areas (T6) met the species richness of the reference site with at least 10 species represented.[41] An increase in vegetation cover was documented in three of the six treatment areas (T2, T5, and T6), while two of the treatment areas (T4 and T5) showed a slight decrease in vegetation cover and one treatment area (T1, the control) showed no change. The treatment area that achieved the highest mean percent vegetation cover was T6 with 13.8% cover (compared to 4.02% in 2020 and 12.7% on 2021), followed by T3 with 10.1% cover (compared to 12.3% cover in 2021). Areas T5 and T6 showed the highest level of species richness, with 9 and 10 species represented, respectively. Vegetation coverage was variable between transects in all treatment areas due to the clustered pattern of the vegetation. The results of the foredune line-intercept sampling are

[40] Refer to State Parks 2022 ARWP, Section 2.3.6.1.

[41] T5 richness decreased from 10 species in 2021 to 9species in 2022. State Parks expects species composition to fluctuate as the foredune develops. For example, the species that was not observed in T5 in 2022 was yarrow (*Achillea millefolium*), a "foredune succession" species (in comparison to "foredune pioneer" species) that was included in the 2020 planting of the treatment areas. Given the initial barren nature of the project area it was not known how well the seeds and container plants, especially the succession species, would establish. Yarrow is typically found in stabilized back dune areas and occasionally in foredunes where it finds protection from surrounding plants and may have difficulty surviving high volumes of sand movement. In 2020, Yarrow was planted in T4, T5 and T6 but by fall 2021 it was only observed in T5 and by fall 2022 it was not observed in any of the treatment areas. Similarly, coastal buckwheat (*Eriogonum parvifolium*), another succession species planted in the project area, was not observed in any treatment area by fall 2021.

summarized in Table 2-16.

Table 2-16. Summary of Foredune Line Intercept Sampling Results

Survey Site(A)	Species Richness	Mean Percent Cover	Range in Percent Cover
2021(B)			
Foredune T1 – Control	0	0.0%	0.0%
Foredune T2 – Native seed	4	1.9%	0.0% - 7.6%
Foredune T3 – Native and grain seed	5	12.3%	0.0% - 28.7%
Foredune T4 – Low density nodes	6	5.7%	0.0% - 13.0%
Foredune T5 – High density nodes	10	2.1%	0.0% - 5.6%
Foredune T6 – Parks' classic	8	12.7%	7.5% - 21.3%
Reference Site – North Oso Flaco foredune	10	23.0%	6.2% - 60.1%
2022			
Foredune T1 – Control	2	0.0%	0.0%
Foredune T2 – Native seed	3	2.7%	0.0% - 21.0%
Foredune T3 – Native and grain seed	4	10.1%	0.0% - 24.8%
Foredune T4 – Low density nodes	7	5.1%	0.0% - 8.6%
Foredune T5 – High density nodes	9	6.4%	0.7% - 16.9%
Foredune T6 – Parks classic	10	13.8%	8.2% - 21.4%
Reference Site – North Oso Flaco foredune	10	23.0%	6.2% - 60.1%

Source: State Parks (see Attachment 08).

(A) The foredune was planted in 2020. All foredune treatment areas were approximately 2.5 years old at the time of the 2022 line intercept sampling. State Parks has not conducted its 2023 line intercept survey as of June 30, 2023. State Parks typically conducts this survey once in September or October, when the survey will not disturb nesting Western Snowy Plover and California Least Tern.

(B) Refer to State Parks' 2022 ARWP, Section 2.3.6.1, Table 2-18.

Comparison of Line Intercept Transect Sampling Results with Other Recent Studies

Other recent analyses have evaluated vegetation cover within the ODSVRA using different sources of aerial imagery, including UCSB's historical vegetation report and results derived from the UAS surveys (see Section 2.3.3.1 and footnote 33).

UCSB's historical vegetation report evaluated vegetation coverage in the same area of the North Oso Flaco foredune as State Parks' transect monitoring. The UCSB report found that vegetation cover in the North Oso Flaco foredune ranged from approximately 24.4% in 2012 to approximately 19.1% in 2020. State Parks' 2021 line intercept sampling corroborates these findings, identifying a mean vegetation coverage of 23.0% in the North Oso Flaco foredune. It is noted that State Parks' sampling was based on four randomly selected transects whereas the UCSB analysis evaluated the entire North Oso Flaco area, so a direct comparison of results between these studies must be interpreted accordingly.

The UCSB UAS survey report analyzed vegetation cover within State Parks' 48-acre foredune project. State Parks' line intercept sampling is generally consistent with findings of the UAS survey report, which found vegetation cover increasing with time for all foredune treatments except the control area (T1; see Section 2.3.3.1). One exception is that State Parks' monitoring showed a slight decrease in vegetation cover in T3 and T4 from 2021 to 2022 whereas the UAS surveys showed a seasonal decrease in vegetation cover in T6 from February 2021 to October 2021. The UAS surveys also observed seasonal decreases in cover from October 2022 to February 2023 in T1, T2, T3, and T4. Notably, however, for fall 2022, the State Parks line intercept transect monitoring and the UCSB UAS surveys showed similar vegetation cover levels in T1, T3, T4, and T6. It is noted that the two studies had different ways of defining vegetation, with State Parks using canopy cover (including woody stems and dormant plants) and UCSB using the NDVI method to determine leaf cover (i.e., generally excluding woody stems and dormant plants). State Parks' methods also have smaller sample sizes and a higher degree of variability in vegetation cover between transects.

A comparison of vegetation cover between State Parks' line intercept transect monitoring and the UAS survey report is presented in Table 2-17.

Table 2-17. Comparison of 48-Acre Foredune Treatment Vegetation Cover between State Parks Transect Monitoring and UAS Survey Report

Survey	Foredune Treatment Area Percent Vegetation Cover					
	T1	T2	T3	T4	T5	T6
Fall 2020 State Parks transects	0.00%	0.10%	4.02%	0.76%	0.40%	3.57%
October 2020 UAS surveys	0.02%	0.41%	2.66%	0.87%	1.65%	2.54%
February 2021 UAS surveys	0.02%	0.50%	2.66%	1.08%	2.08%	4.02%
Fall 2021 State Parks transects	0.00%	1.91%	12.31%	5.69%	2.14%	12.66%
October 2021 UAS surveys	0.14%	1.85%	4.87%	1.93%	3.63%	3.54%
February 2022 UAS surveys	0.08%	1.74%	4.55%	2.24%	4.64%	11.35%
Fall 2022 State Parks transects	0.00%	5.25%	10.13%	5.14%	6.43%	13.79%
October 2022 UAS surveys	0.26%	3.45%	11.47%	6.03%	9.57%	14.82%
February 2023 UAS surveys	0.12%	2.68%	8.93%	5.52%	9.66%	14.83%

Source: State Parks (see Attachment 08).

<u>*Backdune Project Results*</u>

Each of the backdune project areas that were surveyed showed healthy levels of vegetation coverage and similar vegetation composition as compared to the early seral reference site. Of the 20 native species present within the early seral reference site, the project areas had between 12 and 14 of them and a total native species richness of between 22 and 26 species. The dominant species within the early seral reference site, *Lupinus chamissonis*, showed similar percent cover in the project areas with mean cover ranging from 24.0% to 33.9% as compared to 29.3% in the reference site; however, all project areas had an overall lower percent cover than both the early and late seral reference sites. State Parks anticipates vegetation growth and coverage will continue and will approach the reference site's condition within the upcoming growing seasons. The results of the backdune line-intercept sampling are summarized in Table 2-18.

Table 2-18. Summary of Backdune Line Intercept Sampling Results

Survey Site	Age of Planting (years)	Species Richness	Mean Percent Cover	Range in Percent Cover
Bigfoot West (20-VG-04)	2.5	22	36.1%	18.8% - 53.9%
Bigfoot East (21-VG-01)	1.5	26	29.8%	27.2% - 32.1%
Pawprint (18-VG-02)	4.5	26	38.9%	20.4% - 70.5%
Reference site – early seral	-	22	68.8%	63.2% - 76.7%
Reference site – late seral	-	15	77.1%	76.2% - 78.7%

Source: State Parks (see Attachment 08).

2.3.6.2 Photo Point Monitoring

In 2022, State Parks continued its on-the-ground and drone photo point monitoring of backdune and foredune project areas.

On-the-ground photo point monitoring of the 48-acre foredune project has occurred since 2020. Initial photo point monitoring occurred before the installation of the foredune in February 2020. Subsequent monitoring has occurred in May 2020, October 2020, October 2021, and October 2022. 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.

On-the-ground photo point monitoring of backdune areas has occurred annually since 2018 and was conducted again in the summer and fall of 2022. Backdune photo points are positioned to capture changes within the general areas where backdune projects are located. The number of photos for each photo point and the number of photo points vary at each location to sufficiently capture each area. In total, 45 photo points were monitored in the backdunes in 2022.

State Parks drone, or UAS, aerial imagery photo point monitoring has occurred since 2020. For the foredune project, drone photo points were taken in May 2020, December 2020, December 2021, and December 2022. Two photo points were taken of each treatment area (one from the east and one from the west for each area).

Drone photo points were also conducted within the backdune project areas in December 2020, December 2021, and December 2022. The number of photos for each photo point and the number of photo points varied at each location to sufficiently capture each area. Drone photo point monitoring of the foredune and backdune areas is scheduled to continue into 2023.

Select photo point examples are shown in Figure 2-18, Figure 2-19, and Figure 2-20. Refer to Attachment 08 for detailed information on State Parks' photo point sampling methodology and results.

Figure 2-18. Example Ground Photo Point Monitoring – Foredune Project

Top: Ground photo point of foredune treatment area 3 prior to treatment. The photo is facing north and was taken on February 4, 2020. Bottom: Ground photo point of the same foredune treatment area after 2.5 years of growth. The photo was taken on October 18, 2022.

Figure 2-19. Example Ground Photo Point Monitoring – Backdune Project

Top: Ground photo point of backdune vegetation project west of the North Eucalyptus Tree vegetation island (19-VG-02). The photo is facing northeast and was taken on October 17, 2018. Bottom: Ground photo point of the same backdune vegetation project after four years of growth. The photo was taken on October 19, 2022.

Figure 2-20. Example Drone Photo Point Monitoring – Backdune Project

Top: Drone photo point of backdune vegetation projects near the Bigfoot restoration area (20-VG-04). Darkest areas are established vegetation islands. Lighter, olive colored areas, are initial treatment areas. The dark area to the right is part of the 48-acre foredune treatment. The photo is facing south and was taken on May 8, 2020. Bottom: Drone photo point of the same backdune vegetation projects on February 16, 2023. Initial treatment areas can now be seen converted to vegetated areas.

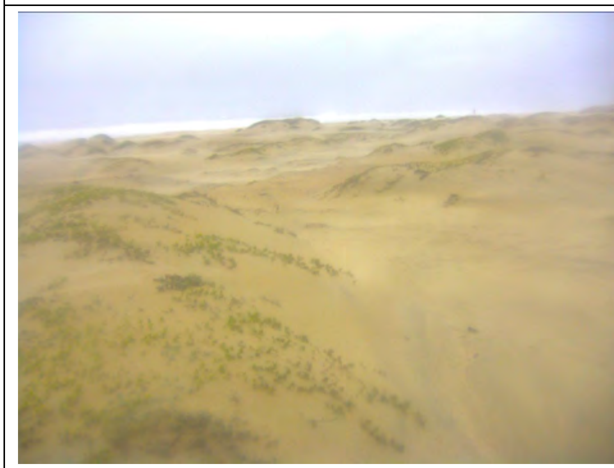
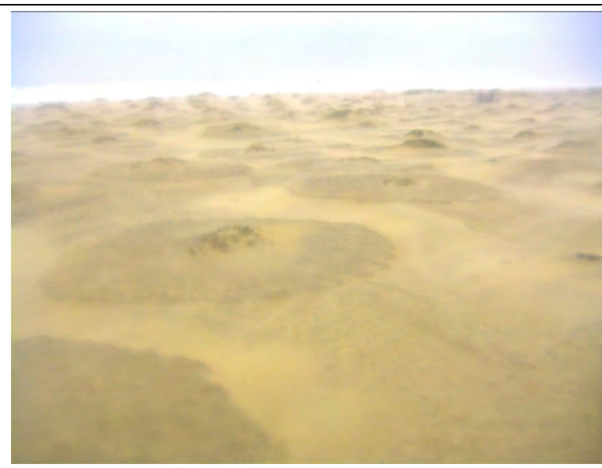
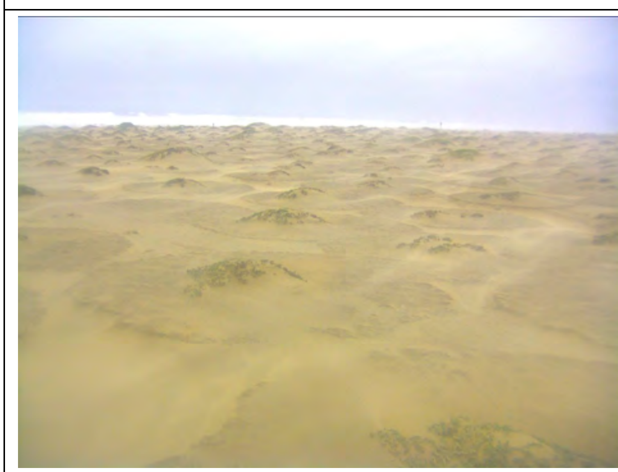
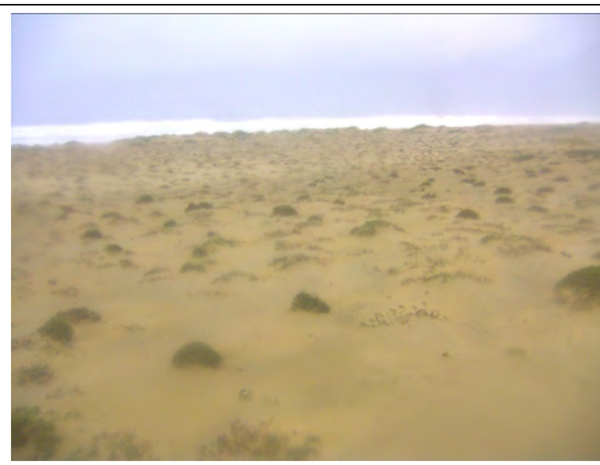
2.3.6.3 Foredune Restoration Project Time-Lapse Photography

In May 2020, State Parks, in coordination with UCSB, installed time-lapse cameras on each of the six foredune treatment area meteorological monitoring stations (see Section 2.3.2.2 and Figure 2-8). The purposes of the cameras are to observe and examine the development and response of the foredune restoration treatments to wind and sand transport events and characterize various formative events (e.g., sediment transport, plant growth, bedform development and migration, erosion events, etc.) at a relatively high temporal frequency. The time-lapse cameras face upwind, roughly west-northwest, and capture oblique images every 30 minutes from 7:00 AM to 5:30 PM local time.

Since deployment of the cameras in May 2020, over 20,000 images have been captured at each restoration treatment area, although not all images are of acceptable quality due to fog, rain, lens fouling, and other factors. UCSB began preliminary analysis of the pre-processed imagery began in late 2022, focusing on data collected over one month (January 2023) to test and verify methods of photo image analysis and provide insight into next steps, limitations, and benefits of the imagery for the restoration project. The January 2023 dataset was selected because the restoration treatments had three years to develop by this time and differences in sediment transport across the plots could be assessed. Additionally, there were noted sediment transport events in this month and the image quality was high for all treatment plots. The images were classified, coded, analyzed, compiled into time series videos, and related to the wind speed, direction, and threshold TWPD collected at each respective monitoring station and time-lapse camera location. An example of imagery obtained from the cameras during a high-magnitude transport event is shown in Figure 2-21.

UCSB has completed a draft analysis of the time-lapse photo monitoring at the ODSVRA. This report is currently under review by State Parks as per the Scientific Review Process, but refer to Attachment 09, Preliminary Analysis of Time-Lapse Photo Monitoring Stations at the ODSVRA Foredune Restoration Site, for preliminary information on the methods and data, used in UCSB's time-lapse photo analysis.

Figure 2-21. Example Time-Lapse Photography Obtained from Camera Monitoring Stations in Foredune Treatment Plots

	
T1	T2
	
T3	T4
	
T5	T6

Images show a large sediment transport event on January 9, 2023, at 7:32 AM Pacific Standard Time (PST) in T1 through T6.

2.3.7 Evaluation Metrics

State Parks' 2021 ARWP incorporated a new set of evaluation metrics intended to provide a streamlined dashboard for reporting PMRP evaluation metrics, tracking Dust Control Program progress, and informing adaptive management strategies at the ODSVRA. The updated evaluation metrics include "Dust Mitigation Targets" that compile specific, measurable endpoints and "Dust Mitigation Indicators" that document progress in key areas that lack a specific, measurable target or endpoint for various reasons.

To provide continuity with past ARWP documents, State Parks' summary report on PMRP evaluation metrics is provided below. Refer to Attachment 10, 2023 PMRP Evaluation Metrics, for a detailed summary of evaluation metrics.

2.3.7.1 Dust Mitigation Targets

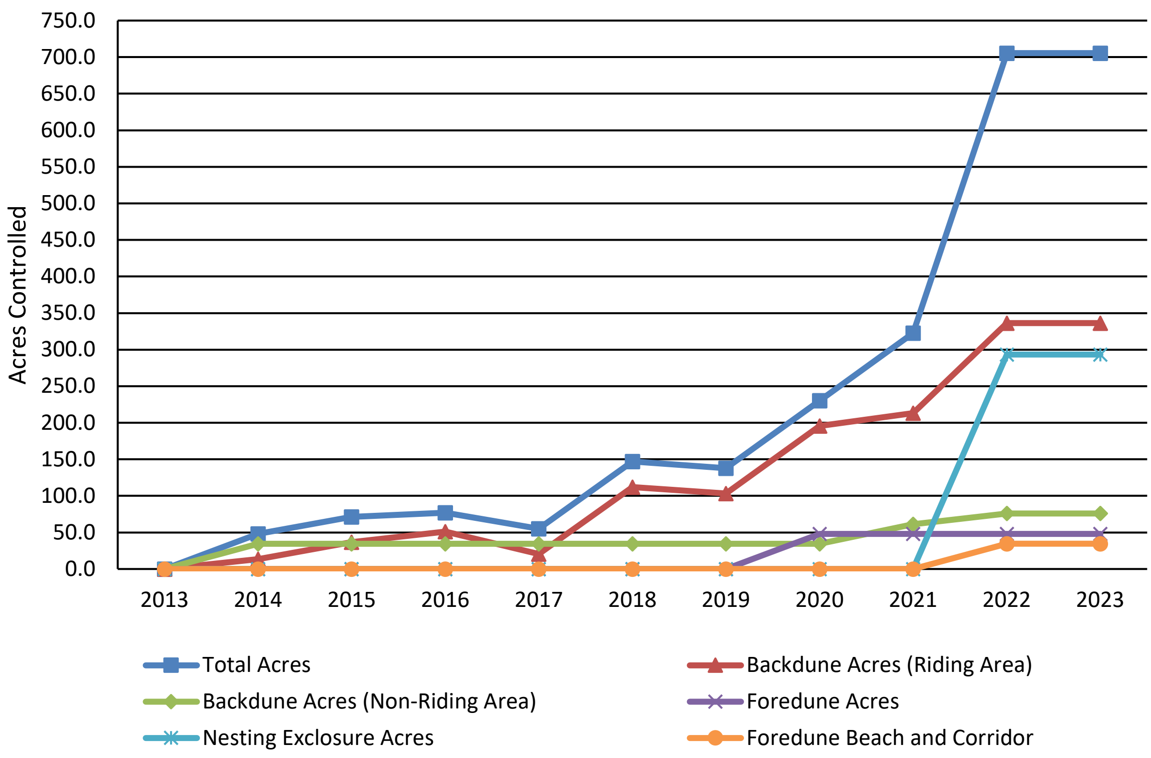
Key dust mitigation targets include the amount of cumulative dust control measures installed at the ODSVRA, the PM_{10} mass emissions reductions achieved from the ODSVRA (as of July 31 of the ARWP reporting year), and the 24-hour average PM_{10} concentration reductions achieved at the CDF and Mesa2 air quality monitoring stations (as of July 31 of the ARWP reporting year).

Dust mitigation targets are compared against 2013 baseline conditions as set forth in the original SOA (see Section 2.2); however, the new excess emissions framework established by the October 2022 SOA amendments will likely result in new evaluation metrics in the future (see Section3.4.2).

Dust Mitigation Treatments

Compared to 2013 baseline conditions, when there were no long-term dust control measures at the ODSVRA, State Parks now manages 740.1 acres of land for dust control benefits (see Figure 2-22). Nearly 90% of this managed land is located inside the ODSVRA open riding and camping area. Refer to Section 2.1 for State Parks' detailed report on dust control measures installed at the ODSVRA as of July 31, 2023.

Figure 2-22. ODSVRA Dust Mitigation Treatments, July 31, 2013, to July 31, 2023



PM_{10} Mass Emissions and Concentration Reductions

As of July 31, 2023, State Parks has reduced mass emissions at the ODSVRA to levels below the original pre-disturbance scenario and the revised pre-disturbance scenario that uses 2013 PI-SWERL data (revised scenario 2), but not the revised pre-disturbance scenario that uses 2019 PI-SWERL data (revised scenario 1). Refer to Section 2.2.2.1 for State Parks' detailed report on PM_{10} mass emissions reductions at the ODSVRA as of July 31, 2023.

As of July 31, 2023, State Parks has reduced 24-hour average PM_{10} concentrations at the SLOAPCD's CDF and Mesa2 air quality monitoring stations to levels below the concentration estimates that DRI predicts would have occurred at the CDF and Mesa2 stations under the original 1939 pre-disturbance modeling scenario. As described in more detail in Section 2.2.1, DRI modeling indicates 24-hour average PM_{10} concentrations at CDF and Mesa2 for the original 1939 pre-disturbance scenario were 88.0 µg/m^3 and 71.2 µg/m^3, respectively.

State Parks continues to make progress towards the CAAQS standard of 50.0 µg/m^3 as required by original SOA Condition 2.b. Compared to 2013 baseline 24-hour average PM_{10} concentrations (124.7 µg/m^3 and 95.7 µg/m^3 at the SLOAPCD's CDF and Mesa2 air quality monitoring stations, respectively), the revised DRI model estimates State Parks has reduced PM_{10} concentrations to 60.9 µg/m^3 at CDF (see Table 2-10) and 62.5 µg/m^3 at Mesa2 (see Table 2-11). Refer to Section 2.2.3 for State Parks' detailed report on 24-hour average PM_{10}

concentration reductions downwind of the ODSVRA as of July 31, 2023.

2.3.7.2 Dust Mitigation Indicators

Key dust mitigation indicators include the number of high wind days and the number of exceedances of the state and federal ambient air quality standards, the status of the 48-acre foredune restoration project, and the amount of backdune stabilization occurring under the Dust Control Program. Dust mitigation indicators are compared against 2013 baseline conditions where appropriate but do not have a specific measurable target or goal to achieve.

Air Quality Indicators

Between January 1, 2023, and June 26, 2023, the number of high wind event days at the SLOAPCD's CDF air quality monitoring station was higher (72 days) compared to the number of days for the same period in 2019 (30 days), 2020 (55 days), 2021 (51 days), and 2022 (64 days).[42] However, the number of days in which the 24-hour average PM_{10} CAAQS of 50 μg/m^3 was exceeded at the SLOAPCD's CDF air quality monitoring station in 2023 (12 days) lower than the same comparable period in 2019 (16 days), 2020 (30 days), 2021 (28 days), and 2022 (54 days). Likewise, the number of days in which the 24-hour average PM_{10} CAAQS of 50 μg/m^3 was exceeded at the SLOAPCD's Mesa2 air quality monitoring station in 2023 (11 days) was lower than the same comparable period in 2019 (14 days), 2020 (28 days), 2021 (30 days), and 2022 (38 days).[43] There were no exceedances of the NAAQS of 150 μg/m^3 at either the CDF or Mesa2 air quality monitoring stations during the listed period. The last exceedance of the NAAQS occurred at the CDF air quality monitoring station in 2013.

Foredune Restoration

In its third growing season (2022), there was a general increase in vegetation cover in each of the foredune treatment areas, with the exception of the control area. However, all treatments showed a decline in vegetation cover from October 2022 to February 2023. This is likely associated with wet and stormy winter conditions during this interval, resulting in plant cover declines (e.g., burial of low-lying plants by sand) and erosion along the seaward margins of the plots. As of February 2023, T6 had the highest vegetation coverage with 14.8%, followed by T5

[42] The SLOAPCD defines "high wind event day" as any day when the 3:00 PM PST hourly wind speed at the CDF air quality monitoring station exceeds 8 miles per hour and the 1:00 PM PST hourly wind direction is between 290 and 360 degrees. Resultant wind speed data for CDF (USEPA Air Quality System ID #060792007) are from CARB's Air Quality and Meteorological Information System website (Subject Top Page: AQMIS 2 - Air Quality and Meteorological Information System). Data may be preliminary.

[43] The 2023 estimate of the number of days above the CAAQS at the CDF air quality monitoring station (12) is based on standard conditions and was provided by the SLOAPCD in their comments on State Parks Draft 2023 ARWP. Otherwise, daily average PM_{10} Beta Attenuation Mass (BAM) data for the CDF (USEPA Air Quality System ID #060792007) and Mesa2 ((USEPA Air Quality System ID #060792004) air quality monitoring stations are from CARB's Air Quality and Meteorological Information System website (Subject Top Page: AQMIS 2 - Air Quality and Meteorological Information System). Data may be preliminary.

with 9.7%, T3 with 8.9%, T4 with 5.5%, T2 with 2.7%, and negligible vegetation in T1 (control site; see Section 2.3.3.1). The greatest year-over-year change occurred in T6, which went from approximately 7% coverage in February 2022 to approximately 15% coverage in February 2023. In 2023, species richness generally remained static in each of the treatment areas as compared to findings in 2022. Refer to Section 2.3.6 for detailed information on State Parks' vegetation monitoring activities.

Backdune Stabilization

Compared to 2013 baseline conditions, when there were no long-term dust control measures at the ODSVRA, State Parks now manages 740.1 acres of land for dust control benefits, including the 293.3-acre plover exclosure and 34.6-acre foredune beach and corridor area. Excluding these areas, State Parks has installed 412.2 acres of total dust control measures at the ODSVRA, including 364.2 total acres of backdune stabilization measures. As of July 31, 2023, backdune stabilization consists of 314.4 acres of vegetation, 17.3 acres of straw treatments, and 32.5 acres of wind fencing. Refer to Section 2.1 for State Parks' detailed report on dust control measures installed at the ODSVRA as of July 31, 2023.

2.4 REPORT ON OTHER DUST CONTROL PROGRAM-RELATED ACTIVITIES

Chapter 7 of State Parks' approved PMRP describes potential actions that State Parks, the SAG, and the SLOAPCD may undertake to further support and inform the overall adaptive management approach to dust control at the ODSVRA. State Parks' report on other dust control program-related activities is provided below.

2.4.1 SAG Responses to Studies

During the 2023 ARWP reporting period (August 1, 2022, to July 31, 2023), the SAG provided formal responses to and reviews of the studies and reports listed below. Refer to Attachment 11, Compilation of Studies Reviewed and Comments Provided by the Scientific Advisory Group from 08/01/22 to 07/31/23, for copies of the studies reviewed and the comments provided by the SAG.

Report: Increments of Progress Towards Air Quality Objectives – ODSVRA Dust Controls 2022 Update
Author: DRI
Draft Date: Fall 2022
Date State Parks Requested SAG Review: August 1, 2023
SAG Response Date: August 28, 2023
Final Publication Date: Report not yet published

Report: Quantifying the Source Attribution of PM_{10} Measured Downwind of the ODSVRA
Author: DRI/SLOAPCD
Draft Date: Fall 2022
SAG Response Date: November 23, 2022 (see Attachment 11-02)
Final Publication Date: April 15, 2023 (see Attachment 11-02)

Report: PI-SWERL September 2022 Results and Implications for Emission/Dispersion Modeling
Author: DRI
Draft Date: Fall 2022 (See Attachment 11-03)
SAG Response Date: February 10, 2023 (see Attachment 11-03)
Final Publication Date: Not Applicable

Report: SAG Framework for Assessing Excess Emissions of PM_{10} from the ODSVRA
Author: SAG/DRI
SAG Draft Date: January 30, 2023 (see Attachment 11-04)
DRI Draft Date: April 2023 (see Attachment 11-04)
SAG Review of DRI Draft: April 19, 2023 (see Attachment 11-04)
Final Publication Date: June 21, 2023 (see Attachment 06)

2.4.2 SAG Participation In Meetings

During the 2023 ARWP reporting period (August 1, 2022, to July 31, 2023), the SAG participated in various meetings. Table 2-19 lists significant meetings of the full SAG, meetings of the SAG with other entities, and presentations by SAG members at public events.

Table 2-19. SAG Participation in Meetings, August 2022 to July 2023

Date(s)	Meeting Name	SAG Role	Participants
August 5, 2022	SAG monthly meeting	Discussion of 2022 ARWP activities and revised SOA	SAG
September 23, 2022	SAG monthly meeting	Discussion of 2022 ARWP activities and revised SOA	SAG
October 11, 2022	SLOAPCD Hearing Board pre-meeting	Coordination with SLOAPCD and State Parks for Hearing Board meeting	SAG, SLOAPCD, State Parks
October 14, 2022	SLOAPCD Hearing Board meeting and ARWP Public Workshop	Presentation of SAG review of 2022 ARWP	SAG, SLOAPCD, State Parks, Hearing Board
October 20, 2022	SAG quarterly meeting (in person at ODSVRA)	Discussion of all activities relating to SAG issues	SAG, State Parks, SLOAPCD
November 8, 2022	SAG monthly meeting	Extended discussion of ARWP activities	SAG

Table 2-19. SAG Participation in Meetings, August 2022 to July 2023			
Date(s)	**Meeting Name**	**SAG Role**	**Participants**
November 22, 2022	SAG membership discussion	Coordination with SLOAPCD, CARB, and State Parks on SAG membership	SAG, SLOAPCD, State Parks, CARB
December 12, 2022	SAG membership discussion	Coordination with SLOAPCD, CARB, and State Parks on SAG membership	SAG, SLOAPCD, State Parks, CARB
January 6, 2023	SAG monthly meeting	State of the Science completion	SAG
February 3, 2023	SAG monthly meeting	State of the Science completion and other issues	SAG
February 23/24, 2023	SAG quarterly meeting (in person at ODSVRA)	Discussion all activities relating to SAG issues	SAG, State Parks, SLOAPCD
March 16, 2023	SAG monthly meeting	Excess emissions framework, upcoming field activities	SAG
April 18, 2023	SAG quarterly meeting	Excess emissions framework, emissivity grids, 2023 ARWP, source attribution	SAG
May 11, 2023	SAG monthly meeting	Discussion of 2023 ARWP, excess emissions, public relations campaign	SAG
June 15, 2023	SAG quarterly meeting	Discussion of 2023 ARWP	SAG, State Parks, SLOAPCD
July 20, 2023	SAG monthly meeting	"Apples to oranges" modeling issue and implications for the ARWP	SAG

2.4.3 Other Sources of Dust

The SOA, as amended, recognizes that PM_{10} concentrations measured at CDF and on the Nipomo Mesa may come from various sources external to the ODSVRA.[44] Accordingly, State Parks and the SLOAPCD continue to study other potential PM_{10} emission sources and their relative contributions to PM_{10} concentrations on the Nipomo Mesa, as summarized below.

[44] See the original SOA, pg. 6,lines 19 to 23, and SOA pg. 14, lines 13 to 15.

2.4.3.1 PM_{10} Speciation Sampling

In 2020, the SLOAPCD collected 13 PM_{10} samples at the CDF air quality monitoring station for speciation analysis to further investigate the amount of salt, inorganic aerosols, crustal material, and other particulate matter in the PM_{10} sampled at the CDF station. The preliminary analysis of these samples was reported in the 2021 ARWP, with the general result being that the number of samples collected (13) was insufficient to allow a robust speciation analysis.[45]

The SLOAPCD and CARB subsequently designed and, in conjunction with DRI, executed a subsequent speciation sampling plan in 2021. In 2023, the results and conclusions of this PM_{10} attribution study were published in the peer-reviewed journal *Atmosphere*.[46] The study evaluated eight days between May and October 2021 when the 24-hour average PM_{10} concentration at the SLOAPCD's CDF air quality monitoring station equaled or exceeded the CAAQS of 50 µg/m^3. The PM_{10} samples for these days were analyzed and used to identify the sources that contributed to the measured PM_{10} sample. The mean source attribution of PM_{10} was found to be approximately 8% organic matter, <1% elemental carbon, 1% sulfate, 22% fresh sea salt, 3% aged sea salt, 43% mineral dust, 2% other, and 20% unidentified. The source of the mineral dust was attributable to the wind-driven saltation and dust emission processes within the ODSVRA. Based on these data, the study concluded that, on days when the 24-hour average PM_{10} concentration at the SLOAPCD's CDF air quality monitoring station equaled or exceeded the CAAQS of 50 µg/m^3, mineral dust was a consequential contributor to measured PM_{10} concentrations.

2.4.4 PUBLIC RELATIONS CAMPAIGN

State Parks, with feedback from the SAG, finalized a public relations campaign to educate the public on regional air quality issues in southern San Luis Obispo County surrounding the ODSVRA, how they are being addressed, and how the public can be part of the solution.[47] The campaign includes:

1. A digital two-page flyer that explains the basics about sand movement in a dune system
2. An air quality-specific video that will provide a broad overview of the Oceano Dunes Air Quality Management Program
3. A Frequently Asked Questions (FAQ) document with specific information about air quality and the PM10 mitigation program
4. Social media posts related to air quality at the ODSVRA

[45] Refer to State Parks'2021 ARWP, Section 2.4.4.1 and Attachment 13.
[46] Wang, et al. 2023. See Attachment 11-02. Also available at: https://www.mdpi.com/2073-4433/14/4/718
[47] State Parks prepared a preliminary public relations campaign in 2021 (see State Parks 2021 ARWP, Attachment 15). The SAG reviewed and provided comments on State Parks' draft public relations campaign.

The digital flyer, the air quality video, and FAQ can be found on the ODSVRA website at: https://ohv.parks.ca.gov/?page_id=26918.

Attachment 12, ODSVRA Public Relations Campaign, contains State Parks' final public relations campaign materials and activities, and the SAG review of those materials.

2.4.5 COASTAL COMMISSION COORDINATION

During the reporting period (August 1, 2022, to July 31, 2023), State Parks communicated with the California Coastal Commission on the 2022 ARWP Primary Work Plan, which included the conversion of 20.5 acres of wind fencing and 6.8 acres of straw treatments to native dune vegetation. Since these activities would occur in project areas that had already been permitted previously, the Coastal Commission determined that the activities under the 2022 ARWP were not subject to a new or amended Coastal Development Permit. All activities were found to be consistent with Coastal Development Permit 3-12-050, as amended.

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3 WORK PLAN (AUGUST 1, 2023, TO JULY 31, 2024)

This chapter of the ARWP proposes activities that State Parks will undertake to maintain and sustain the progress that the Dust Control Program has made in reducing PM_{10} emissions and ambient air concentrations. As described in Chapter 2, the SOA amendments adopted in October 2022 modify how State Parks, the SAG, and the SLOAPCD are to model PM_{10} emissions and evaluate the success of State Parks' Dust Control Program. This modification resets the modeling framework and key parameters that had been applied and reported on in the past and limits the information that State Parks can publicly provide until the new modeling framework is fully developed. Accordingly, State Parks' Work Plan emphasizes and focuses on the activities necessary to finalize and implement the new SOA excess emissions framework. State Parks is not proposing the installation of any new dust control measures (i.e., measures that would occupy land not currently occupied) as part of the Work Plan because 1) the State Parks has reduced PM_{10} mass emissions to levels below pre-disturbance estimates for two of three modeling scenarios; 2) there is uncertainty regarding the use of a single emissivity grid in any pre-disturbance modeling scenario; and 3) the new modeling framework is anticipated to yield a new set of numbers that may affect potential future dust control measures at the ODSVRA.

For the period of approximately August 1, 2023, to July 31, 2024, State Parks is proposing the following Dust Control Program activities:

- Convert 37.5 acres of existing temporary dust control measures to long-term vegetation measures, including:
  - Straw treatments (5.0 acres installed in 2021)
  - Wind fencing (32.5 acres installed in 2020)
- Continue foredune monitoring and assessment (vegetation, sand volume, roughness)
- Provide supplemental vegetation planting in previous vegetation treatment areas (non-foredune only).
- Conduct a dune emissivity (PI-SWERL) sampling campaign, in coordination with the SAG, in targeted strategic areas such as the foredune restoration areas, the nesting exclosure, and certain longitudinal transects that have been re-sampled previously
- Maintain existing straw treatment measures
- Continue Dust Control Program field monitoring and air quality modeling activities
- Continue SAG consultation, including updating the approach to evaluating Dust Control Program progress
- Implement the Dust Control Program public relations campaign
- Coordinate with the California Coastal Commission on 2023 ARWP permitting

requirements, if needed

- As needed, 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 DUST CONTROL MEASURES PROPOSED FOR 08/01/23 TO 07/31/24

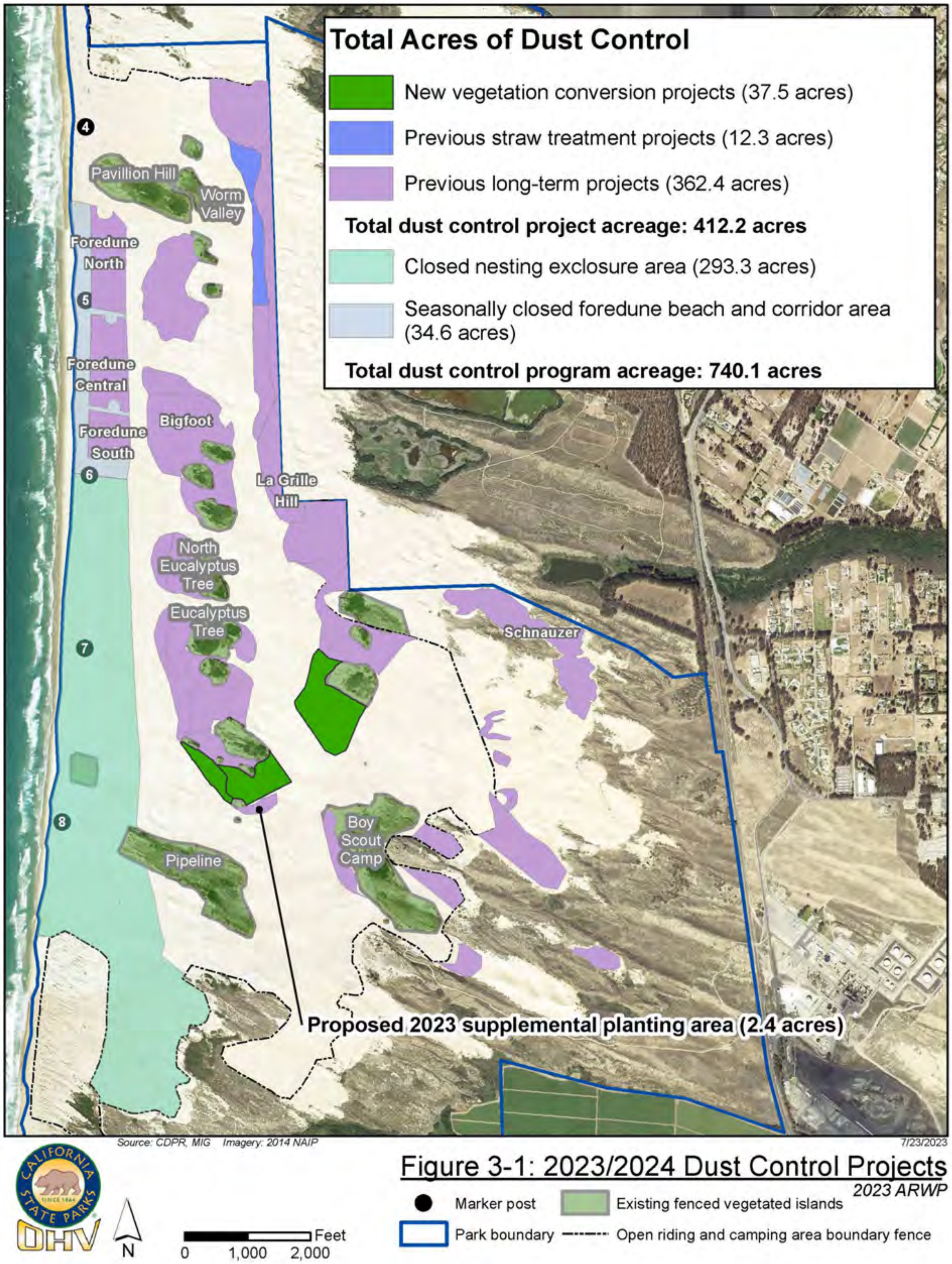
3.1.1 CONVERSION OF EXISTING TEMPORARY DUST CONTROL MEASURES TO VEGETATION

State Parks proposes to convert a total of 37.5 acres of existing temporary dust control measures to native dune vegetation, as follows:

- **Existing Straw:** State Parks proposes to convert the remaining 5.0 acres of an 11.8-acre straw treatment installed in 2022 (22-ST-02; see Figure 2-2 and Attachment 01, Figure A01-13) to native dune vegetation. This project is located west of the Tabletop vegetation island, in the center of the ODSVRA open riding and camping area (perpendicular to marker posts 7 and 8), adjacent to one existing wind fencing (21-WF-02, see Attachment 01, Figure A01-12) and three existing vegetation projects (21-VG-04, 22-VG-01, and 23-VG-02; see Figure 2-1 and Attachment 01, Figures A01-12 and A01-13).
- **Existing Wind Fencing:** State Parks proposes to convert two wind fence projects to native dune vegetation. The two projects were installed in 2021 and total 32.5 acres (21-WF-01 and 21-WF-02; see Attachment 01, Figure A01-12). These projects are located in the center of the ODSVRA open riding and camping area, adjacent to one existing straw treatment (22-ST-02; see Figure 2-2 and Attachment 01, Figure A01-13) and three existing vegetation projects (see Figure 2-1 and Attachment 01, Figures A01-12 and A01-13).

Refer to Figure 3-1 for the locations of State Parks' proposed conversion projects.

Figure 3-1. 2023/2024 Dust Control Projects



3.1.1.1 Supplemental Planting in Previous Treatment Areas

In addition to converting existing temporary dust control measures to new long-term vegetation, State Parks also proposes to perform supplemental planting and seeding activities on previously installed vegetation projects, including approximately 2.4 acres south of the Tabletop vegetation island (22-VG-10; see Attachment 01, Figure A01-13). Refer also to Figure 3-1 for the location of State Parks' supplemental planting activities planned to occur during the fall and winter of 2023/2024.

State Parks will, in coordination and consultation with the SAG, continue to evaluate and monitor backdune vegetation projects and conduct supplemental planting activities in areas where vegetation has not yet become established. State Parks' criteria for identifying supplemental planting activities is described in Section 3.1.1.2.

3.1.1.2 Criteria for Supplemental Planting

This section describes the process by which State Parks determines which non-foredune areas require supplemental vegetation efforts.[48]

State Parks evaluates past Dust Control Program vegetation projects in late spring and again in late summer after heavy spring winds have subsided to determine potential locations for supplemental planting activities. Sections of past project areas are chosen for supplementation if a substantial percentage of initial plantings did not establish, typically as a result of sand inundation, sand scouring, and/or poor weather conditions following initial planting. Past project areas where vegetation initially established and in subsequent years suffered substantial loss are also evaluated for supplemental planting. Dune topography upwind has a major impact on whether or not conditions will result in a high probability of planting success. For example, a quickly moving dune ridge upwind of the project area will likely result in plant burial and subsequent loss.

In general, areas where supplemental planting has a high probability of success in the near future are prioritized over areas that would have a higher probability of success if supplemental plantings were postponed to a future date when conditions improve.

Candidate areas for supplementation are prioritized based on the following criteria in order of highest priority to lowest priority:

1. Past project areas with significant loss that are contiguous with new project areas that in turn will improve upwind protection for supplemental plantings.

[48] As of July 31, 2023, there are no Dust Control Program vegetation projects that have experienced significant vegetation loss such that project viability / effectiveness is reduced.

2. Past project areas with partial loss where previously established vegetation will act as support cover for supplemental plantings.
3. Past project areas where loss was clearly a result of poor weather conditions and not sand inundation. In this scenario, supplemental planting during the most advantageous weather conditions would be prioritized.
4. Past project areas with significant loss where dune topography has improved upwind since initial plantings, resulting in improved planting conditions.
5. Past project areas with significant loss where conditions have not changed. Additional methods are used to improve likelihood of success, including application of additional stabilization measures and/or planting of species that are more resilient to disturbance than the species used in the initial planting.

3.1.1.3 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, 2023, State Parks estimates up to approximately 107,950 plants and 490 pounds of native seed would be required to complete the conversion of approximately 37.5 acres of temporary dust control projects to native dune vegetation. Additional plants (7,015) and native seed (35 pounds) would be required for State Parks' proposed supplemental planting activities (see Section 3.1.1.1). With this supplemental planting activity, State Parks estimates a total of up to approximately 114,965 plants and 525 pounds of native seed would be required to complete the proposed 2023 vegetation planting activities.

Refer to Attachment 13, 2022/2023 ODSVRA Dust Control Program Vegetation Restoration Projects, for State Parks' proposed 2023 ARWP planting projects and estimates ofplanting and seeding activity by project.

3.1.1.4 Measures to Avoid Delays in Implementation

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), State Parks 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, State Parks will maintain a perimeter fence to prohibit OHV activity and camping in the restoration area.

3.1.1.5 Planning for Future Plant Growing Activities

State Parks is contracted with California Polytechnic State University (Cal Poly), San Luis Obispo for horticulture work through June 2023 and is coordinating with Cal Poly on a new contract for plant-growing activities that will extend through December 2026 and support the sustained success of the Dust Control Program.

3.1.2 Continued Foredune Monitoring and Assessment

State Parks will continue coordinating with the SAG and UCSB on foredune monitoring and assessment activities from August 1, 2023, to July 31, 2024.

Foredune monitoring includes transects within each treatment plot as outlined in Section 2.3.6.1, collaboration with UCSB on topographic and vegetation changes based on UAS monitoring outlined in Section 2.3.3 and time-lapse imagery described in Section 2.3.6.3, and analysis of images from monitoring stations within the treatment area described in Section 2.3.6.2). State Parks will coordinate with the SAG on the monitoring methods for evaluating vegetation cover and species richness in foredune treatment areas.

The SAG continues to recommend that supplemental planting activities within the 48-acre foredune project are not yet required as the system continues to evolve. State Parks will coordinate with the SAG on supplemental planting and restoration activities in the 48-acre foredune project, if necessary.

3.1.3 Maintenance of Existing Straw Treatment and Wind Fencing Measures

State Parks' proposed Work Plan will result in the removal of all remaining wind fencing from the ODSVRA; however, approximately 12.3 acres of straw treatments will remain in the northeastern corner of the ODSVRA open riding and camping area. State Parks will continue to maintain all existing straw treatment projects installed before August 1, 2023, including 22-ST-01, until they are replaced with vegetation. Potential maintenance activities that may be required to maintain effective dust control in straw treatment areas may include replacing treatments (if warranted due to shifting sand conditions).

3.2 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, 2022, to December 1, 2023. State Parks will coordinate and consult with the SAG on the need for field monitoring and air quality modeling activities after December 1, 2023, pursuant to the Dust Control Program's adaptive management framework (see Section 3.6).

3.2.1.1 Meteorological, PM_{10}, and Saltation Monitoring

In consultation and coordination with the San Luis RCD, DRI, and UCSB, State Parks will continue to operate and maintain the existing meteorological, PM_{10}, and saltation monitoring instruments and sites shown in Figure 2-6 and described in Section 2.3.1. This effort will include post-deployment calibration of MetOne Particle Profilers and continued evaluation of key evaluation metrics (see Section 2.3.7 and Attachment 10 for more information on evaluation metrics). In addition, State Parks, in consultation with the San Luis RCD, DRI, and the SAG, may deploy new instruments in existing dust control measures intended to assess and evaluate the continued effectiveness of measures installed at the ODSVRA.

3.2.1.2 PI-SWERL Surveys

In consultation with DRI, State Parks will work with the SAG to determine where additional useful PI-SWERL measurement campaigns should be carried out in 2023/2024 to further the current understanding of the dust emissions system and inform air quality modeling and management of dust emissions at the ODSVRA. PI-SWERL measurements are critical to informing the excess emissions stipulation in the SOA, and ongoing measurement campaigns are important for assessing the temporal and spatial dimensions of dust emissions from the ODSVRA. Any new measurements can be incorporated into the global data set of PI-SWERL measurements to inform adaptive management strategies in the future.

3.2.1.3 UAS Surveys

Consistent with previous years (see Section2.3.3), UAS surveys for the 2023 Work Plan (August 1, 2023, to December 1, 2024) will occur in October 2023, February 2024, and October 2024. Campaigns will involve flights with RGB and multispectral payloads as in the 2022-23 period. The same data products mentioned in Section 2.3.3 will be produced (georeferenced digital orthophoto mosaics, DEMs, GCD maps, vegetation maps).

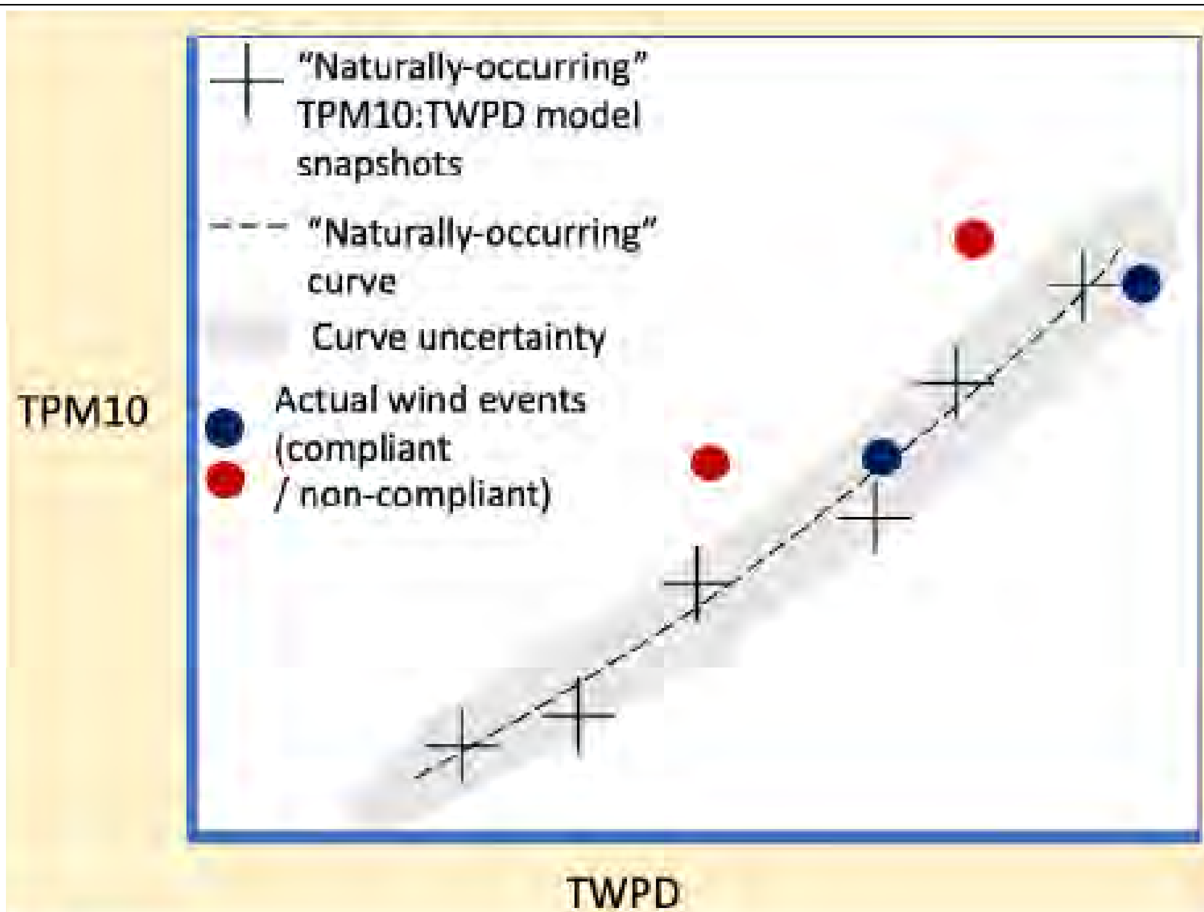
3.3 AIR QUALITY MODELING ACTIVITIES

As described in this ARWP (e.g., see Section 2.2), the October 2022 SOA amendments established a new requirement that focuses on reducing excess emissions from the ODSVRA, and the development of this new excess emissions framework will result in pre-disturbance and dust control scenarios that will be defined differently from scenarios in this and past ARWP documents. This framework and its key considerations are described below.

3.3.1 Overview of Excess Emissions Framework/Proof of Concept

The October 2022 SOA amendments require State Parks to design the ARWPs to "eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal PM_{10} air quality standards." In January 2023, the SAG began work on identifying a simple but objective framework for establishing a naturally occurring PM_{10} baseline against which excess emissions could be evaluated.[49] The SAG's proposal leverages the approach developed by DRI for comparing TPM_{10} to TWPD, with the goal being to determine the relation between TPM_{10} and TWPD that is representative of naturally occurring emissions at any site downwind of the ODSVRA (e.g., CDF, Mesa2). Naturally occurring TMP_{10} and TWPD would be estimated by modeling PM_{10} concentrations and wind speeds for the pre-disturbance emissions scenarios established by the SAG in February 2022 (see Section 2.2.1) and, moving forward, actual observed TPM_{10} and TWPD could then be compared to the expected TPM_{10}:TWPD ratio for naturally occurring emissions. The difference between the actual measured or observed values and the estimated naturally occurring condition could then be attributed as excess emissions consistent with the SOA. The SAG's conceptual excess emissions framework is depicted in Figure 3-2.

Figure 3-2. SAG Proposed Excess Emissions Framework



SAG concept for setting a naturally occurring emissions baseline for TPM_{10} relative to TWPD. The diagram is conceptual only and does not reflect actual data or modeling.

[49] See Attachment 11-04 for the SAG's January 30, 2023, memorandum titled *Framework for Assessing "Excess Emissions" of PM_{10} from Oceano Dunes*.

The SAG has proposed an iterative approach for implementing its recommended excess emissions framework. As the initial step, the SAG requested that DRI perform initial model runs to establish a proof of concept for the excess emissions framework.

DRI completed the proof-of-concept test in April 2023, comparing extracted data for SAG-defined 2013 baseline conditions against SAG-defined 1939 pre-disturbance conditions.[50] The resulting modeling of the TPM_{10}:TPWD ratio indicated that 2013 baseline emissions were above 1939 pre-disturbance emissions, yielding an excess of emissions under 2013 conditions. DRI concluded that the SAG's excess emissions framework was feasible but acknowledged that several modeling-related issues involving the modeled emissivity grid, wind speed filters, and other factors would need to be resolved. As part of the proof-of-concept evaluation, DRI also observed a bias in modeled TWPD that may result in underestimates of modeled TPM_{10} that could lead to uncertainty regarding when an excess emissions condition has occurred. The SAG concurred with DRI's conclusion that the proposed excess emissions framework was feasible.[51] The SAG also observed that it was necessary to reduce model uncertainty and biases and identified several issues to resolve in subsequent steps undertaken to develop and refine the proposed excess emissions framework, including the influence of certain data points on regression statistics used to develop emissions curves, the need for confidence bands around emissions curves, the consideration of a non-zero offset to TWPD to account for minimal emissions up to a certain wind threshold, and bias correction for modeled TWPD values.

3.3.2 SAG Recommendations for Establishing "Excess Emissions" Curve

As described in Section 3.3.1, the SAG has identified a conceptual approach for evaluating Dust Control Program progress towards the new SOA excess emissions framework that is predicated on an established relation between TPM_{10} measured in a 24-hr period and TWPD over the same 24-hour period. Modeling conducted by DRI and reviewed by the SAG demonstrated the conceptual excess emissions approach was feasible; however, both DRI and the SAG identified key issues regarding the modeling approach. The SAG proposal is currently under review by State Parks and the SLOAPCD, and an updated proposal is expected to be completed in the coming ARWP cycle. State Parks will continue to coordinate with the SAG to develop a work plan that refines the SOA excess emissions framework and finalizes recommendations for modeled emissivity grids and excess emissions curves.

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[50] See Attachment 11-04 for DRI's April 2023 document titled *Framework for Assessing Excess Emissions from the Oceano Dunes – Phase 1: Modeled TMP10 for CDF, Mesa2, and S1 Tower, and TWPD for S1 Toer for 1939 (as previous modeled) and 2013 (as previously modeled)*.

[51] See Attachment 11-04 for the SAG's April 19, 2023 memorandum titled S*AG Review of Desert Research Institute (DRI) Report "Framework for Assessing 'Excess Emissions' of* PM_{10} *from the Oceano Dunes Phase I."*

3.3.3 SAG Recommendations for Modeled Emissivity Grids

As described in Section 2.3.5.3, the SAG has undertaken a comprehensive evaluation of PI-SWERL measurements collected at the ODSVRA between 2013 and 2022 and provided recommendations for how the ODSVRA emissivity grid should be divided into zones for the purposes of modeling current (2023) and pre-disturbance (1939) scenarios under the SOA new excess emissions framework. The SAG proposal is currently under review by State Parks and SLOAPCD, and this review is anticipated to be completed in the coming ARWP cycle. State Parks will continue to coordinate with the SAG to develop a work plan that refines the SOA excess emissions framework and finalizes recommendations for modeled emissivity grids and excess emissions curves.

3.4 OTHER DUST CONTROL PROGRAM ACTIVITIES

3.4.1 Continued SAG Consultation

Pursuant to the SOA, as amended, State Parks will continue to utilize the SAG for consultation and evaluation. Priority areas for State Parks consultation with the SAG in 2023-2024 include, but are not limited to, updating the approach to evaluating SOA progress under the new excess emissions framework (see Section 3.3).

The SAG will continue to exercise its independent advisory role by preparing scientific reports and reviews that inform the implementation and monitoring of ODSVRA dust mitigation activities. The SAG may consult with State Parks and the SLOAPCD to ensure access to relevant context and information in preparing such reports and reviews. To ensure independence, however, 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.

3.4.1.1 SAG Meetings and Workshops

The SAG anticipates the following meeting and workshop activities in 2023-2024:

- Quarterly full-day SAG meetings, with the participation of State Parks and SLOAPCD staff as needed. Public health conditions permitting, it is anticipated that Fall 2023, spring 2024, and fall 2024 meetings will be held in person at the ODSVRA. Winter 2024 and summer 2024 meetings will be held via videoconference.
- Regular monthly calls among the full SAG, with State Parks and SLOAPCD staff as needed.
- Additional ad hoc calls among subgroups of the SAG to address specific work tasks with State Parks and SLOAPCD staff as needed.
- SAG presentations at public meetings and workshops, as requested by State Parks and the SLOAPCD.

3.4.2 Update of Evaluation Metrics

State Parks, in consultation with the SAG, will update the Dust Control Program's evaluation metrics to reflect the SOA new excess emissions framework once this framework has been finalized.

3.4.3 Public Relations Campaign

As described in Section 2.4.4, State Parks has finalized a public relations campaign to educate the public on regional air quality issues in southern San Luis Obispo County surrounding the ODSVRA, how they are being addressed, and how the public can be part of the solution. State Parks will continue to implement aspects of this campaign, including the social media posts, in 2023/24. See Attachment 12 for details of the State Parks public relations campaign.

3.4.4 Coastal Commission Coordination

Some of State Parks' proposed Dust Control Program activities for the August 1, 2023, to July 31, 2024, period may constitute development under the California Coastal Act (e.g., installing monitoring equipment, etc.). Therefore, these activities may require a Coastal Development Permit (CDP) from the California Coastal Commission (CCC). In September 2017, the CCC approved CDP 3-12-050 to implement a five-year adaptive management Dust Control Program at the ODSVRA. 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 the ODSVRA. State Parks will coordinate with CCC staff on the appropriate CDP process for the proposed 2023 ARWP activities. The appropriate process may include an amendment to CDP #3-12-050.[52]

If necessary, State Parks will submit a formal CDP application to the California Coastal Commission by November 1, 2023, pending SLOAPCD approval of the 2023 ARWP by October 31, 2023. State Parks will coordinate weekly with a representative from the CCC 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 2023 ARWP activities no later than February 2024. This timeline is tentative and subject to change based on the final approved 2023 ARWP and issues outside the control of State Parks, including CCC staff workload and other complex Coastal Act issues.

[52] In March 2021, the CCC voted to ban OHV recreation and limit street-legal vehicle use and camping at the ODSVRA by 2024. This action is subject to several ongoing lawsuits. State Parks will continue to operate the ODSVRA in a manner that supports OHV recreation and the Dust Control Program for the immediate future.

3.5 MODELED PM_{10} MASS EMISSIONS AND CONCENTRATION REDUCTIONS

To provide continuity with previous ARWP documents, DRI, in consultation with State Parks and the SAG, has modeled the PM_{10} mass emissions and concentration reductions that are estimated to be achieved by State Parks' proposed conversion of 37.5 acres of existing, temporary straw treatment and wind fencing projects to native dune vegetation. The results of this modeling are summarized below. See Attachment 03 for DRI's detailed modeling results.

3.5.1 ESTIMATED PM_{10} MASS EMISSIONS REDUCTIONS

As described in Section 3.1.1, State Parks proposes to convert 37.5 acres of straw treatments and wind fencing to native dune vegetation. The DRI modeling conducted for this 2023 ARWP estimates that this 37.5 acres of new vegetation will reduce ODSVRA PM_{10} mass emissions by 1 metric ton per day. In total, the DRI model estimates that, by July 31, 2024, State Parks' Dust Control Program (740.1 acres of total dust control) will have reduced modeled baseline mass emissions by 82.9 metric tons per day, a 45.4% reduction in baseline mass emissions. The resulting modeled PM_{10} mass emissions estimates continue to be below the mass emissions estimates that would have occurred within the ODSVRA open riding and camping area boundary under the land cover conditions present in 1939 for the original pre-disturbance model (108.4 metric tons per day) and the revised pre-disturbance model using 2013 PI-SWERL data (scenario 1; 130.4 metric tons per day), but not the revised pre-disturbance model using 2019 PI-SWERL data (scenario 2; 83.2 metric tons per day).

3.5.2 ESTIMATED PM_{10} CONCENTRATION REDUCTIONS AT CDF AND MESA2

The DRI modeling conducted for this 2023 ARWP estimates that the 37.5 acres of new vegetation proposed by State Parks will reduce 24-hour average PM_{10} concentrations at the CDF station by an additional 0.2 µg/m^3 (from 60.9 µg/m^3 to 60.7 µg/m^3), or 0.1% of original 2013 baseline PM_{10} concentrations (124.7 µg/m^3). In total, the revised DRI model estimates the cumulative reduction in 24-hour PM_{10} concentrations at the CDF station from the 740.1 acres of dust control measures planned to be in the ground at the ODSVRA by July 31, 2024, to be 64.0 µg/m^3, which equals a 51.3% reduction in baseline modeled 24-hour PM_{10} concentrations. The Dust Control Program's modeled 24-hour average PM_{10} concentration at the CDF monitoring station (60.7 µg/m^3) is below the 24-hour average PM_{10} concentration value that would have occurred at CDF under the land cover conditions present in 1939 for the original pre-disturbance model (88.0 µg/m^3; concentration estimates are not available for the revised pre-disturbance model) but above the CAAQS (50.0 µg/m^3).

For the Mesa2 air quality monitoring station, the DRI modeling conducted for this 2023 ARWP estimates that the 37.5 acres of new vegetation proposed by State Parks will reduce 24-hour average PM_{10} concentrations by an additional 0.3 µg/m^3 (from 62.5 µg/m^3 to 62.2 µg/m^3), or 0.3% of the original 2013 baseline PM_{10} concentration (97.5 µg/m^3). In total, the revised DRI model estimates the cumulative reduction in 24-hour PM_{10} concentrations at the Mesa2 monitoring station from the 740.1 acres of dust control measures planned to be in the ground at ODSVRA by July 31, 2024, to be 35.3 μg/m^3, which equals a 36.2% reduction in baseline modeled 24-hour PM_{10} concentrations. The Dust Control Program's modeled 24-hour average PM_{10} concentration at the Mesa2 monitoring station (62.2 μg/m^3) is below the 24-hour average PM_{10} concentration value that would have occurred at Mesa2 under the land cover conditions present in 1939 for the original pre-disturbance model (71.2 μg/m^3); concentration estimates are not available for the revised pre-disturbance model) but above the CAAQS (50 μg/m^3).

3.5.3 Additional Dust Controls Needed to Achieve SOA Goals

As described in Section 2.2.2 and Section 2.2.3, State Parks' Dust Control Program, as of July 31, 2023, has 1) maintained modeled PM_{10} mass emissions reductions at levels (100.9 metric tons per day to 112.3 metric tons per day) that are below the original 1939 pre-disturbance scenario (108.4 metric tons per day) and the revised 1939 pre-disturbance scenario based on 2013 PI-SWERL data (scenario 1; 130.4 metric tons per day), but not the revised 1939 pre-disturbance scenario based on 2019 PI-SWERL data (scenario 2; 83.2 metric tons per day); and 2) reduced modeled 24-hour average PM_{10} concentrations at the SLOACPD's CDF and Mesa2 air quality monitoring stations to levels that are below the original modeled pre-disturbance concentration levels. In addition, as described in Section 3.5.1 and Section 3.5.2, State Parks' proposed Work Plan is estimated to result in further reductions in PM_{10} mass emissions from the ODSVRA and 24-hour average concentrations at the SLOACPD's CDF and Mesa2 air quality monitoring stations.

In its conditional approval of the 2022 ARWP, the SLOAPCD required State Parks to prepare the 2023 ARWP as follows: "The same PI-SWERL dataset(s) used to derive the emissivity grid for the pre-disturbance scenario shall be used to derive the emissivity grid for the mitigation scenario, with the exceptions noted below for seasonal closures and the Plover Exclosure. If recommended by the SAG, State Parks may recalculate pre-disturbance emissions using different assumptions and/or data than those used by the SAG in their initial recommendation (e.g., 2022 PI-SWERL measurements may be incorporated); however, the same updates must also be applied to the calculation of emissions under the mitigation scenario." As demonstrated in Section 2.2.1 and Section 2.2.2, State Parks has complied with this condition, including modeling pre-disturbance and mitigation scenarios using the same PI-SWERL datasets. While the results of the modeling are contingent on the PI-SWERL dataset incorporated into the model, two of the three model runs indicate State Parks has reduced mass emissions to levels below pre-disturbance values; however, the disparate results of the modeling are far from conclusive and indicate it is premature for State Parks to estimate potential additional dust control measures that may be required at the ODSVRA based on accounting methods that are in flux and subject to change as State Parks, the SAG, and the SLOACPD develop and finalize the new excess emissions framework included in the October 2022 SOA amendments (see Section 2.2), which require State Parks' ARWPs be designed to "eliminate emissions in excess of naturally occurring emissions from the ODSVRA that contribute to downwind violations of the state and federal PM_{10} air quality standards." This new excess emissions framework will result in pre-disturbance and dust control scenarios that will be defined differently from scenarios in this and past ARWP documents; however, the development of the excess emissions framework is in its early stages, as neither the ODSVRA's current emissions levels under this new framework nor the PM_{10} baseline against which excess emissions could be evaluated have been defined. Since it is unknown whether and to what degree excess emissions exist under the new framework, there are no estimates of potential additional dust control measures to be installed at the ODSVRA under the new SOA framework available at this time.

3.5.4 Contingency Planning for Additional Dust Control Measures

Although it is premature for State Parks to identify specific additional dust control measures to be installed at the ODSVRA at this time, State Parks is committed to achieving the PM_{10} emissions reduction targets developed for the ODSVRA in coordination with the SAG and the SLOAPCD. The excess emissions framework that will be developed by State Parks, the SLOAPCD, and the SAG will modify how Dust Control Program progress is measured and is intended to lead to a scientifically justified determination of whether additional dust control measures are or are not necessary at the ODSVRA. To ensure the timely deployment of dust control measures at the ODSVRA, should such measures be found necessary, State Parks is committed to conducting preliminary contingency planning efforts that will identify preliminary areas to prioritize for dust control. Such areas will be determined, to the extent possible, in coordination with the SAG, and will likely focus on areas that are most emissive and/or most likely to achieve defined excess emissions goals given operational restraints. The process for determining such areas will include use of the DRI model to evaluate potential emissions reductions, field investigations to verify that projects can be feasibly implemented while still allowing for safe recreation and emergency access, and other assessments to confirm that projects can be successfully implemented while meeting the ODSVRA's operational needs. In addition, State Parks will plan to ensure there are sufficient dust mitigation and planting materials (seed, straw, and/or container stock) for additional dust control measures, if required.

3.6 ADAPTIVE MANAGEMENT

State Parks is committed to monitoring, verifying, and adapting measures to continue to achieve dust emission goals. State Parks will, in consultation with the SAG, develop the framework for adaptive management that will guide the Dust Control Program under the new excess emissions framework established by the October 2022 SOA amendments. Items that may be included in the framework include, but are not limited to, plans for long-term meteorological and PM_{10} monitoring, PI-SWERL monitoring, and monitoring of the 48-acre foredune (and possibly other vegetated areas); periodic assessment of measured trends and model efficacy; and potential strategies for quantifying when an excess emissions condition exists and how best to address the condition. The intent of the adaptive management framework would be to track the continuing viability and effectiveness of dust control measures to ensure that excess emissions are minimized. Long-term monitoring would also directly inform adaptive management decisions regarding maintenance of dust control measures and/or the need for new measures necessary to minimize excess emissions conditions.

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4 BUDGETARY CONSIDERATIONS

State Parks' estimated budget to develop and implement the 2023/2024 Work Plan described in Chapter 3 is $4,515,257. A detailed breakdown of this estimated budget is provided in Table 4-1. This budget covers all activities from July 1, 2023, through June 30, 2024,including existing contracts with SAG members. The approximately $4.52 million budget shown in Table 4-1 is higher than the costs that State Parks identified for proposed activities in the 2022 ARWP ($3.63 million) due to factors such as increased labor and material costs and changes in contracts.

Table 4-1. Estimated 2023/2024 Work Plan Budget

Dust Control Activity	Third Party Contract Costs	Other Costs	Total Costs[A]
Vegetation Plantings (Conversion of Wind Fencing, Foredune, and Supplemental Plantings)			
Labor	$650,000	$172,000	$822,000
Materials	$0	$165,000	$165,000
Equipment	$195,000	$0	$195,000
Greenhouse facilities	$315,000	$0	$315,000
Subtotals	$1,160,000	$337,000	$1,497,000
Maintenance and Installation of Wind Fencing			
Labor	$60,000	$150,000	$210,000
Materials	$0	$15,000	$15,000
Equipment	$123,000	$0	$123,000
Subtotals	$183,000	$165,000	$348,000
Monitoring (Sand Flux, Air Quality, Meteorological, UAS, and Other Monitoring) and Modeling			
Instrument operations	$110,000	$40,000	$150,000
Data analysis	$679,000	$0	$679,000
Subtotals	$789,000	$40,000	$829,000
Dust Control Project Design and Technical Assistance			
Scientific expertise (DRI)	$200,000	$0	$200,000
SAG Costs			
Miscellaneous[B]	$921,000	$0	$921,000
Other Items of Expense			
Miscellaneous[B]	$767,257	$0	$767,257
TOTAL COSTS	**$4,020,257**	**$542,000**	**$4,515,257**

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

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5 IMPLEMENTATION SCHEDULE

Tables 5-1 through 5-7 below present schedules for implementing the dust control activities identified in Chapter 3. The tables cover an approximately 14-month period from June 2023 to July 2024.

Table 5-1. Conversion of Existing Temporary Dust Control Measures to Vegetation

State Parks Task/Activity[(A)]	2023							2024						
	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				

(A) The conversion of existing temporary dust control measures to vegetation includes both primary and secondary Work Plan components, including the conversion of the nesting exclosure to vegetation.

Table 5-2. Continued Foredune Monitoring and Assessment by State Parks Staff

State Parks Task/Activity	2023							2024						
	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 5-3. Supplemental Planting in Previous Treatment Areas

State Parks Task/Activity	2023							2024						
	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 5-4. Maintenance of Existing Straw Treatment Measures

State Parks Task/Activity	2023							2024						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Replenish and/or replace straw treatments if needed									O	→	→	X		
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-5. Field Monitoring and Air Quality Modeling Activities

State Parks Task/Activity	2023							2024						
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Meteorological, PM, and saltation data acquisition	→	→	→	→	→	→	→	→	→	→	→	→	→	→
PI-SWERL surveys	To be determined													
UAS surveys					O X				O X					
Improvement of DRI air quality model performance	→	→	→	→	→	→	→	→	→	→	→	→	→	→
KEY:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-6. Continued SAG Consultation and Evaluation														
State Parks Task/Activity	**2023**							**2024**						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Consult with SAG on 2023 ARWP	O	→	→	→	X									
Develop excess emissions framework	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SAG quarterly meetings			X		X				X			X		
Consult with SAG on 2024 ARWP											O	→	→	→
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

Table 5-7. Public Relations Campaign														
State Parks Task/Activity	**2023**							**2024**						
	June	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**
Prepare digital two-page flyer	→	→	→	X										
Develop air-quality-specific video	→	→	→	X										
Develop FAQ document	→	→	→	X										
Social media posts				O	→	→	→	→	→	→	→	→	→	→
Table Key:	O	Task Start			→	Task In Progress				X	Task Complete			

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