Oceano Dunes State Vehicular Recreation Area
Particulate Matter Reduction Plan

2019 Annual Report and Work Plan

October 15, 2019

State of California

Department of Parks and Recreation

Off-Highway Motor Vehicle Recreation Division

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Oceano Dunes SVRA
Particulate Matter Reduction Plan
2019 Annual Report and Work Plan

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

Acronym / Symbol	**Full Phrase or Description**
APCO	Air Pollution Control Officer
BSNE	Big Springs Number Eight
CAAQS	California Ambient Air Quality Standards
CCC	California Coastal Commission
CEQA	California Environmental Quality Act
DEM	Digital Elevation Model
DRI	Desert Research Institute
EIR	Environmental Impact Report
GCD	Geomorphic Change Detection
GNSS	Global Navigation Satellite System
Kg	Kilogram
LIDAR	Light Detection and Ranging
LSPDM	Lagrangian Stochastic Particle Dispersion Model
m^2	Square Meter
m^3	Cubic Meter
NOP	Notice of Preparation
OHMVR	Off-Highway Motor Vehicle Recreation
PI-SWERL®	Portable In-Situ Wind Erosion Laboratory
PMRP	Particulate Matter Reduction Plan
PM	Particulate Matter
PM_{10}	Coarse Particulate Matter
PPK	Post Processed Kinetic
REL	Reference Exposure Level
RTK	Real Time Kinetic
SAG	Scientific Advisory Group
SB	Straw Bale
SLOAPCD	San Luis Obispo County Air Pollution Control District
SOA	Stipulated Order of Abatement
SODAR	Sonic Detection and Ranging
SVRA	State Vehicular Recreation Area
UAS	Unmanned Aerial System
VG	Vegetation
WF	Wind Fence
WRF	Weather and Research Forecasting
µg	Micrograms
$	U.S. Dollar
%	Percent

1 INTRODUCTION

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

SOA Condition 4 requires the OHMVR Division to prepare and submit to the SLOAPCD and the Oceano Dunes SVRA PMRP Scientific Advisory Group (SAG) an Annual Report and Work Plan by August 1 of each year from 2019 to 2022. In general, SOA Condition 4 requires the Annual Report and Work Plan to:

- Review dust control activities implemented over the previous 12-month period and, using tracking metrics specified in the PMRP, document progress towards SOA goals.
- 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.
- Using air quality modeling, estimate the downwind benefits and anticipated reductions in PM_{10} concentrations associated with proposed dust control activities.
- Describe the budgetary considerations for development and implementation for proposed dust control activities.
- Provide a detailed implementation schedule with deadlines associated with the physical deployment of proposed dust control actions.

The SLOAPCD approved the OHMVR Division's Draft PMRP on June 10, 2019. The 2019 Annual Report and Work Plan represents the OHMVR Division's initial compliance documentation pertaining to the implementation of the Draft PMRP. The 2019 Annual Report and Work Plan reflects the best information currently available to the OHMVR Division, the SLOAPCD, and the

SAG; however, as described in greater detail throughout this document, the OHMVR Division and the SAG conducted significant data collection campaigns during the spring and summer of 2019 that will refine and revise the information presented in this document once this data has been analyzed by the OHMVR Division, the SAG, and the SLOAPCD.

2 ANNUAL REPORT

2.1 Dust Controls Implemented Over the Previous Year

From summer 2018 to July 31, 2019, the OHMVR Division installed 36.1 acres of straw bale projects (2018-SB-01 and 2018-SB-02), 36.1 acres of new vegetation projects (2018-VG-01 and 2018-VG-02), 8.0 acres of supplemental planting activities at previous restoration sites (2017-VG-01 and 2017-VG-02), and 48.6 acres of wind fencing projects, (including 14.4 acres of maintenance activities (2018-WF-01, 2018-WF-02, 2018-WF-03, and 2018-WF-04). Straw bales installed at Oceano Dunes SVRA can support vegetation plantings and, therefore, the OHMVR Division has converted all 36.1 acres of straw bale projects installed over the past year to vegetation. The dust control measures implemented by the OHMVR Division over the past year are listed in Table 2-1, summarized in the sections below, and shown on Exhibit 1, SOA Dust Control Measures.

Table 2-1: 2019 Annual Report Dust Control Projects Summary[(A)]

ID	Type	New Acres Controlled	Acres Converted to New Vegetation	Acres of Supplemental Treatments	Net Increase in Acres of Dust Control
2018-SB-01	Straw Bale	27.0	--[(B)]	--	--[(B)]
2018-SB-02	Straw Bale	9.1	--[(B)]	--	--[(B)]
2018-VG-01	Vegetation	--	27.0	--	27.0
2018-VG-02	Vegetation	--	9.1	--	9.1
2017-VG-01	Vegetation	--	--	5.2	--
2017-VG-02	Vegetation	--	--	2.8	--
2018-WF-01	Wind Fencing	6.6	--	--	6.6
2018-WF-02	Wind Fencing	28.6	--	14.4	28.6
2018-WF-03	Wind Fencing	7.9	--	--	7.9
2018-WF-04	Wind Fencing	5.5	--	--	5.5
Totals	**10 Projects**	**84.7 Acres**	**36.1 Acres[(B)]**	**22.4 Acres**	**84.7 Acres**

(A) All acreage values are approximate.
(B) Straw bale projects 2018-SB-01 and 2018-SB-02 were converted to vegetation projects. Therefore, the increase in acres of dust control for these projects is listed under vegetation restoration project 2018-VG-01 and 2018-VG-02.

As shown in Table 2-1, there was a net increase of 84.7 acres of dust control at Oceano Dunes SVRA between summer 2018 and July 31, 2019.

2.1.1 Straw Bale Projects

In summer 2018, the OHMVR Division installed approximately 5,100 straw bales on 36.1 acres of land. The straw bale projects consisted of standard straw bales oriented perpendicular to the prevailing, sand-transporting wind direction and spaced approximately every 16.4 feet (5 meters), depending on topography.

The straw bale projects were installed in two different areas as described below and shown on Exhibit 1:

- **BBQ Flats (2018-SB-01)**: The OHMVR Division installed approximately 3,630 straw bales on approximately 27 acres of land adjacent to the BBQ Flats vegetation islands (within the SVRA's open riding and camping area).
- **Eucalyptus North (2018-SB-02):** The OHMVR Division installed approximately 1,360 straw bales on approximately 9.1 acres of land adjacent to the Eucalyptus North vegetation island (within the SVRA's open riding and camping area).

The straw bale project locations were established by the SOA and informed by 1930's-era aerial photography that shows the vegetation that existed prior to the State of California operating a beach camping and dune recreation area.

Pursuant to SOA Condition 1.b., the straw bales are to remain in place and be maintained until such time as they are replaced by vegetation or the SLOAPCD Air Pollution Control Officer (APCO) approves alternate mitigation measures. In the fall and winter of 2018/2019, the OHMVR Division broke up the straw bales and spread them throughout the treatment areas to prepare the site for native plant installation (described in Section 2.1.2 below).

2.1.2 Vegetation Projects

From summer 2018 to July 31, 2019, the OHMVR Division treated a total of 44.9 acres of land with native plants, native seed, straw, fertilizer, and sterile grass seed. In total, the OHMVR Division installed more than 106,000 locally-collected native dune plants and almost 450 pounds of locally-collected native dune seed in the four project areas described below and shown on Exhibit 1:

- **BBQ Flats (2018-VG-01):** The OHMVR Division planted vegetation on approximately 27 acres of land adjacent to the BBQ Flats vegetation island (within the SVRA's open riding and camping area). This vegetation project replaced the straw bales the OHMVR Division installed pursuant to SOA Condition 1.a in summer 2018 (see Section 2.1.1).
- **Eucalyptus North (2018-VG-02):** The OHMVR Division planted vegetation on approximately 9.1 acres of land adjacent to the Eucalyptus North vegetation island (within the Oceano Dunes SVRA open riding and camping area). This vegetation project also replaced the straw bales OHMVR Division installed pursuant to SOA Condition 1.a in summer 2018 (see Section 2.1.1).
- **Heather, Acacia, and Cottonwood (Paw Print; 2017-VG-01):** The OHMVR Division planted vegetation on approximately 5.2 acres of land adjacent to the Heather, Acacia, and Cottonwood vegetation islands, which are sometimes collectively referred to as the "paw print" (within the SVRA's open riding and camping area). This vegetation project enhanced and supplemented a prior restoration project undertaken by the OHMVR Division in 2017/2018 (i.e., the vegetation was planted on 5.2 acres of land within an existing restoration area approximately 9.3 acres in size; see Exhibit 2, 2018/2019 Supplemental Dust Control Restoration Project).
- **LaGrille Hill (2017-VG-02):** The OHMVR Division planted vegetation on approximately 2.8 acres of land adjacent to the LaGrille Hill vegetation island (inside the SVRA's open riding and camping area). This vegetation project also enhanced and supplemented a prior restoration project undertaken by the OHMVR Division in 2017/2018 (i.e., the vegetation was planted on 2.8 acres of land within an existing restoration area approximately 9.1 acres in size).

A summary of all treatments, plants per acre, seed per acre, and a list of plant species used in each vegetation project described above is included in Attachment 1.

2.1.3 Wind Fencing Projects

From summer 2018 to July 31, 2019, the OHMVR Division installed approximately 45,281 feet (13,801.6 meters) of linear feet of wind fencing on approximately 48.6 acres of land. The wind fencing projects consisted of an array of four-foot-high wind fencing rows, oriented perpendicular to the prevailing, sand-transporting wind direction and spaced approximately seven times the fence height (or approximately 28 feet apart (8.5 meters), depending on topography; see Exhibit 3, Example 2018 Wind Fence Photographs). The wind fencing projects were installed in four different areas as described below and shown on Exhibit 1.

- **Heather, Acacia, and Cottonwood (Paw Print; 2018-WF-01 and 2018-WF-02):** The OHMVR Division installed two wind fencing arrays on approximately 35.2 acres of land adjacent to the Heather, Acacia, and Cottonwood vegetation islands.
- **Eucalyptus Tree and Eucalyptus South (2018-WF-03):** The OHMVR Division installed wind fencing arrays on approximately 7.9 acres of land adjacent to the Eucalyptus Tree and Eucalyptus South vegetation islands.
- **Humpback, Table Top, Caterpillar Hill (2018-WF-04):** The OHMVR Division installed wind fencing arrays on approximately 5.5 acres of land adjacent to the Humpback, Table Top, and Caterpillar Hill vegetation islands.

Like the straw bale projects described in Section 2.1.1, wind fencing project locations were established by the SOA and informed by 1930's-era aerial photography. Pursuant to SOA Condition 1.b., the wind fencing projects are to remain in place and be maintained until such time as they are replaced by vegetation or the APCO approves alternate mitigation measures. By April 2019, approximately 30% (14.4 acres) of the wind fencing installed the previous summer had deteriorated, requiring maintenance activities including resetting the fence posts, repairing damaged sections, replacing or repairing the orange construction fencing, and general maintenance and upkeep.

2.1.4 Trackout Control Projects

Pursuant to SOA Condition 1.c, the OHMVR Division is required to install an APCO-approved trackout control device at the Grand Avenue and Pier Avenue entrances to Oceano Dunes SVRA in the City of Grover Beach and the unincorporated community of Oceano, respectively, by June 30, 2019.

In May 2019, the OHMVR Division installed two temporary trackout mats at the Pier Avenue exit (see Exhibit 4, Pier Avenue Trackout Mat). The mats abate track out onto public streets from vehicles exiting the park. The temporary mats are removed at least once per week and all accumulated sand is removed from the street and disposed at an approved facility.

In addition to the new trackout mats, the OHMVR Division continued its program of street sweeping Grand and Pier Avenues a minimum of five times per week. The OHMVR Division also contracts with a private sweeping firm to cover a portion of Pier Avenue a minimum of three days per week from Air Park Drive to the State Park boundary. This sweeping complements the work that San Luis Obispo County conducts on Pier Avenue.

2.2 Statement of Progress Achieved

The dust control measures identified in Section 2.1 reduced saltation and dust emissions downwind of the treatment areas. While there is preliminary information on the effectiveness of these measures at reducing saltation and PM_{10} at and in the vicinity of the treatment area (see Section 2.3), the OHMVR Division cannot, at this time, state with certainty the degree to which the 2018/2019 dust control measures have made progress towards SOA goals, including the specific goal to achieve a 50% reduction in maximum PM_{10} baseline emissions downwind of Oceano Dunes SVRA. This is because current estimates of progress in meeting SOA goals are based on air quality modeling conducted by the Desert Research Institute's (DRI) Lagrangian Stochastic Particle Dispersion Model (LSPDM) and, as described in Section 2.3, the OHMVR Division has pursued significant data collection campaigns in spring and summer of 2019 that will update the LSPDM once the analyses of the new data is complete. Nonetheless, the current LSPDM estimates that the 48.1 acres of wind fencing and the 36.1 acres of new vegetation restoration projects implemented from summer 2018 to July 31, 2019 reduce PM_{10} emissions by approximately 11.1 metric tons per day (based on the average emissions for the 10 highest modeled emission days) and 14.6 metric tons per day (for May 22, 2013)[1]. In addition, these measures reduce the maximum 24-hour PM_{10} baseline concentrations at the CDF station by approximately 25.0 micrograms per cubic meter (μg/m^3; a 17.7% reduction based on the average emissions for the 10 highest modeled emission days) and 27.6 μg/m^3 (a 17.5% reduction for May 22, 2013)[2]. In contrast, the SLOAPCD estimates the 2018/2019 dust control measures may have reduced downwind PM_{10} concentrations by approximately 22%, although this estimate is not based on the LSPDM nor is it a reduction from maximum PM_{10} baseline concentrations[3].

2.3 Monitoring Activities Conducted Over the Previous Year

From summer 2018 to July 31, 2019, the OHMVR Division conducted various sand flux, air quality, meteorological, and other monitoring to evaluate the effectiveness of installed dust control measures and/or provide necessary additional information, as identified in Draft PMRP Chapter 3. These activities are described below.

2.3.1 Saltation/Sand Flux Monitoring

During the 2018 season, Big Springs Number Eight (BSNE) sand flux instruments were installed in two areas (see Exhibit 5, Example Monitoring Equipment):

- 64 instruments were operated in the approximately 35.2 acre-area comprised of the 2018 wind fencing projects adjacent to the Heather, Acacia, and Cottonwood vegetation islands (Paw Print) and a vegetation planting project installed in this area prior to 2018.
- 48 instruments were operated in a 10-acre wind fence array installed prior to 2018.

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[1] Emissions reductions are from Table 5-3 of the June 2019 Draft PMRP.
[2] Maximum PM_{10} baseline concentrations are from 5.5 from the June 2019 Draft PMRP.
[3] SLOAPCD, 2019. *California Department of Parks and Recreation's February 1, 2019 Oceano Dunes SVRA Concept Draft Particulate Matter Reduction Plan in Response to Stipulated Order of Abatement Number 17-01.* Letter from Gary Willey, Air Pollution Control Officer, SLOAPCD, to Dan Canfield, Acting Deputy Director, OHMVR Division. February 25, 2019.

For both arrays, the average reduction in sand flux in the main portion of the array after the initial adjustment region near the upwind edge of the array was 94% (Gillies et al., 2019; see Attachment 2)[4]. In the case of the approximately 35.2 acre fence array, the initial adjustment region required 8% of the array (so that the main portion represents 92% of the array), whereas for the 10 acre fence array the adjustment region required 17% of the array (83% in main portion).

During the 2019 wind season 76 BSNE sand flux instruments were installed in three zones:

- 20 instruments in the 25.3-acre Barbeque Flats vegetation project.
- 22 instruments in the 7.9-acre wind fence array adjacent to the Eucalyptus Tree and Eucalyptus South vegetation islands.
- 34 instruments in the wind fence array adjacent to the Heather, Acacia, and Cottonwood vegetation islands (Paw Print).

Through July 15, 2019, sand flux has been measured during 20 wind events during the 2019 season and will be analyzed in a similar manner to the work previously done at the site. DRI is anticipated to analyze the sand flux data by the end of 2019.

2.3.2 Air Quality / PM_{10} Monitoring

PM_{10} samplers placed upwind and downwind of the approximately 35.2 acre wind fence array and vegetation projects adjacent to Heather, Acacia, and Cottonwood vegetation islands (Paw Print) show that for periods where PM_{10} exceed the California Ambient Air Quality Standard of 50 µg/m^3, which suggest active emissions are occurring in the dunes, the percent reduction between upwind and downwind samplers is 54% (DRI, 2019; see Attachment 2). This change indicates that emission of PM_{10} from within the wind fence array was low to perhaps zero. Although the concentration change cannot be used to directly quantify changes in emission

[4] Gillies, J.A., V. Etyemezian, G. Nikolich (2019). Dust Control Projects ODSVRA – Sand Fence Effectiveness, 2018. Report Prepared for California State Parks, ODSVRA, Pismo Beach, CA.

flux, the decrease in concentration suggests that the emission flux within the fence array is less than upwind of the array (otherwise the concentration would continue to increase as more dust is input into the air mass as it passes over the array). Even with zero net emission flux within the array, the dust in the air from upwind sources would cause the concentration at the downwind edge to be elevated.

2.3.3 Meteorological Monitoring (including SODAR)

In 2019, the OHMVR Division installed 15 meteorological and air quality monitoring stations across Oceano Dunes SVRA to help assess individual project effectiveness and update the meteorology used in the DRI emissions model (see Exhibit 6, 2019 Work Plan Meteorological Monitoring). This network of meteorological and air quality instruments was deployed with spatial and temporal resolution equivalent to the 2013 network that helped to define the SOA's baseline time period (May 1, 2013 to August 31, 2013). The air and meteorological monitoring is ongoing. The data collected for use through August 31, 2019 will be evaluated by DRI and prepared for use in modeling exercises by November 30, 2019.

In addition, on May 14, 2019 a Vaisala Triton (ID#295) sonic detection and ranging (SODAR) wind profiler unit was installed in the southeast portion of Oceano Dunes SVRA, near the Phillips 66 refinery (see Exhibit 6). This SODAR unit will provide information on the atmospheric boundary layer profile and upper air wind conditions that will inform the updated PMRP model and the dynamic downscaling activity proposed to be undertaken by DRI (see Section 3.1.9).

2.3.4 PI-SWERL Monitoring (Oceano Dunes SVRA Erodibility and Emissions Grid)

DRI deployed Portable In-Situ Wind Erosion Lab (PI-SWERL) instruments over the period May 6 to May 30, 2019. During that time, conditions were favorable for testing on eight days. Three PI-SWERL instruments were operated for a total of approximately 475 (pending final quality assurance checks) valid tests. The overall aims of the effort were to:

- Update the emissions grid that was obtained based on 2013 testing and that has been used extensively for understanding the dust emissions distributions in riding and non-riding areas.

- Answer specific questions that have arisen regarding the distribution of emissions, such as the length of the transition region between riding area and non-riding area emissions.
- Identify changes to the emissions distributions that may have been brought about by the installation of various controls since the 2013 PI-SWERL test were conducted.

During the PI-SWERL sampling, sand moisture content data was also collected to evaluate the effect of moisture on erodibility and emissivity. DRI is currently evaluating the PI-SWERL data. The planned date for delivery of the new PI-SWERL gridded emissions database is October 31, 2019. The evaluation of the effect of moisture on erodibility and emissivity is planned to be completed by the end of December 2019.

2.3.5 LIDAR Monitoring

Light detection and ranging (LIDAR) monitoring data was collected within the approximately 35.2-acre wind fence array between April 3 and July 17, 2018 to evaluate potential elevation changes within the fence array. The monitoring revealed that within the fence array, sand mass accumulated significantly on the leading edges. The mean accumulated mass for the array was 248 kilograms per square meter (kg/m^2). Interior to the array there was a mean loss of-78 kg/m^2, which translates into approximately two inches (0.05 meters) in elevation change (Glick, 2019)[5].

2.4 Other Relevant Actions

2.4.1 Monitoring of Crystalline Silica

The OHMVR Division did not conduct any crystalline silica monitoring from summer 2018 to July 31, 2019 and there is at present no additional sampling planned. The SLOAPCD currently is collecting air filter samples at the CDF air quality monitoring station and will analyze the samples to determine exposure to crystalline silica according to the Chronic Reference Exposure Level (REL) for ambient crystalline silica adopted in 2005 by the California Office of

[5] Glick, 2019. Personal communication between Jack Gillies, DRI, and Ronnie Glick, California State Parks. 2019.

Environmental Health Hazard Assessment. The REL applies to respirable particles that are 4 microns or less in diameter. The annual REL for crystalline silica is 3 µg/m^3.

2.4.2 Analysis of Other Potential PM Sources

Section 7.3 of the Draft PMRP identifies opportunities for studying contributions to PM_{10} on the Nipomo Mesa from two potential sources of PM_{10} external to Oceano Dunes SVRA recreational operations: contribution to PM_{10} from marine sources and agricultural sources. The OHMVR Division, working with the Scripps Institution of Oceanography (Scripps), undertook an approximately 3-week long sampling event in spring 2019. For three times per day, from May 13 to June 2, air filter samples were swapped out at a temporary pump apparatus installed at the CDF air quality monitoring station. Additionally, off shore sea water, surf foam, and dune sand and soil samples were collected. Select samples from the CDF location are currently being analyzed by Scripps to determine carbon content and carbon type in the samples. They will also be analyzed by X-ray fluorescence to determine elemental content. Select same-day samples from the CDF location and from sea water, surf foam, and dune sand are also being examined via DNA analysis to determine if marine plankton species have transported downwind, as summarized in the Draft PMRP. Additionally, similar fieldwork and analyses are planned for fall 2019. This effort by Scripps is part of a three year long investigation. A preliminary report of 2019 findings is anticipated in the first quarter of 2020.

2.4.3 Topographic and Sediment Budget Monitoring

The OHMVR Division did not perform any topographic or sediment budget monitoring activities related to the development of a digital elevation model (DEM) or digital, georeferenced orthophotograph from summer 2019 to July 31, 2019.

2.4.4 Educational Outreach Campaign

The OHMVR Division did not perform any activities specifically related to the educational outreach campaign required by the SOA and described in Section 7.7 of the Draft PMRP.

2.4.5 California Environmental Quality Act (CEQA)

On June 13, 2019, the OHMVR Division issued a Notice of Preparation (NOP) of a Subsequent Environmental Impact Report (EIR) and Public Scoping meeting. The NOP is the first step in the EIR process evaluating the potential environmental impacts associated with implementation of the Draft PMRP. The OHMVR Division anticipates the EIR process will conclude in early 2020.

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3 WORK PLAN

3.1 Dust Control Actions Proposed for the Next Year

For the time period from approximately August 1, 2019 to July 31, 2020, the OHMVR Division is proposing to undertake and/or complete the following dust control activities:

- Complete necessary dust control-related contracting and procurement requirements.
- Establish on-site project manager/Oceano Dunes District Superintendent.
- Convert approximately 20 acres of wind fencing to vegetation.
- Maintain remaining wind fencing project areas.
- Establish approximately 40 acres of seasonal (approximately April to October) dust control measures in the back dune regions of Oceano Dunes SVRA.
- Begin development of a vegetated foredune that, over time, could ultimately be up to approximately 48 acres in size.
- Continue to refine the DRI LSPDM through robust and ongoing monitoring activities.
- Coordinate with the SAG and the SLOAPCD to determine the appropriate baseline approach for meeting SOA air quality objectives and conduct necessary baseline analyses.
- Take additional actions necessary to fill-in gaps in information and resource availability.

These actions are briefly summarized below. Each summary includes a table that identifies the main implementing actions, whether the action is underway or would be undertaken, and what preliminary evaluation metrics are anticipated to be collected and reported over the coming year. The evaluation metrics listed in this chapter are based on the 19 Outcome Metrics and 45 Implementation Metrics contained Attachment 8. The Draft PMRP identifies that specific targets should be established for each implementation and outcome metrics. The OHMVR Division will coordinate with the SAG and the SLOAPCD on the development of these specific targets over the coming year.

3.1.1 Complete Contracting and Procurement

The OHMVR Division anticipates the proposed dust control actions will require contracting and procurement of labor and materials. The OHMVR Division anticipates contracts for labor and materials will occur through the next year as necessary to support dust control actions. Table 3-1 summarizes the main implementing actions, work plan status, and reportable metrics for this dust control-related contracting and procurement actions.

Table 3-1: Contracting and Procurement Actions, Status and Metrics

Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
SAG contracting		X	X	X		Number of contracts (I27)[(A)]
Air quality and/or meteorological equipment	X					Number of contracts (I27)
Plant propagation services, facilities, and/or materials		X	X	X		Number of contracts (I27)
Contract labor resources, including planting services and environmental reviews (e.g., CEQA)	X		X	X		Number of contracts (I27)

(A) The Draft PMRP also includes Implementing Metrics I4, I13, I25, I16, and I26 that are related to budgets for contracting and procurement services. See Chapter 4 for 2019 Work Plan budget considerations.

3.1.2 Establish On-Site Project Manager / Oceano Dunes District Superintendent

The OHMVR Division is currently recruiting to permanently fill the on-site project manager / Oceano Dunes District Superintendent vacancy. The OHMVR Division anticipates this position will be permanently filled by the end of 2019. Table 3-2 summarizes the main implementing actions, work plan status, and reportable metrics for actions related to establishing an on-site project manager/Oceano Dunes District Superintendent.

Table 3-2: On-Site Project Manager/District Superintendent Actions, Status, and Metrics						
Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Job Posting	X					NA
Recruitment		X		X		NA
Interviews/hiring			X	X		Number of applicants (I28)
Training			X	X		Hired on-site manager (I29)

3.1.3 Convert Wind Fencing to Vegetation

Consistent with SOA Condition 1.b., the OHMVR Division proposes to convert approximately 20 acres of the 48.6 acres of wind fencing installed in summer 2018. The area proposed for the initial conversion from wind fencing to vegetation is located on the western edge of the approximately 35.2-acre wind fence array located adjacent to the Paw Print vegetation island (see Exhibit 7, 2019/20 SOA Dust Control Vegetation Projects, and Exhibit 8, 2019/20 SOA Dust Control Project). Following removal of the existing wind fencing, the OHMVR Division will proceed with restoration of the approximately 20-acre project area. The OHMVR Division's restoration methods are fully described in Chapters 6 and 7 of the June 2019 Draft PMRP.

The OHMVR Division has prepared a planting palette with targets for container stock and native seed needed for dust control projects over the next year (see Attachment 3). The OHMVR Division estimates a total of approximately 96,600 native dune plants and more than 900 pounds of native dune seed are needed for proposed 2019/20 vegetation planting projects.[6] Table 3-3 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to convert existing wind fencing to vegetation.

[6] This total includes vegetation need to convert wind fencing, begin development of the proposed foredune (see Section 3.1.6), and supplemental plantings anticipated to be required at 2018/2019 restoration project areas (Barbeque Flats and North Eucalyptus; see Section 2.1.2).

Table 3-3: Convert Wind Fencing To Vegetation Actions, Status, and Metrics						
	2019 Work Plan Status					
Implementing Action, Task, and/or Requirement	*Already Complete*	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
Install perimeter fencing around treatment area (as necessary)			X	X		NA
Native seed collection and/or native plant cultivation		X	X	X		Quantities of seed (I14) Numbers of plants (I15)
Wind fence removal			X	X		Length of fencing removed (I12)
Vegetation planting/restoration			X			Acres planted (I5, I6) Annual plant survival rate (03) Increase in area covered by live plants (O4)
Monitoring activities			X			Plant inspection/viability monitoring (I9) Acres replanted (I7, I7) Saltation monitoring (I17) Remote Sensing (I22, I23, I24) PM_{10} emissions reductions (O1)

3.1.4 Maintain Existing Wind Fencing That Will Not Be Converted to Vegetation

Consistent with SOA Condition 1.b., the OHMVR Division proposes to maintain approximately 28.6 acres of wind fencing installed in summer 2018 that will not be converted to vegetation by July 31, 2020 (see Exhibit 7). Maintenance activities would include replacing fence posts, fencing materials, and potentially installing new fence rows to maintain historical design control values for wind fencing arrays (greater than 80% to 90% control in the center of the array). Table 3-4 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to maintain existing wind fencing that will not be converted to vegetation.

Table 3-4: Maintain Existing Wind Fencing Actions, Status, and Metrics						
Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Install perimeter fencing around treatment area (as necessary)			X	X		NA
Replace posts, fencing materials, and fence rows as needed			X	X		Length of wind fencing installed and fence spacing (I12) Area stabilized by fencing (I10)
Monitoring activities			X			Saltation monitoring (I17) Remote Sensing (I22, I23, I24) PM_{10} emissions reductions (O1)

3.1.5 Install 40 Acres of Seasonal Dust Control Measures in Back Dune Regions

The OHMVR Division will install approximately 40 acres of seasonal dust control measures (wind fencing and/or straw bales) in the back dune regions of Oceano Dunes SVRA. The OHMVR Division would install seasonal dust control measures in locations developed in coordination with the SAG. This process would start with enclosing the treatment areas with perimeter fencing. The areas closed off may or may not be continuous depending on topography and the size and location of the areas to be controlled. Wind fencing and straw bale arrays can be designed to provide a specific control efficiency and can be deployed over a large area rapidly. To install wind fencing and straw bales, the OHMVR Division would transport the materials to the control area using a flatbed truck or heavy equipment capable of pulling trailers. The OHMVR Division would set the artificial materials by hand or use a loader or backhoe. For wind fencing, the OHMVR Division would drive fence poles into the ground and stretch plastic or metal mesh fencing material across the fence poles in approximately 80-foot sections. The OHMVR Division may use heavy equipment to move and distribute sand that has accumulated in wind fencing projects throughout the park. For straw bales, the OHMVR Division may also move sand that has accumulated in the array to other areas of the park or "roll" the bale forward onto sand that has accumulated on the upwind side of the bale. The frequency of maintenance activities would be determined based on sand accumulation and other factors that may reduce the design effectiveness of the installed project. In addition, the OHMVR Division could need to replenish materials that wear down or become buried (see Section 3.1.4). Table 3-5 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to install and maintain 40 acres of seasonal dust control measures.

Table 3-5: Install Seasonal Dust Control Measures Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Install perimeter fencing around treatment area (as necessary)			X	X		NA
Install posts, fencing materials or straw bales, and fence rows as needed			X	X		Length of wind fencing installed and fence spacing (I12) Area stabilized by fencing (I10)
Monitoring activities			X			Saltation monitoring (I17) Remote Sensing (I22, I23, I24) PM_{10} emissions reductions (O1)

3.1.6 Begin Development of a Vegetated Foredune

The OHMVR Division will, as recommended by the SAG, begin development of a vegetated foredune that could, over time, ultimately be up to approximately 48 acres in size (see Exhibit 9, 2019/2020 SOA Foredune Installation). During the 2019/2020 season, foredune development may begin with an initial, smaller vegetated treatment area (the size of which would be determined in coordination with the SAG). This smaller, vegetated treatment area would allow the OHMVR Division, SAG, and SLOAPCD the ability to measure, adjust, and adapt later foredune planting methods and activities based on field conditions and measured results. This adaptive process would allow the OHMVR Division to maximize the benefits of a foredune planting project and evaluate the effectiveness of the foredune project within the context of the OHMVR Division's PMRP activities.

The start of any potential foredune development will first require the OHMVR Division and the California Coastal Commission to complete all necessary environmental review and permit processes that include public review periods and other administrative timelines that are potentially outside the control of the OHMVR Division. The OHMVR Division will coordinate with the SAG on the location and design of the initial and overall vegetated foredune area; however, the area ultimately selected for development will need to be reviewed for operational and logistical constraints such as safe paths of travel, development on privately-owned land, public safety, and potential conflicts with natural and other park resources. For example, a vegetated foredune will likely need to be set back from the western snowy plover seasonal nesting exclosure to reduce potential impacts on nesting birds. In addition, any existing infrastructure near the foredune development area (most notably the vault toilet buildings) will remain open to service vehicles and the public.

After environmental reviews are completed, necessary permits obtained, and on-the-ground constraints resolved, the foredune development process will start by enclosing planting areas with perimeter fencing. The areas closed off will not be continuous, but it will have gaps that allow the public to pass from the camping area to the west to the riding area to the east. Such safe paths of travel would follow the prevailing wind pattern to reduce long-term maintenance needs on the protective fencing. Following installation of the perimeter fencing a, the OHMVR Division will proceed with development of the foredune project, which will take several years to monitor and successfully complete. The OHMVR Division's foredune development methods are fully described in Chapters 6 and 7 of the Draft PMRP. Table 3-6 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to develop a vegetated foredune.

Table 3-6: Vegetated Foredune Actions, Status, and Metrics						
Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
CEQA/permitting		X		X		Certified Environmental Impact Report California Coastal Commission approval
Install perimeter fencing around treatment area (as necessary)			X	X		NA
Native seed collection and/or native plant cultivation		X	X	X		Quantities of seed (I14) Numbers of plants (I15)
Vegetation planting/restoration			X			Acres planted (I1, I2) Annual plant survival rate (03) Increase in area covered by live plants (O4)
Monitoring activities			X			Plant inspection/viability monitoring (I5) Change in fraction of plant cover (O5) Change in foredune sand volume/sediment monitoring (O6) Change in hummocks and topographical variability (O9, O10) Increase in silhouette profile (O12) Saltation monitoring (I17, O11, O18, O19) Remote Sensing (I22, I23, I24) PISWERL emissivity (O8) PM_{10} emissions reductions (O1) Meteorological monitoring (O7)

3.1.7 Refine PMRP Model through Monitoring Activities

The OHMVR Division will continue to work with the SAG and the SLOAPCD to address reducible uncertainties and refine the DRI LSPDM presented in Chapter 3 of the Draft PMRP. This will involve the continuation of the monitoring activities described in Chapter 2, data analyses, and updating the DRI LSPDM model inputs to reflect new meteorological, air quality, and other data collection efforts. Table 3-7 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to update the PMRP model through modeling results.

Table 3-7: PMRP Model Update and Monitoring Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Monitoring activities	X	X	X			Saltation monitoring (I17, O17, O18, O19) Remote Sensing (I22, I23, I24) PISWERL emissivity (I25, O18, O19) PM_{10} emissions reductions (O1) Meteorological monitoring (I18, I19, I20) Baseline and repeat unmanned aerial surveys (I23)
Update PMRP model			X	X		Updated baseline modeling information and emission reduction estimates

3.1.8 Determine Baseline Approach

Section 4.1 of the Draft PMRP summarizes the SOA's baseline time period (May 1 to August 31, 2013) and the conditions that occurred during this time. The Draft PMRP presented these conditions in four different ways because the SOA did not explicitly define baseline conditions:

- The days where the measured, 24-hour average PM_{10} concentration at the CDF station equaled or exceeded the California Ambient Air Quality Standard (CAAQS) of 50 µg/m3 (per SOA Condition 2.b)
- The single day (May 22, 2013) where the measured, 24-hour average PM_{10} concentration at the CDF station equaled or exceeded the National Ambient Air Quality Standard (NAAQS) of 150 $\mu g/m^3$ (per SOA Condition 2.b)
- The day with the maximum modeled 24-hour PM_{10} emissions level – also May 22, 2013 (per SOA Condition 2.c)
- The ten days with the highest modeled emissions levels, in terms of metric tons per day (to inform future management decisions at Oceano Dunes SVRA)

The establishment of a clear baseline, supported by the best available evidence, is imperative because the baseline conditions set the standard against which the success of the PMRP will be evaluated. The OHMVR Division, the SAG, and the SLOAPCD, have noted several concerns regarding the use of single day to define baseline conditions. The OHMVR Division will continue to work with the SAG and the SLOAPCD to determine the correct baseline approach for meeting SOA objectives (see Draft PMRP Chapter 4). This will involve several meetings to review different options for defining baseline conditions as it relates to the SOA and, depending, on the baseline definition selected by the OHMVR Division, the SAG, and the SLOAPCD, the potential modification of the SOA. It is the intent of the OHMVR Division to work with the SAG and the SLOAPCD to develop the baseline conditions against which the success of the PMRP will be evaluated no later than January 2020. Table 3-8 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to update the SOA baseline approach.

Table 3-8: SOA Baseline Update Actions, Status, and Metrics						
Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Monitoring activities	X	X	X			Saltation monitoring (I17, O17, O18, O19) Remote Sensing (I22, I23, I24) PISWERL emissivity (I25, O18, O19) PM_{10} emissions reductions (O1) Meteorological monitoring (I18, I19, I20)
Meetings with SAG and SLOAPCD to discuss baseline options				X		Updated baseline definition(s)
Update PMRP model			X	X		Updated baseline modeling information and emission reduction estimates

3.1.9 Additional Actions to Address Reducible Uncertainty and Gaps in Information

The OHMVR Division will continue to work with the SAG and the SLOAPCD to take action to address reducible uncertainty associated with the LSPDM as well as fill in other gaps in information necessary to best meet SOA objectives. These include: wind climatology analysis; equipment calibrations; dynamic downscaling for more accurate modeling of wind fields; and an updated topographic database. These actions are described below.

Wind Climatology Analysis

In 2019, DRI began a wind climatology analysis for Oceano Dunes SVRA using available PM and meteorological data from the SLOAPCD's CDF and Mesa2 monitoring stations as well as upper air soundings from Vandenberg Air Force Base and data from the National Oceanic and Atmospheric Administration's National Data Buoy Center. This is analysis is currently on hold due to a lack of up-to-date contract between the OHMVR Division and DRI. The OHMVR Division re-entered into a contract with DRI in September 2019. This renewed contract will enable DRI to complete the wind climatology analysis by the first quarter of 2020.

Field Calibrations of MetOne Particulate Profiler Equipment

The OHMVR Division will coordinate with the SLOAPCD on the deployment of a portable PM_{10} monitoring station within Oceano Dunes SVRA for the following purposes:

- In-situ calibration of the MetOne Particle Profilers used to monitor PM patterns across Oceano Dunes SVRA with a Federal Equivalent Method (FEM) monitor under high PM conditions, which has not been previously available
- A measurement location downwind of the foredune development area to aid in determining the changes in PM that accompany the initiation and development of the foredune restoration project.

Details regarding the security, transport, and measurement location options for the portable PM_{10} monitoring station are provided in Attachment 4.

Dynamic Downscaling for More Accurate Modeling of Wind Fields

Given the complex wind flow and topography of Oceano Dunes SVRA, an improved simulation of winds by using more realistic upper-air structure information in the Oceano Dunes and surrounding area is desired. DRI has recommended updating the existing meteorological data set, prepared using CALMET, with output from the Weather and Research Forecasting (WRF) model. The WRF model is a state-of-the-art dynamical, non-stationary model that performs better in areas of complex terrain than CALMET. Additionally, WRF adequately transfers, adds value and physical consistency to the meteorological information at the regional and local level. This downscaling process is known as dynamical downscaling and it is currently performed by operational and research institutions to improve the representation of the modeled local weather and climate information derived from the forecasting and global climate models. The WRF model and dynamic downscaling process are described in greater detail in Attachment 5. DRI will incorporate outputs from the WRF model into the LSPDM by November 30, 2019.

Updated Topographic Database / Dataset for Topographic and Sediment Budget Monitoring

The OHMVR Division, in coordination with the SAG, will undertake high resolution land surveying to identify baseline terrain conditions (in a digital elevation model or digital orthophotograph mosaic format) and support an evaluation of changes in vegetation cover and geomorphology following implementation of dust control projects including a future foredune planting. This surveying would be conducted using an Unmanned Aerial Systems (UAS) methodology involving a commercial drone and high resolution digital camera system. The UAS flights will gather high-resolution (approximately 1.5 centimeter ground sample distance) digital aerial imagery with sufficient overlap and georeferencing to allow Structure-from-Motion Multi-View Stereo algorithms in commercial software (e.g., Agisoft Metashape) to produce detailed DEMs of the surface of the beach and dune topography in the restoration area. Onsite georeferencing will be provided by installed survey control monuments (rebar benchmarks) that will be occupied by a survey-grade global navigation satellite system (GNSS) receiver for a minimum of four hours to provide sufficient data for an accurate (millimeter scale) positioning and vertical elevation (NAD83, etc.) to be derived from the National Geodetic Survey's Online Positioning User Service solution. The Wingtra UAS platform has an onboard GNSS receiver that can resolve precise positioning of all photos in post-processed kinetic (PPK) mode. For improved accuracy and truthing of the PPK georeferencing, several survey targets (2-foot flat vinyl checkerboard sheets) will also be installed within the mapping domain and georeferenced with a roving GNSS receiver in real-time kinetic (RTK) mode referenced to the onsite base station. The baseline data gathered from the initial UAS survey will provide a 3D rendering of the terrain as a DEM, as well as a digital, georeferenced orthophoto mosaic with approximately 1 to 2 centimeter pixel resolution. These data products will be used to update the DEM incorporated into the LSPDM and provide a baseline state from which volumetric, geomorphic, and areal changes in sand volumes, vegetation, and landforms within and around dust control projects, including a future foredune, can be detected and assessed.

If financial resources permit, the tentative sequence for the topographic data collection effort would be:

- The initial UAS surveys will completed before any new dust control efforts begin so as to capture baseline conditions (i.e., in winter 2019/2020)

- Surveys would occur in 2019 and 2020 bracketing the installation of temporary projects (e.g., wind fencing) and the phenology of plant growth - once when plant cover is minimal and once when cover is near maximum. Surveys must also consider exclosure timelines for Western Snowy Plover nesting season. As such, the best times are likely early October and late February.

Subsequent DEMs and orthophotomosaics will provide comparative data for changes in aerial cover and type of vegetation (including new planting regimes), aeolian landforms, sand transport pathways, and related sediment volumetric changes. A Geomorphic Change Detection (GCD, per Wheaton et al., 2010) will be conducted on sequential DEMs using spatial-temporal statistics to identify areas and volumes of significant erosion/deposition[7]. The survey domain will be partitioned into distinct, linked geomorphic units (beach, foredune/restoration zone, backdune and the volumetric changes within each will be quantified and assessed to provide insights into the sediment mass balance and morphodynamics of dust control projects. The effectiveness of dust control projects over time will be assessed using the UAS-derived GCD maps, orthophoto mosaics, sediment volume changes, and morphodynamic observations using some of the criteria for assessing dune restoration effectiveness documented in Walker, et al. (2013)[8]. Notably, a positive sediment mass balance should occur whereby sand transported by aeolian saltation would be deposited within the dust control project. Correspondingly, this would translate to a reduction in aeolian saltation and related PM_{10} emissions within, and downwind of the dust control project. Onsite monitoring using instrument stations equipped with saltation sensors, PM_{10} monitoring instruments, and weather stations will

[7] Wheaton, J.M., Brasington, J., Darby, S.E. and Sear, D.A., 2010. Accounting for uncertainty in DEMs from repeat topographic surveys: improved sediment budgets. Earth surface processes and landforms 35(2): 136-156.

[8] Walker, I. J., Eamer, J. B. R., & Darke, I. B. (2013). Assessing significant geomorphic changes and effectiveness of dynamic restoration in a coastal dune ecosystem. Geomorphology, 199, 192–204. https://doi.org/10.1016/j.geomorph.2013.04.023

quantify the responses of the system in between UAS surveys to provide information on the regime of events that cause observed changes.

Evaluation of Specific Role of Vehicle Activity on PM_{10} Generation

Although off-highway vehicle recreation is not identified as a significant direct contributor to elevated PM_{10} levels downwind of Oceano Dunes SVRA, the specific role of vehicle activity on the potential creation of PM and in the subsequent wind- and saltation-driven emission of particulate dust are not yet fully understood. Therefore, the OHMVR Division, in coordination with the SAG, SLOAPCD, and CARB, will develop plans for further scientific studies that inform understanding of the underlying effects of vehicle activity on dust emissions. For example, as the first phase of a planned vegetation restoration project, a portion of project area could be closed to OHV recreation for a defined period of time and the change in saltation and PM_{10} emissions observed over that time to see what emissions levels are in the absence of OHV activity (which may be relevant to baseline emissions levels discussed in Section 3.1.8).

Table 3-9 summarizes the main implementing actions, work plan status, and reportable metrics for actions necessary to address reducible uncertainty and gaps in information.

Table 3-9: Address Reducible Uncertainty Actions, Status, and Metrics

Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Wind climatology analysis			X	X		Changes in annual and average high wind day mean 24-hour PM_{10} by station (O2) Updated baseline definition(s)/ updated baseline modeling information and emission reduction estimates (O20)
Field calibration of Met One Profilers			X	X		Frequency of station inspection and calibration (I19, I20) Budget for equipment (I21)

Table 3-9: Address Reducible Uncertainty Actions, Status, and Metrics						
Implementing Action, Task, and/or Requirement	*2019 Work Plan Status*					*Evaluation Metrics and/or Success Criteria To Document In 2020 Annual Report*
	Already Complete	*Already Underway*	*To Be Undertaken*	*To Be Completed*	*Not Proposed*	
Dynamic downscaling			X	X		Changes in annual and average high wind day mean 24-hour PM_{10} by station (O2)
Update topographic database and sediment monitoring			X			Change in sand volumes (O6, I17 I22, I23, I24), hummocks (O9), topographic variability (O10), and silhouette profile (O12)
Evaluate role of vehicle activity			X			Updated information on emissivity and erodibility absent vehicle activity Updated baseline definition(s) (O20)

3.2 Expected Outcomes, Effectiveness, and Potential Emissions Reductions

The proposed dust control measures identified in Section 3.1 are intended to reduce dust emissions downwind of Oceano Dunes SVRA. The estimated emission reductions and effectiveness of the dust control measures on downwind PM_{10} concentrations, based on air quality modeling conducted by DRI for the Draft PMRP, are discussed in greater detail in this section.

It is important to note the information below is based on the DRI LSPDM results as presented in the June 2019 Draft PMRP. As described in Section 2.2, the OHMVR Division has pursued significant data collection campaigns in spring and summer of 2019 that will update the information below once the analyses of the new data is complete. Therefore, all estimates of expected outcomes, effectiveness, and potential emissions reductions are preliminary, subject to change, and would require confirmation in the updated DRI LSPDM.

3.2.1 Installation of a Vegetated Foredune

The DRI LSPDM estimated that the future installation of a 22.7-acre foredune would reduce emissions between 4.0 metric tons per day (based on the average emissions for the 10 highest modeled emission days) and 5.2 metric tons per day (for May 22, 2013)[9]. Assuming each acre in the general foredune location has the same erodibility, the installation of an approximately 48 acre foredune could potentially scale upwards to emissions reductions of approximately 8.5 (for the 10 highest modeled emission days) to 11.0 metric tons per day (for May 22, 2013). This potential reduction would need to be confirmed by the updated DRI LSPDM model.

The DRI LSPDM also estimated that the future installation of a 22.7-acre foredune would reduce downwind PM_{10} concentrations at the CDF monitoring station by approximately -20.7 µg/m^3 (based on the modeled days where the PM_{10} CAAQS standard was exceeded) to -10.5 µg/m^3 (based on the modeling results for May 22, 2013).[10] Assuming the same scaling factor for downwind PM_{10} concentrations measured at CDF, the 48-acre foredune could reduce measured PM_{10} concentrations at the CDF monitoring station by approximately -43.8 µg/m^3 (based on the modeled days where the PM_{10} CAAQS standard was exceeded) to -22.2 µg/m^3 (based on the modeling results for May 22, 2013). This potential reduction would need to be confirmed by the updated DRI LSPDM model.

3.2.2 Conversion of Existing Wind Fencing to Native Dune Vegetation

Although the analysis contained in the Draft PMRP did not specifically evaluate the potential mass reduction in PM_{10} emissions associated with the conversion of approximately 20 acres of existing wind fencing to native dune vegetation, some potential outcomes may be inferred from on the information contained in the Draft PMRP. As provided in Section 6.2.2 of the Draft PMRP, the effectiveness of wind fencing varies from 40% to 86% depending on the location measured, the spacing of the fencing, and depth of the fencing. The fencing that would be

[9] Emissions reductions are from Table 5-8 of the June 2019 Draft PMRP.
[10] Emissions reductions are from Table 5-9 of the June 2019 Draft PMRP.

replaced by vegetation generally has a control efficiency of 94% when operating under optimal conditions (see Section 2.3.1). The establishment of a continuous cover of vegetation or materials, such as broadcast straw or mulch, on a sand surface should effectively reduce sand transport and the emissions of dust associated with the sand movement to zero, providing a control effectiveness of 100%. After scaling the emission reductions identified in Table 5-8 of the PMRP for the Initial SOA dust control measures to 20 acres, and assuming the controls are working at 100% efficiency, it is estimated the installation of vegetation could help reduce existing emissions by approximately 3.5 tons per day (assuming each acre of the 84.5 acres of Initial SOA dust control measures identified in the Draft PMRP had the same erodibility and emissivity factors). Assuming the same scaling factor for downwind PM_{10} concentrations measured at CDF, this level of control could reduce measured PM_{10} concentrations at the CDF monitoring station by approximately -1.6 $\mu g/m^3$ (based on the modeled days where the PM_{10} CAAQS standard was exceeded) to -2.8 $\mu g/m^3$ (based on the modeling results for May 22, 2013). These potential reductions would need to be confirmed by the updated DRI LSPDM model.

It is important to note the modeling included in the Draft PMRP assumed 100% control effectiveness for dust control projects. Therefore, from a modeling perspective, converting wind fencing to vegetation only replaces one form of dust control with another, and does not result in emissions controls beyond that estimated in the Draft PMRP.

3.2.3 Install 40 Acres of Seasonal Dust Control Measures

The DRI LSPDM estimated that the future installation of dust control measures in an approximately 163-acre area near the center of Oceano Dunes SVRA would reduce emissions between 12.4 metric tons per day (based on the average emissions for the 10 highest modeled emission days) and 21 metric tons per day (for May 22, 2013)[11]. Assuming each acre in this area has the same erodibility, the installation of 40 acres of seasonal dust control measures in this

[11] Emissions reductions are from Table 5-8 of the June 2019 Draft PMRP.

area would scale downwards to emissions reductions of approximately 3.0 to 5.1 metric tons per day. This potential reduction would need to be confirmed by the updated DRI LSPDM model.

The Draft PMRP did not present an estimate of PM_{10} concentration reductions at the CDF station associated with dust control measures in an approximately 163-acre area near the center of Oceano Dunes SVRA. Therefore, estimates of reductions in PM_{10} concentration at the CDF station cannot be made at this time for the installation of 40 acres of seasonal dust control measures.

3.2.4 Preliminary Estimate of Progress to be Gained

The preliminary estimate of the progress to be gained by the 2019 Work Plan in meeting the current SOA goal pertaining to a 50% reduction in maximum 24-hour PM_{10} baseline emissions is presented in Table 3-10. These preliminary estimate of progress would need to be confirmed by the updated DRI LSPDM model.

Table 3-10 2019 Work Plan Estimate of Progress (Open Riding and Camping Area Baseline)

Day	Dust Control Emissions Reductions (Riding Area)						Remaining Emissions	Percent Reduction
	2013 Baseline Emissions[(A)]	Pre-SOA (47.7 Acres)	Initial SOA (84.5 Acres)	2019 Work Plan		Total (220.2 Acres)		
				Foredune (48 Acres)	Backdune Fencing (40 Acres)			
5/22/2013	151.6	-3.5	-14.6	-11.0	-5.1	-34.2	117.4	-22.6%
5/23/2013	152.5	-3.4	-15.6	-11.8	-4.8	-35.6	116.9	-23.3%
4/8/2013	129.0	-3.8	-13.2	-10.4	-2.5	-29.9	99.1	-23.2%
5/18/2013	112.9	-2.7	-11.9	-9.1	-3.5	-27.2	85.7	-24.1%
6/18/2013	105.3	-2.6	-9.8	-7.6	-3.5	-23.5	81.8	-22.3%
5/29/2013	100.1	-2.9	-11.2	-8.9	-1.8	-24.8	75.3	-24.8%
5/26/2013	95.1	-2.3	-9.4	-7.4	-2.9	-22	73.1	-23.1%
5/30/2013	86.9	-2.2	-8.7	-6.6	-2.6	-20.1	66.8	-23.1%
4/15/2013	79.6	-2.4	-8.3	-6.6	-1.5	-18.8	60.8	-23.6%
5/27/2013	76.2	-1.8	-7.6	-5.7	-2.4	-17.5	58.7	-23.0%
Mean	108.9	-2.8	-11.1	-8.5	-3.0	-25.4	83.5	-23.3%

Source: Table 4-1 and Table 5-8 of the June 2019 Draft PMRP, modified to reflect 2019 Work Plan activities.
(A) 2013 baseline emissions from Table 4-1 of the Draft PMRP. Emissions are for the open riding and camping area only.

3.2.5 Planned Field Measurements

In addition to the currently proposed LSPDM updates, the OHMVR Division will evaluate the effectiveness of proposed dust control measures in the field through a combination of sand flux and PM_{10} monitoring equipment.

Baseline Sand Flux Measurements

The degree of success of planned dust control projects will, in part, be judged on the change in sand flux across the treatment area. To quantify the changes in the mass flux of sand within dust control project areas, measurements of sand flux will be made using multiple BSNE saltation traps (Fryrear, 1986)[12]. These simple, but effective sand traps have been used extensively at Oceano Dunes SVRA (and elsewhere) to measure sand transport following its modification by control measures such as sand fencing (Gillies et al., 2017)[13] and re-vegetation involving spreading straw followed by planting of native species. The relative change in sand flux from uncontrolled to controlled conditions is used to define the effectiveness of the control measure to reduce sand transport.

The methodological approach to quantify control effectiveness uses multiple BSNE traps, with their collection orifice at the same height above the ground surface (15 centimeter), spaced closer together on the windward side of an area modified by a sand/dust control project, followed by a more even spacing of traps through to the downwind edge of the control area. This pattern is used because it is well-documented that roughness, whether it be in the form of a sand fence, or distributed roughness elements, modifies the sand flux as a function of downwind travel distance in a non-linear fashion (Gillies et al., 2017, Gilies et al., 2018)[14,15]. The

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[12] Fryrear, D. (1986). A field dust sampler. Journal of Soil and Water Conservation 41: 117-120.

[13] Gillies, J.A., V. Etyemezian, G. Nikolich, R. Glick, P. Rowland, T. Pesce, M. Skinner (2017). Effectiveness of an array of porous fences to reduce sand flux: Oceano Dunes, Oceano CA. Journal of Wind Engineering and Industrial Aerodynamics 168: 247-259, doi: 10.1016/j.weia.2017.06.015.

[14] IBID.

[15] Gillies, J.A., V. Etyemezian, G. Nikolich, W.G. Nickling, J. Kok (2018). Changes in the saltation flux following a step-change in macro-roughness. Earth Surface Processes and Landforms, 43: 1871-1884, doi: 10.1002/esp.4362.

relative reduction in sand flux, i.e., sand flux internal to the control area/sand flux upwind and external to the control area defines the effectiveness of the control measure (0 to 1, where 0 represents a complete arresting of the sand flux and an effectiveness of 100%). The control effectiveness over the spatial extent of a control measure is quantified as the mean of the flux measurements made at each downwind measurement position (furthest east)/corresponding sand flux made at the upwind position.

Ideally, multiple transects of BSNEs across the width of the restoration would be installed prior to any dust control activities to quantify the mean sand flux in the area, except with an exclusion fence to restrict access to all OHV activity. As it may not at this time be feasible to have a sufficiently long period to define the sand flux across the control area prior to any restoration activities (due to time constraints and planting schedules), the methodological approach of Gillies et al. (2018) will be used to quantify the relative changes in sand flux in the restoration area caused by the restoration activities[16]. BSNEs will be maintained on the upwind edge of the control area to the west of all restoration activities (but within the exclusion fencing) to quantify the incoming sand flux. Multiple west-east transects of BSNEs (5 traps per transect, 10 transects from north to south) will be emplaced with their collection orifice at 15 centimeter (above local ground surface). The traps will be monitored by the OHMVR Division and the sand samples within the traps will be collected following a regional high wind/sand transport/elevated PM_{10} event. Samples will be collected if the leading edge traps contain multiple grams of sand. Traps downwind of the leading edge traps will be collected if they contain multiple grams of sand. If the downwind traps, checked following collection of the leading edge traps, do not contain sufficient sand for accurate weighing they will be noted as containing a trace amount (less than 1 gram). Personnel involved in sample collection will be provided with a vial of sand (collected from the foredune restoration area) that contains 1 gram of sand so that they can make an effective judgement on whether to collect the sample or not. BSNE traps that record trace amounts of sand within them will be considered to show zero flux

[16] IBID.

when included in the calculation of effectiveness. Sand flux reduction, and control effectiveness, attributable to dust control projects will be determined by maintaining this sampling network throughout the duration of the treatment. Effectiveness of the control will be reported on an annual basis, if sand transport is measured by the leading edge BSNEs.

PM_{10} Measurements

Measuring emissions (in terms of micrograms per square meter per second) of PM_{10} from an actively emitting surface is a challenge due to the complexity of the configuration of instruments required as well as the necessary quality of the measurements in terms of precision, accuracy, and time resolution. For previous studies at Oceano Dunes SVRA, it has been assumed that dust emission scales with saltation flux, such that a reduction in sand flux creates a commensurate reduction in dust or PM_{10} flux. To provide confidence that this does occur PM_{10} monitors (MetOne Particle Profilers) have been placed upwind and in the immediate downwind position of control measures. The expectation is that if sand flux reduction is observed, PM_{10} concentrations will not increase across the horizontal distance of the area under control. To date, when this measurement procedure has been used at Oceano Dunes SVRA for areas that have had sand flux controls in place, the difference between upwind and downwind PM_{10} has shown a decrease (e.g., Gillies et al., 2017; Gillies et al., 2019; see Attachment 2)[17,18]. This suggests that the emission of PM_{10} within the area being controlled has been reduced along with the sand flux. For dust control projects upwind and downwind monitoring of PM_{10} will be undertaken to keep a record of how the relative concentration (downwind/upwind) changes through time to provide confirming data of the effectiveness of the developing foredune to modulate dust emissions from the area.

[17] See footnote 7.
[18] See footnote 4.

3.3 Sensitivity Analysis / Projection of Additional Controls Necessary to Achieve a 50% Reduction in Maximum Baseline Emissions

As described in Section 2.2, the OHMVR Division has completed or is in the progress of completing several significant data collection campaigns in spring and summer of 2019 that will update Draft PMRP modeling. Therefore, at this time, it is premature to complete a sensitivity analysis that evaluates the effect of increasing the magnitude of the dust control measures described in Section 3.1.

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4 BUDGETARY CONSIDERATIONS

The OHMVR Division's estimated budget to develop and implement the 2019/2020 dust control actions described in Chapter 3 is $2,642,230. A detailed breakdown of this estimated budget is provided in Table 4-1.

Table 4-1: Estimated 2019 Work Plan Budget

Dust Control Activity	3rd Party Contract Costs	Other Costs	Total Costs
Vegetation Plantings (Conversion of Wind Fencing, Foredune, and Supplemental Plantings)			
Support Services	$343,000	$0	$343,000
Labor	$257,000	$104,000	$361,000
Materials	$0	$95,000	$95,000
Equipment	$97,000	$125,000	$222,000
Greenhouse Facilities	$150,000	$0	$150,000
Subtotals	*$847,000*	*$324,000*	*$1,171,000*
Maintenance and Installation of Wind Fencing			
Labor	$156,000	$18,000	$174,000
Materials	$0	$50,000	$50,000
Equipment	$100,000	$0	$100,000
Subtotals	*$256,000*	*$68,000*	*$324,000*
Monitoring (Sand Flux, Air Quality, Meteorological, and Other Monitoring)			
Instrument Operations	$229,000	$29,000	$258,000
Data Analysis	$300,000	$0	$300,000
Subtotals	*$529,000*	*$29,000*	*$558,000*
Dust Control Project Design and Technical Assistance			
Scientific Expertise	$368,000	$0	$368,000
Subtotals	*$368,000*	*$0*	*$368,000*
Other Items of Expense			
Miscellaneous	$221,230	$0	$221,230
Subtotals	*$221,230*	*$0*	*$221,230*
TOTAL COSTS	**$2,221,230**	**$421,000**	**$2,642,230**
Note: Cost estimate does not include permanent staff positions assigned to these duties but does include seasonal staff time and overtime for permanent staff.			

The approximately $2.64 million budget shown in Table 4-1 is similar to the costs the OHMVR Division incurred from summer 2018 to July 31, 2019. Compared to the previous 12 months:

- Costs for greenhouse services (to grown native plants) have increased at off-site growing facilities (private facilities and Cal Poly San Luis Obispo facilities)
- Labor costs have increased to install native dune plants and restoration materials;
- Contract costs for scientific and technical assistance for additional field investigations (PI-SWERL, air quality monitoring) and scientific analysis (DRI LSPDM, analysis of new field measurements, etc.).

Costs for greenhouse services and labor to install plants have increased primarily due to the increase in the amount of planting projects at Oceano Dunes SVRA. Prior to the 2018/19 restoration season, the OHMVR Division had planted a maximum of approximately 20 acres of vegetation per year for dust control purposes. In 2018/19 and again in 2019/20, the OHMVR Division planted approximately 40 acres of native dune vegetation. This additional acreage represents a large increase in the labor required to grow out plants, prepare restoration sites for plant and seed material, and install plants.

5 IMPLEMENTATION SCHEDULE

Draft PMRP Attachment 9 presents an overall implementation schedule for the PMRP. The tables below present updated schedules for implementing the dust control activities identified in Chapter 3 over the August 1, 2019 to July 31, 2020 time period.

Table 5-1 2019/2020 Contracting and Procurement Schedule

Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec ' 19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
SAG Contracting	Dec '18	Apr '19												
Air quality and/or meteorological equipment	Mar '19	Sep '19												
Plant propagation services, facilities, and/or materials	Apr '19	May '23												
Contract labor resources, including planting services and environmental reviews (e.g., CEQA)	Jun '19	Aug '19												

Table Key:	
	Action start.
	Action in progress.
	Action complete.

Table 5-2 2019/2020 On-Site Project Manager/District Superintendent Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Job Posting	Dec '18	Mar '19												
Recruitment	Jan '19	Nov '19												
Interviews/Hiring	Oct '19	Dec '19												
Training	Dec '19	May '20												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-3 2019/2020 Convert Wind Fencing to Vegetation Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Install perimeter fencing around treatment area (as necessary)	Aug '19	Oct '20												
Native seed collection and/or native plant cultivation	Jan '19	Nov '20												
Wind fence removal	Aug '19	Oct '20												
Straw bales/mulch	Oct '19	Nov '20												
Vegetation planting/restoration	Jul '19	Feb '20												
Monitoring activities	Jan '20	Dec '23												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-4 2019/2020 Wind Fencing Installation and Maintenance Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Install perimeter fencing around treatment area (as necessary)	Jan '20	Mar '20												
Replace posts, fencing materials, and fence rows as needed; Install 40 acres of new fencing projects	Feb '20	Mar '20												
Remove 40 acres of new fencing projects	Jul '20	Aug '21												
Monitoring activities	Feb '20	TBD												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-5 2019/2020 Vegetated Foredune Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
CEQA	Jun '19	Dec '19												
California Coastal Commission Approval	Dec '19	TBD												
Install perimeter fencing around treatment area	Jan '19	TBD												
Native seed collection and/or plant cultivation	Apr '19	Feb '20												
Vegetation planting	Jan '20	Mar '20												
Monitoring activities	Jan '20	Dec '23												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-6 2019/2020 PMRP Model Update and Monitoring Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Meteorological and PM data acquisition	May '19	Dec '23												
PI-SWERL measurements	May '19	Jun '23												
PI-SWERL analyses	Jul '19	Oct '23												
DEM update	TBD	TBD												
Incorporate DEM update into LSPDM	Oct '19	Dec '22												
Updated LSPDM modeling	Dec '19	Mar '23												
Compare model predictions with PM data measurements	Dec '19	Mar '23												
Improve LSPDM performance	Jun '19	Dec '23												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-7 2019/2020 SOA Baseline Update Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Review available field and modeling data	May '19	Mar '20												
Develop alternative SOA baseline options	Jan '20	Mar '20												
Recommend baseline approach to APCD	Feb '20	Mar '20												
Table Key:														
	Action start.													
	Action in progress.													
	Action complete.													

Table 5-8 2019/2020 Additional Actions to Address Reducible Uncertainty Schedule														
Implementing Action, Task, or Requirement	*Task Start Date*	*Task End Date*	*2019/2020 Implementation Schedule*											
			Aug '19	*Sep '19*	*Oct '19*	*Nov '19*	*Dec '19*	*Jan '20*	*Feb '20*	*Mar '20*	*Apr '20*	*May '20*	*Jun '20*	*Jul '20*
Wind climatology analysis	Oct '19	Mar '20												
Field calibration of Met One Profilers	Oct '19	Jul '20												
Dynamic downscaling	Oct '19	Nov '19												
Update topographic database and sediment monitoring	Oct '19	TBD												
Evaluate role of vehicle activity	TBD	TBD												

Table Key:	
	Action start.
	Action in progress.
	Action complete.

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Oceano Dunes SVRA Draft PMRP

2019 Annual Report and Work Plan

EXHIBITS

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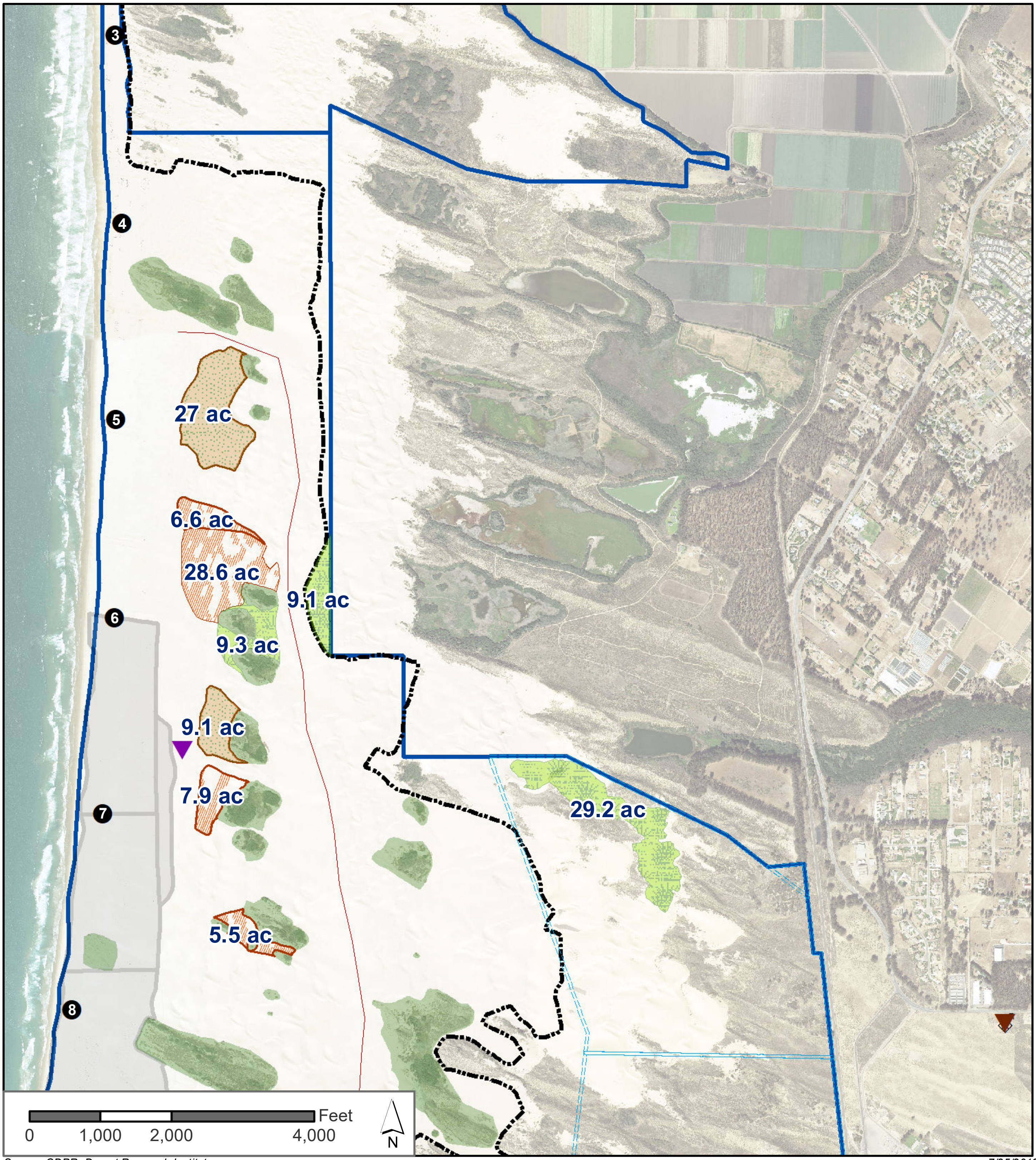
Exhibit 1



Source: CDPR, Desert Research Institute *7/25/2019*

- Pre-SOA vegetation project (2014 and 2017)
- Initial SOA wind fencing projects
- Initial SOA straw bales/restoration
- Existing fenced vegetation islands (186 acres)
- Sand Highway, approx.
- Open riding and camping area boundary fence
- Marker post
- Nesting exclosure
- Park boundary

Wind monitoring towers

- CDF
- S1

Phillips 66 Lease area

CALIFORNIA STATE PARKS SINCE 1864 OHV

SOA Dust Control Measures

Oceano Dunes SVRA 2019

Exhibit 2

Source: CDPR, Desert Research Institute

7/29/2019

- 2018/2019 supplemental restoration (8.2 acres)
- Initial SOA wind fencing projects
- Initial SOA straw bales/restoration
- Pre-SOA vegetation project (2014 and 2017)
- Existing fenced vegetation islands (186 acres)
- Sand Highway, approx.
- Open riding and camping area boundary fence
- Park boundary

2018/19 Supplemental Dust Control Restoration Project

Oceano Dunes SVRA 2019

Exhibit 3: Example 2018 Wind Fence Photographs

Exhibit 3. 2018 wind fencing projects installed at Oceano Dunes SVRA. Partially buried fencing requiring maintenance is visible in the top and lower right photographs.

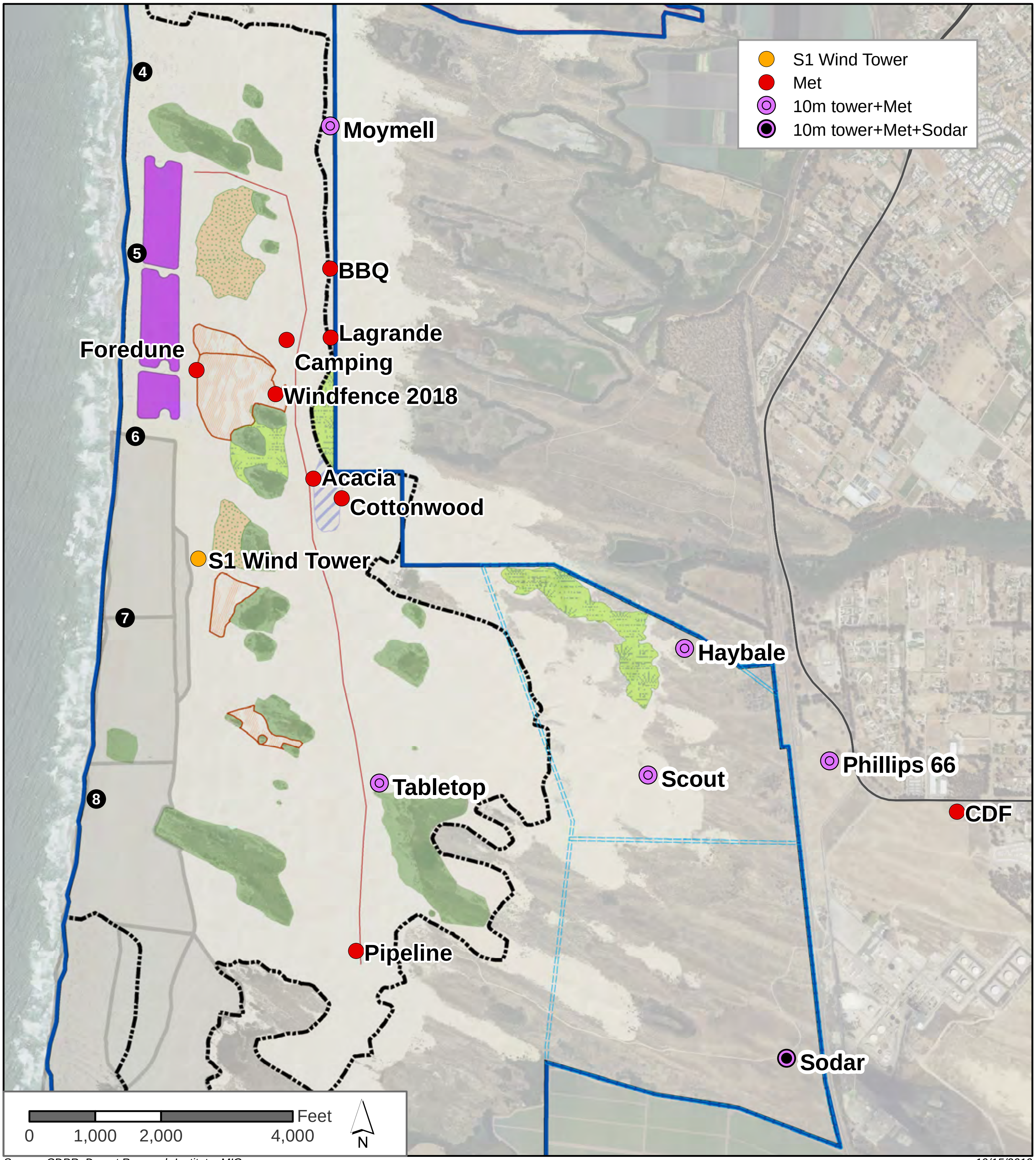
Exhibit 4: Pier Avenue Trackout Mat

Exhibit 4. Pier Avenue Trackout Mats.

Exhibit 5: Example Monitoring Equipment

Exhibit 5. Example monitoring equipment, including BSNEs (top left), PM_{10} and wind speed/direction instruments (top right), and meteorological monitoring stations (bottom).

Exhibit 6



Source: CDPR, Desert Research Institute, MIG

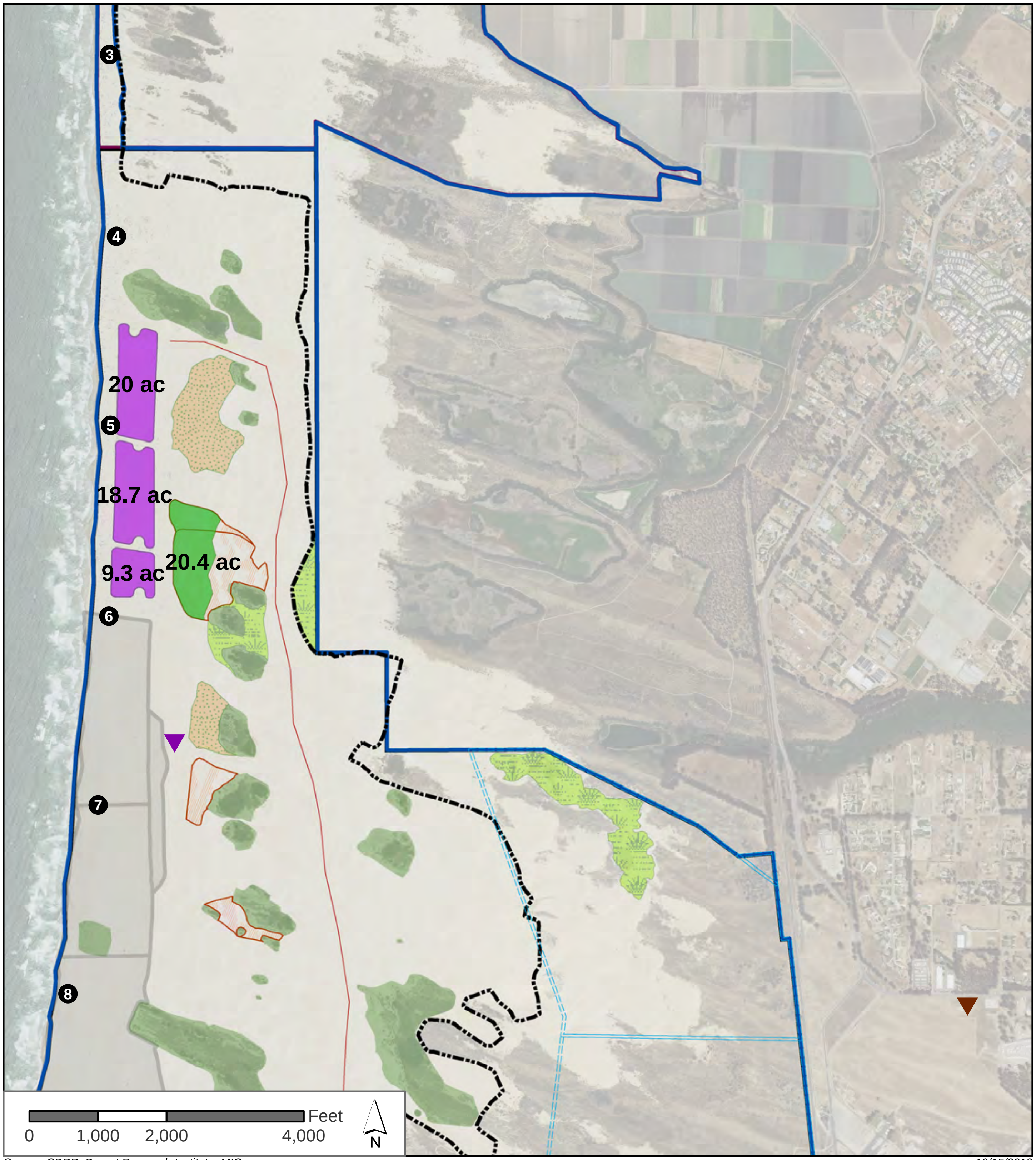
10/15/2019

- Potential foredune (48 acres)
- Pre-SOA vegetation project (2014 and 2017)
- Pre-SOA wind fencing project (removed)
- Initial SOA wind fencing projects
- Initial SOA straw bales/restoration
- Existing fenced vegetation islands (186 acres)
- Phillips 66 Lease area
- Sand Highway, approx.
- Marker post
- Open riding and camping area boundary fence
- Nesting exclosure
- Park boundary

2019 Monitoring Network

Oceano Dunes SVRA 2019

Exhibit 7



Source: CDPR, Desert Research Institute, MIG

10/15/2019

- Potential foredune (48 acres)
- Planned 2019 SOA wind fence restoration
- Initial SOA wind fencing projects
- Initial SOA straw bales/restoration
- Pre-SOA vegetation project (2014 and 2017)
- Existing fenced vegetation islands (186 acres)
- Phillips 66 Lease area
- Sand Highway, approx.
- Marker post
- Open riding and camping area boundary fence
- Nesting exclosure
- Park boundary

Wind monitoring towers

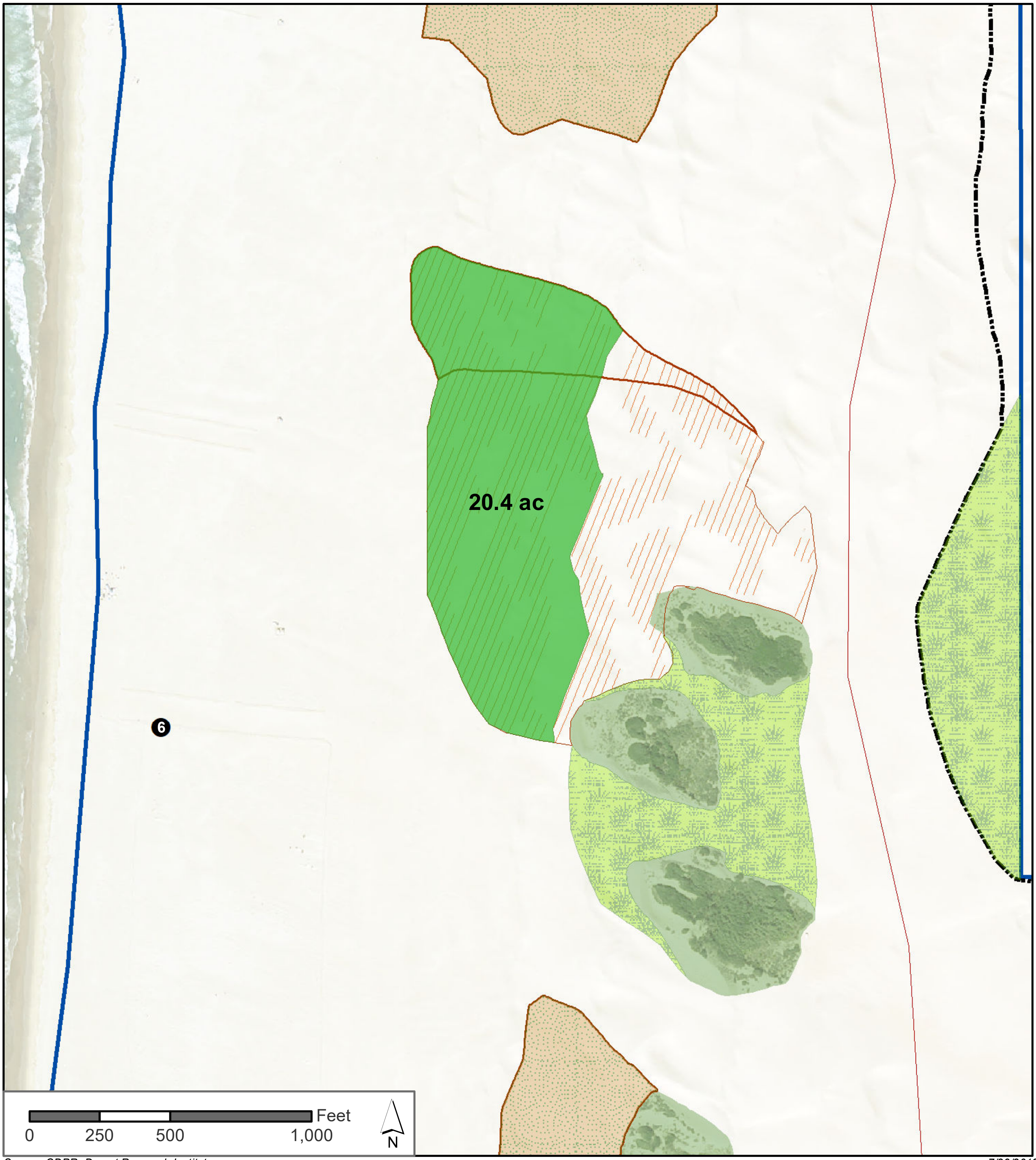
CDF S1

CALIFORNIA STATE PARKS SINCE 1864 OHV

2019/20 SOA Dust Control Vegetation Projects

Oceano Dunes SVRA 2019

Exhibit 8



Source: CDPR, Desert Research Institute

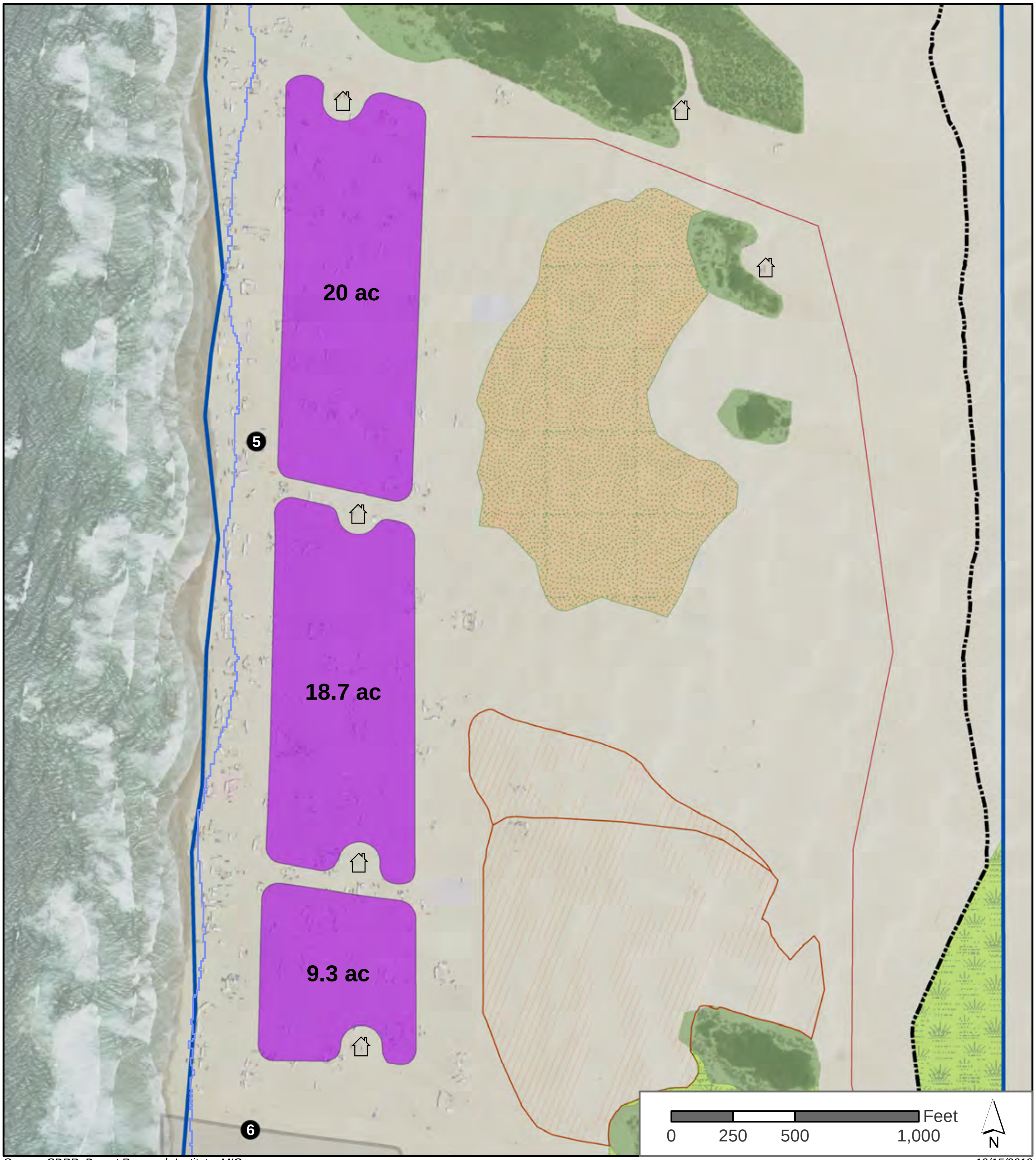
7/29/2019

Planned 2019 SOA wind fence restoration
Initial SOA wind fencing projects
Initial SOA straw bales/restoration
Pre-SOA vegetation project (2014 and 2017)
Existing fenced vegetation islands (186 acres)
Sand Highway, approx.
Marker post
Open riding and camping area boundary fence
Park boundary

2019/20 SOA Dust Control Vegetation Project

Oceano Dunes SVRA 2019

Exhibit 9



Source: CDPR, Desert Research Institute, MIG

10/15/2019

- Potential foredune (48 acres)
- Initial SOA wind fencing projects
- Initial SOA straw bales/restoration
- Pre-SOA vegetation project (2014 and 2017)
- Existing fenced vegetation islands (186 acres)
- Mean Higher High Water (MHHW), 2000
- Vault toilets
- Sand Highway, approx.
- Marker post
- Open riding and camping area boundary fence
- Park boundary

California State Parks OHV

2019/20 SOA Foredune Installation

Oceano Dunes SVRA 2019

Oceano Dunes SVRA Draft PMRP

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ATTACHMENT 1

Restoration 2018-19 Project Summary

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Restoration 2018-19 Project Summary

Site	BBQ Flats	Eucalyptus North	LaGrille Hill	Pawprint	
Site Description	New Site	New Site	Supplemented	Supplemented	
Site Established	2018-19	2018-19	2017-18	2017-18	
Total Area Planted					**Total**
Total Area (acre)	**25.30**	**8.56**	**2.84**	**5.17**	**41.87**
Total Native Plant Count	72,126.00	22,856.00	5,445.00	5,924.00	**106,351.00**
Plants /Acre	2,850.83	2,670.09	1,917.25	1,145.84	**2,540.03**
Number of Plants by Species					
Achillea millefolium	9,215	3,234	748	748	**13,945**
Acmispon glaber	472	184	0	0	**656**
Ambrosia chamissonis	644	0	0	0	**644**
Astragalus nuttallii	0	0	0	98	**98**
Atriplex leucophylla	147	0	0	0	**147**
Camissoniopsis chieranthifolia	547	0	0	0	**547**
Corethrogyne filaginifloria	1,813	662	150	248	**2,873**
Dudleya lanceolata	35	56	0	0	**91**
Ericameria ericoides	2,513	868	207	207	**3,795**
Erigeron blochmaniae	5,047	1,774	416	416	**7,653**
Eriogonum parvifolium	2,352	824	194	194	**3,564**
Eriophyllum staechadifolium	12,365	3,817	867	867	**17,916**
Erysimum insulare	4,729	1,675	591	990	**7,985**
Fragaria chiloensis	9	0	18	0	**27**
Lupinus chamissonis	21,835	7,098	1,667	1,667	**32,267**
Monardella crispa	3,285	1,024	262	262	**4,833**
Oenothera elata	1,225	0	0	0	**1,225**
Phacelia ramosissima	441	174	0	0	**615**
Salix lasiolepis	160	67	0	0	**227**
Senecio blochmaniae	5,292	1,399	325	325	**7,341**
Total Area Covered with Straw					**Total**
Total Area (acre)	**25.30**	**8.56**	**0.00**	**0.00**	**33.86**
Total Bales	3,634.00	1,356.00	0.00	0.00	**4,990.00**
Total Bales/Acre	143.64	158.41	0.00	0.00	**147.37**
Straw Hand Scattered					
Area (acre)	25.24	7.45	0.00	0.00	**32.69**
Bales	3,589.00	1,302.00	0.00	0.00	**4,891.00**
Bales/Acre	142.22	174.77	0.00	0.00	**149.64**
Straw Hand Punched					
Area (acre)	1.07	1.07	0.00	0.00	**2.13**
Bales	45.00	54.00	0.00	0.00	**99.00**
Bales/Acre	42.17	50.61	0.00	0.00	**46.39**

Restoration 2018-19 Project Summary

Site	BBQ Flats	Eucalyptus North	LaGrille Hill	Pawprint	
Total Area Seeded					**Total**
Total Area (acre)	**25.30**	**8.56**	**2.84**	**5.17**	**41.87**
Area (%)	60.43%	20.44%	6.78%	12.35%	**100.00%**
Native Seed Weight (lb)	360.37	65.53	9.07	12.96	**447.93**
Native Seed (lb) /Acre	14.24	7.66	3.19	2.51	**10.70**
Native Seed Weight (g)	163,463.83	29,724.41	4,114.15	5,878.66	**203,181.05**
Native Seed (g) /Acre	6,461.02	3,472.48	1,448.65	1,137.07	**4,852.66**
Fertilizer 15-15-15 (lb)	1,500.00	600.00	100.00	100.00	**2,300.00**
Fertilizer 15-15-15 (lb) /Acre	59.29	70.09	35.21	19.34	**54.00**
Sterile Triticale (lb)	1,600.00	600.00	100.00	100.00	**2,400.00**
Sterile Triticale(lb) /Acre	63.24	70.09	35.21	19.34	**57.00**
Seed Weight (lb) by Species					
Abronia maritima	77.98	0.00	0.00	0.00	**77.98**
Abronia umbellata	0.34	0.12	0.02	0.03	**0.51**
Acmispon glaber	24.48	8.35	1.15	1.78	**35.76**
Achillea millefolium	15.56	5.31	0.73	1.19	**22.79**
Ambrosia Chamissonis	112.80	0.00	0.00	0.00	**112.80**
Astragalus Nuttalli	0.05	0.02	0.00	0.01	**0.08**
Atriplex leucophylla	0.07	0.00	0.00	0.00	**0.07**
Baccharis pilularis	0.50	0.17	0.02	0.04	**0.73**
Camissoniopsis chieranthifolia	0.62	0.00	0.00	0.00	**0.62**
Corethrogyne filaginifolia	0.21	8.00	1.10	0.09	**9.40**
Erigeron blochmaniae	5.84	1.99	0.27	0.44	**8.54**
Eriastrum densifolium	0.04	0.03	0.05	0.07	**0.19**
Ericameria ericoides	31.35	10.70	1.48	2.32	**45.85**
Erysimum insulare	0.37	0.13	0.02	0.02	**0.54**
Eriogonum parvifolium	34.26	11.69	1.61	2.56	**50.12**
Eriophyllum staechadifolium	13.76	4.69	0.65	1.01	**20.11**
Juncus lesueurii	0.43	0.15	0.02	0.03	**0.63**
Lupinus chamissonis	5.60	1.91	0.26	1.25	**9.02**
Malacothrix incana	0.15	0.00	0.00	0.00	**0.15**
Monardella crispa	5.84	1.99	0.27	0.49	**8.59**
Phacelia ramosissima	19.67	6.71	0.93	1.47	**28.78**
Senecio blochmaniae	10.45	3.57	0.49	0.16	**14.67**
fore dune mix	191.62	0.00	0.00	0.00	**191.62**
back dune mix	168.75	65.53	9.07	12.96	**256.31**
ACMI Duff	24.91	8.50	1.17	1.76	**36.34**
ASNU Duff	0.15	0.05	0.01	0.01	**0.22**
CACH Duff	3.89	1.33	0.18	0.27	**5.67**
ERIN Duff	0.66	0.23	0.03	0.05	**0.97**
ERST Duff	15.76	5.38	0.74	1.11	**22.99**
LUCH Duff	122.34	41.74	5.76	8.64	**178.48**

Oceano Dunes SVRA Draft PMRP

2019 Annual Report and Work Plan

ATTACHMENT 2

Dust Control Projects ODSVRA – Sand Fence Effectiveness, 2018 (Draft)

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Dust Control Projects ODSVRA - Sand Fence Effectiveness, 2018 (DRAFT)

J.A. Gillies, V. Etyemezian, G. Nikolich
Division of Atmospheric Sciences, Desert Research Institute, Reno and Las Vegas, NV

Draft date: 04/04/2019

Introduction

Since 2014 California State Parks has installed control measures including sand fence and roughness arrays to temporarily reduce, and planted vegetation in critical areas to eliminate, sand transport and the associated dust emissions in areas of the Oceano Dunes State Vehicular Recreation Area (ODSVRA) State Park. These control measures are emplaced to try and reduce the amount of particulate matter ≤10 µm aerodynamic diameter (PM_{10}) originating from within the ODSVRA due to wind erosion that is part of the overall PM_{10} burden measured at air quality monitors operated by the San Luis Obispo Co. Air Pollution Control District (SLOCAPCD). The reduction of PM_{10} is mandated by the Stipulated Order of Abatement issued in April 2018.

Arrays of sand fences of varying size have been installed each year within the ODSVRA beginning in 2014. In 2014, 4 foot-high plastic sand fences of ≈50% porosity were emplaced into ≈30 acres of dunes. They were oriented approximately perpendicular to the prevailing direction of high wind and spaced 10 fence heights apart (10h). In 2015 the same type of fencing was emplaced in ≈37 acres, but the spacing was reduced to 7 fence heights apart (7h). Gillies et al. (2017) report on the effectiveness of these arrays of porous fences to reduce sand flux and dust emissions. Measurements of sand flux through the arrays indicated that it diminishes exponentially with increasing distance, reaching equilibrium at ≈93 fence heights for the 10h spacing and ≈27 fence heights for the 7h spacing. Fences spaced 7h apart reduced sand flux for the entire area by 78%, and 86% for the area that was a distance of >27 h from the leading fence. Fences spaced at 10 h reduced sand flux for the entire area by 40%, and 56% for the area >93h downwind from the leading fence. PM_{10} monitoring upwind and downwind of the array and in the absence of the array in 2015, indicated that the downwind PM_{10} concentration was less than the upwind for the fence array, whereas in the absence of fences PM_{10} increased in the downwind direction over the same fetch distance, suggesting the presence of the fences was reducing the flux of PM_{10} from within the fence array. A reasonable estimate of the reduction in dust emissions attributable to the fence arrays is that is equivalent to the reduction achieved in the sand flux, as for sandy soils it has been observed that the ratio of dust flux to sand flux is relatively stable and independent of wind speed (Gillette., 1999).

The 2017 and 2018 sand flux data in the fence arrays are provided in Table 1. The 2017 sand flux data indicated that the sand transport reduction for the entire surface area defined by the perimeter of the array, when sand flux measured upwind of the array resulted in sand catches in the single-height BSNE traps ≥10 g was 55% (±100%), which characterized days with the highest sand flux rates. The mean normalized sand flux (i.e., NSF=sand flux interior the array/sand flux exterior to the array) was 0.24 (±0.33) over 89% of the sand fence array, which matches quite closely the results of 2015 and 2016 for sand fence arrays spaced at 7h.

Table 1. Sand flux reduction (Normalized Sand Flux, NSF) in the fence arrays in 2017 and 2018

2017 (10 Acre Plot)				2018 (37.7 Acre Plot)				2018 (10 Acre Plot)			
Mean Horizontal Distance (m)	Mean Normalized Distance (HD/fence Height)	Mean NSF	Std. D. NSF	Mean Horizontal Distance (m)	Mean Normalized Distance (HD/fence Height)	Mean NSF	Std. D. NSF	Mean Horizontal Distance (m)	Mean Normalized Distance (HD/fence Height)	Mean NSF	Std. D. NSF
0	0	1	0	0	0	0.67	0.42	0	0	0.88	0.28
9.8	8.0	0.10	0.03	12.6	10.3	0.14	0.28	12.6	10.3	0.02	0.03
12.2	10.0	0.04	0.01	21.1	17.3	0.03	0.05	21.1	17.3	0.03	0.05
15.8	13.0	0.07	0.03	38.2	31.3	0.004	0.01	38.2	31.3	0.20	0.30
18.3	15.0	0.21	0.18	67.1	55.0	0.01	0.01	63.8	52.3	0.02	0.07
20.7	17.0	0.05	0.02	97.9	80.3	0.01	0.02	93.9	77.0	0.10	0.09
24.4	20.0	0.08	0.05	143.9	118.0	0.01	0.01	97.9	80.3	0.09	0.19
35.4	29.0	0.19	0.17	191.8	157.3	0.05	0.07	115.0	94.3	0.05	0.10
37.8	31.0	0.06	0.02	243.0	199.3	0.20	0.26	123.5	101.3	0.04	0.06
41.5	34.0	0.12	0.03	294.2	241.3	0.09	0.13				
61.0	50.0	0.05	0.09	336.9	276.4	0.09	0.21				
63.4	52.0	0.72	0.32	388.1	318.4	0.02	0.49				
67.1	55.0	0.17	0.09	430.8	353.4	0.07	0.15				
95.1	77.9	0.04	0.02								
97.5	79.9	4.19	3.97								
101.2	82.9	2.03	1.49								
137.8	112.9	0.61	1.08								
140.2	114.9	0.73	0.47								
143.9	117.9	0.52	0.93								
HD >0		0.55	1.03	HD> 21.1*		0.06	0.08	HD> 21.1*		0.06	0.11
HD> 12.2 and Excluding HD=97.5 & 101.2		0.24	0.33	*Mean and Std D. based on using all traps (i.e., not mean of Columns)				*Mean and Std D. based on using all traps (i.e., not mean of Columns)			

Information from Gillies et al. (2016; 2017) was used to guide dust control using fence arrays in 2018. In spring 2018, two arrays of sand fences that covered 37.7 acres and 10 acres were constructed within the ODSVRA with the fence-to-fence distance set at 7h (Fig. 1).

Sand flux was measured at the 37.7-acre fence array using paired BSNE (Fryrear, 1986) sand traps upwind of the fence and at 32 positions within the array. The change in NSF as a function of downwind distance for the 37.7-acre array in 2018 is shown in Fig.2. For 2018, at horizontal distance, HD, ≥35 m (normalized distance, ND, ≥29 [ND=HD/fence height]), which is after the adjustment of the sand flux to the fences (Fig. 3), the mean NSF=0.062 (±0.08). This horizontal distance represents 92% of the length of the measurement transect through the array. This is a significant decrease in NSF between 2017 and 2018. The rate of decrease in NSF as a function of distance into the array was similar to that measured in 2017 with flux adjustment occurring at HD ≈33 m (ND≈27) into the array compared with 35 m (ND≈29) in 2018.

Sand flux was measured at the 10-acre fence array using paired BSNE (Fryrear, 1986) sand traps upwind of the fence and at 24 positions within the array. The change in NSF as a function of downwind distance for the 10-acre array in 2018 is shown in Fig.4. For the 10 acre array, at HD≥21 m (ND≥17.3), which is after the adjustment of the sand flux to the fences (Fig. 5), the mean NSF=0.06 (±0.11), which represents 83% of the length of the measurement transect through the array. The 10 acre array has a similar sand flux reduction effectiveness (≈94%) as the 37.7-acre array (≈94%) within the area where sand flux is adjusted to the fences. This increase in sand flux reduction effectiveness may be due to the wind direction during above-threshold transport conditions being more often aligned perpendicular to the fence alignment in 2018 (Fig. 6). The rate of change in NSF as a function of distance into the arrays is similar for both size arrays, suggesting that they were performing at the same effectiveness level. In both arrays, increases in NSF through the arrays are associated with topographic highs (near dune crests), where wind speeds are likely to be accelerating due to compression of the stream lines as they travel over the dunes.

Data obtained from the UAV-lidar measurements made soon after the fence arrays were emplaced with a flight on April 3, 2018 was followed by a second flight on July 17, 2018, 107 days, later corroborate the sand flux reduction effectiveness measurements made with the transect of BSNE sand traps. Figure 7 shows the difference in height of the sand surfaces interior and exterior to the sand fence arrays that has resulted from the sand transport events that occurred between the two lidar measurement periods. As can be seen from Fig. 7, increases in surface elevation are evident on the leading edges of both arrays, where the saltating sand interacts with the first few rows of fences. Deeper into the arrays, the elevation of the sand surfaces between the fences is essentially below the detection limits of the lidar. Observable change in elevation is associated with elevation highs and lows within the fence arrays and where gaps in the fencing occurred due to topography that was not amenable for fence placement (steep lee-side slopes). Areas outside of the fence arrays and the re-vegetated areas show a high degree of elevation change due to the very active sand transport in the absence of control measures. The purple hexagon in Fig. 7 was to be perimeter-fenced area that would have eliminated riding within in, but the fencing was not emplaced.

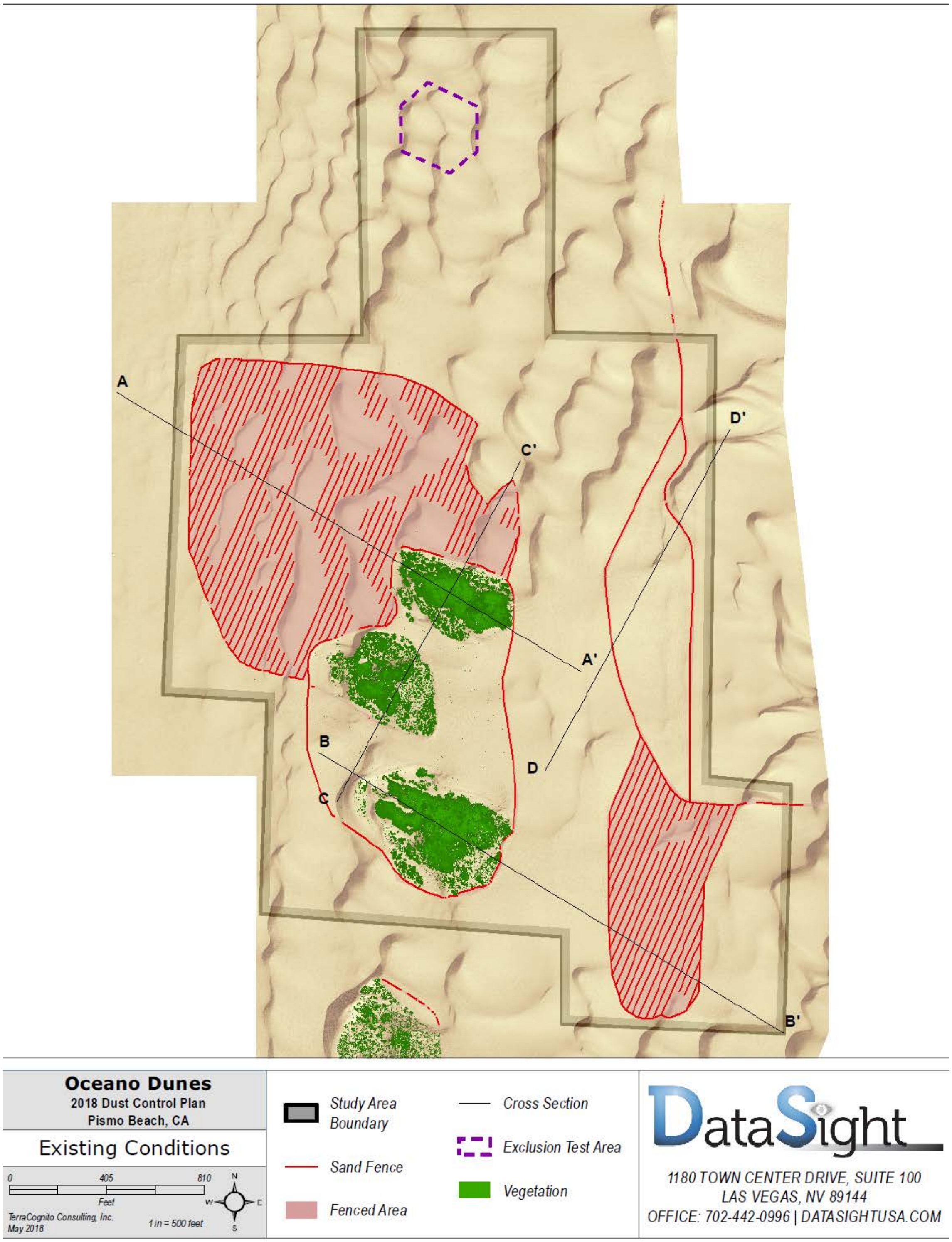

Figure 1. Sand fence arrays established in 2018.

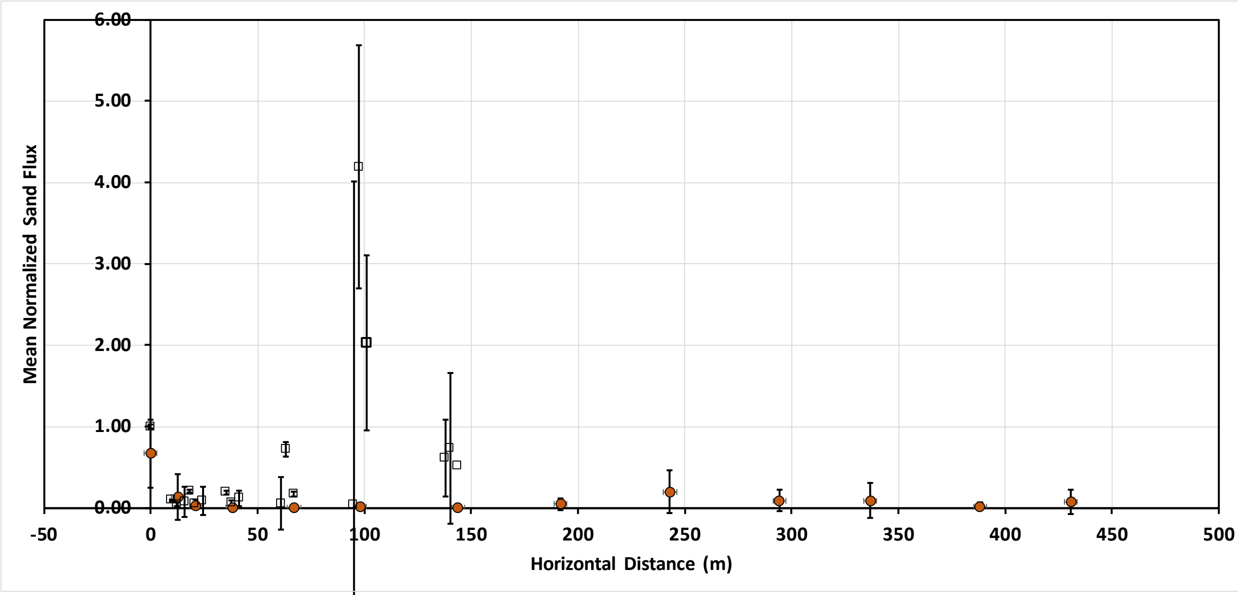

Figure 2. Change in NSF as a function of downwind distance in the 10-acre array in 2017 (white squares) and the 37.7-acre fence array in 2018 (orange circles). Vertical error bars represent the standard deviation of the mean NSF based on three BSN traps within two sequential fences for the 33 sampling days. Horizontal error bars represent the standard deviation of the mean of horizontal distances for the BSNE traps within two sequential fences (Std. Dev=3 m).

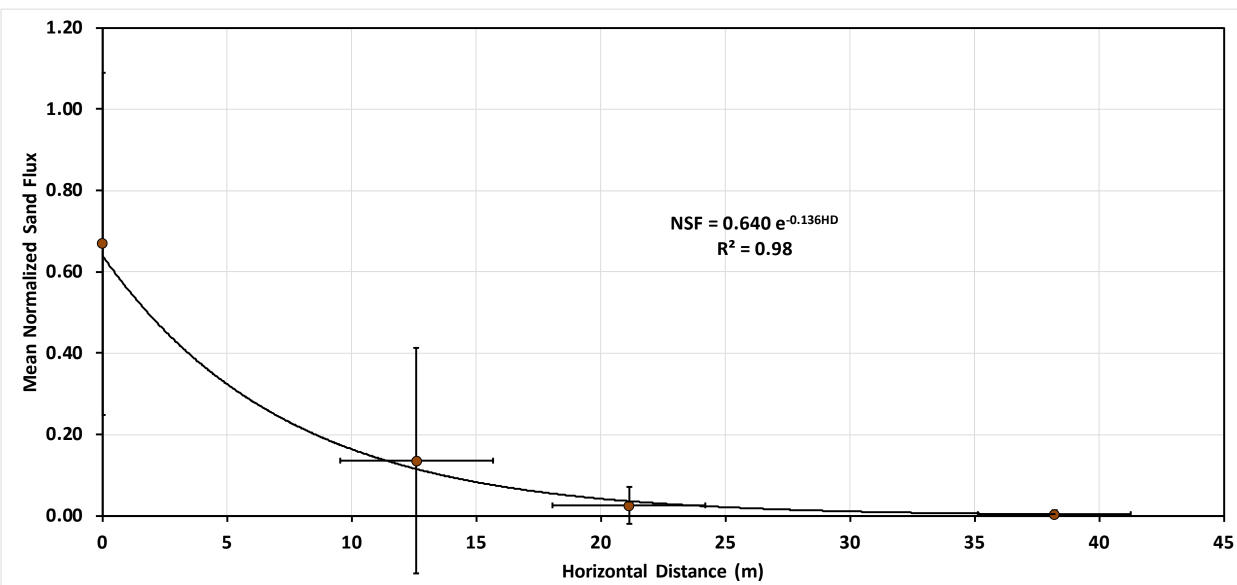

Figure 3. Change in NSF as a function of downwind distance in over the distance 0-33 m in the 37.7-acre fence array in 2018. Vertical error bars represent the standard deviation of the mean NSF based on the three BSN traps within two sequential fences for the 33 sampling days. Horizontal error bars represent the standard deviation of the mean of horizontal distances for the BSNE traps within two sequential fences (Std. Dev=3 m).

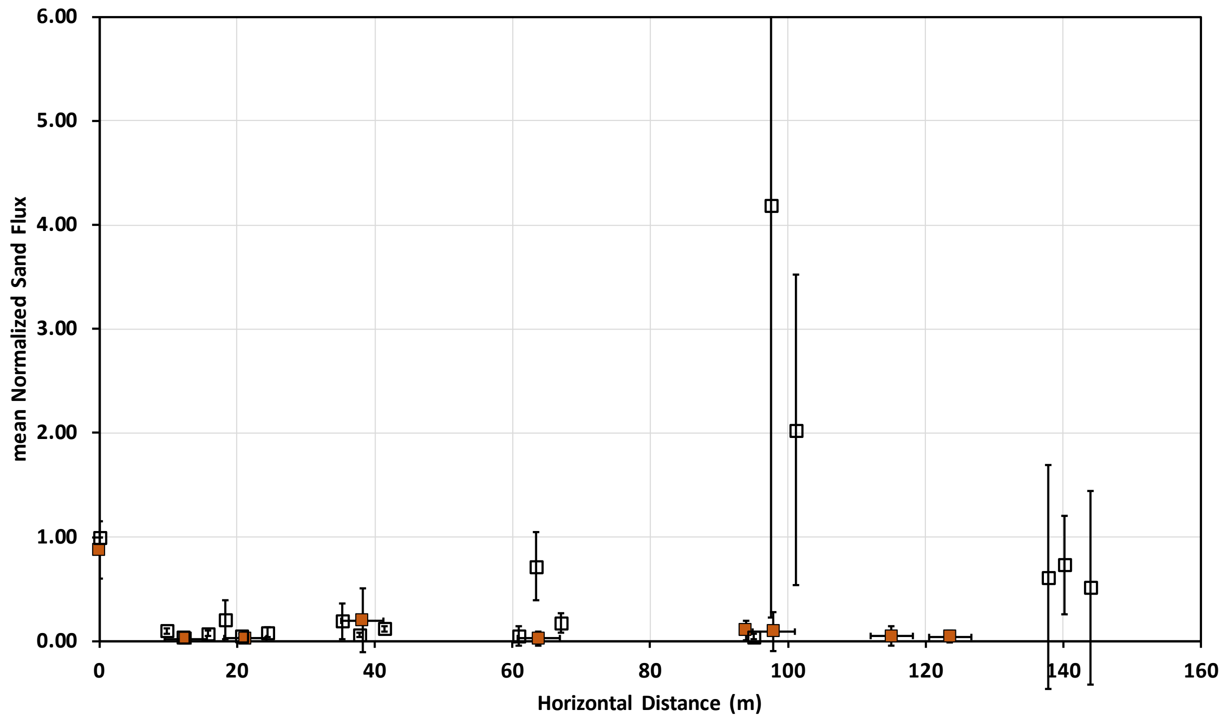

Figure 4. Change in NSF as a function of downwind distance in the 10-acre fence array in 2017 (white squares) and 2018 (orange squares). Vertical error bars represent the standard deviation of the mean NSF based on the three BSN traps within two sequential fences for the 31 sampling days. Horizontal error bars represent the standard deviation of the mean of horizontal distances for the BSNE traps within two sequential fences (Std. Dev=3 m).

The presence of the sand fence arrays has been demonstrated to affect the concentration of PM_{10} between the leading and trailing edges of an array. This was first observed in 2016 (Fig. 8). In 2018, two MetOne Particle profilers and two E-Bams were placed upwind and downwind of the fence array to evaluate the change in PM_{10} across the distance spanned by the fence array.

Over the period from May 18 through July 24, 2018 there were 14 days of sand transport and dust emission events recorded by the BSNE traps and MetOne instruments at both measurement positions. Comparing the hourly mean PM_{10} measurements for each paired hour of observation indicates that on average, for all available data pairs of hourly mean PM_{10}, the mean ratio of downwind PM_{10}/upwind PM_{10} was 0.57 (±0.39). If these data are sorted into the conditions: PM_{10} ≤50 µg m^{-3} and >50 µg m^{-3} as defined by the upwind sampler, the mean ratio of downwind PM_{10}/upwind PM_{10} was 0.46 (±0.23). PM_{10} values >50 µg m^{-3} likely represent conditions when saltation is occurring and dust is being actively emitted in uncontrolled areas of the dunes. Under this condition the reduction in the measured PM_{10} across the travel distance of the 37.7-acre fence array was approximately 54% (±23%). This represents a

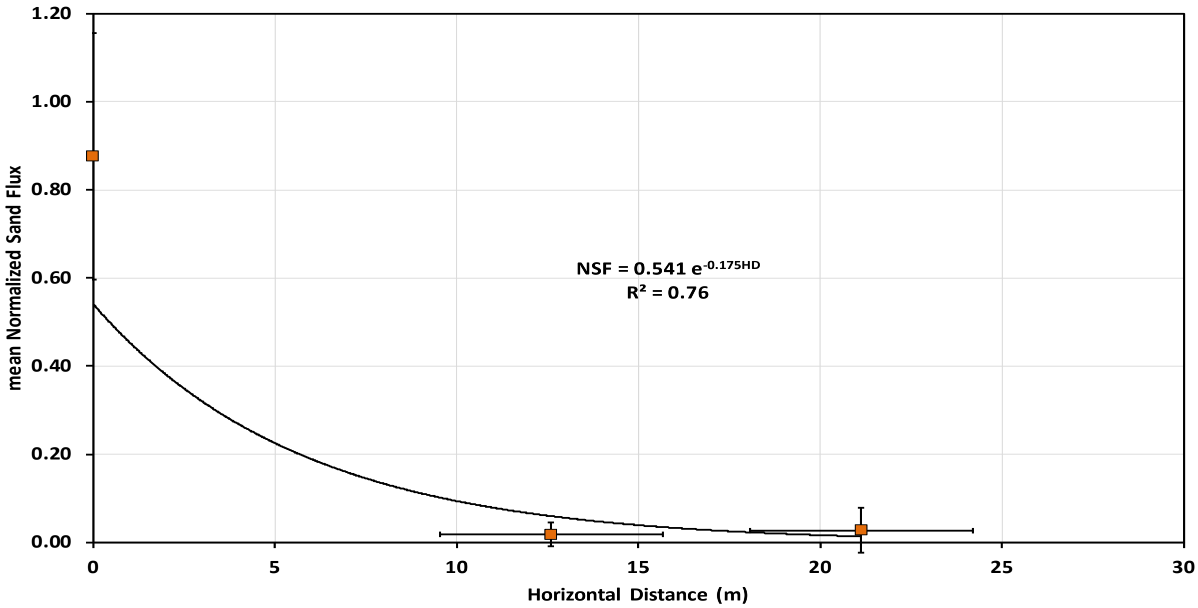

Figure 5. Change in NSF as a function of downwind distance in over the distance 0-21 m in the 10 acre fence array in 2018. Vertical error bars represent the standard deviation of the three BSN traps within two sequential fences for the 31 sampling days. Horizontal error bars represent the standard deviation of the mean of horizontal distances for the BSNE traps within two sequential fences (Std. Dev=3 m).

substantial reduction due to the presence of the fences, which have reduced the saltation by approximately 94% across 84% of the travel distance between the two monitors.

Looking at the day (05-31-2018) with the highest mean hourly PM_{10} value (665 μg m^{-3}) as measured with the MetOne instrument on the upwind edge of the 37.7-acre fence array, and filtering the data for above-threshold wind speed (>5.5 m s^{-1}) and for the wind direction range 301° to 315° (upwind) and 278° to 301° (downwind) for paired hours of observation (n=8), the ratio of downwind PM_{10}/upwind PM_{10} was 0.28 (±0.09). This suggests that under very confined conditions of wind speed and direction, closely aligned to be perpendicular to the fences, the effectiveness of the array in reducing dust emissions is very high, perhaps as much as 100%. Consider that if the input of dust from the fence array is zero, you would still see PM_{10} at the downwind monitor because PM_{10} entering at the upwind monitor would not all deposit or disperse before reaching the downwind measurement position. The dust reduction could be 100% but the concentration ratios wouldn't show that. It should be possible to use the DRI Lagrangian Particle Dispersion Model (Mejia et al., 2019) to evaluate dust control effectiveness.

It should also be possible, in future years, to use the DRI Lagrangian Particle Dispersion Model (Mejia et al., 2019) to provide an estimate of the dust flux reduction due to the controls applied on the dunes to reduce sand flux and dust emissions, at least for controlled areas that are >10 times the length of the model grid cell (i.e., 20 m). The model can be used to evaluate, for example, what the emission flux must be between an upwind and a downwind position to account for the observed change in PM_{10}

Figure 6. Wind Roses during 2018 monitoring season. Data shown are only for when wind speed is greater than 6 m s^{-1}.

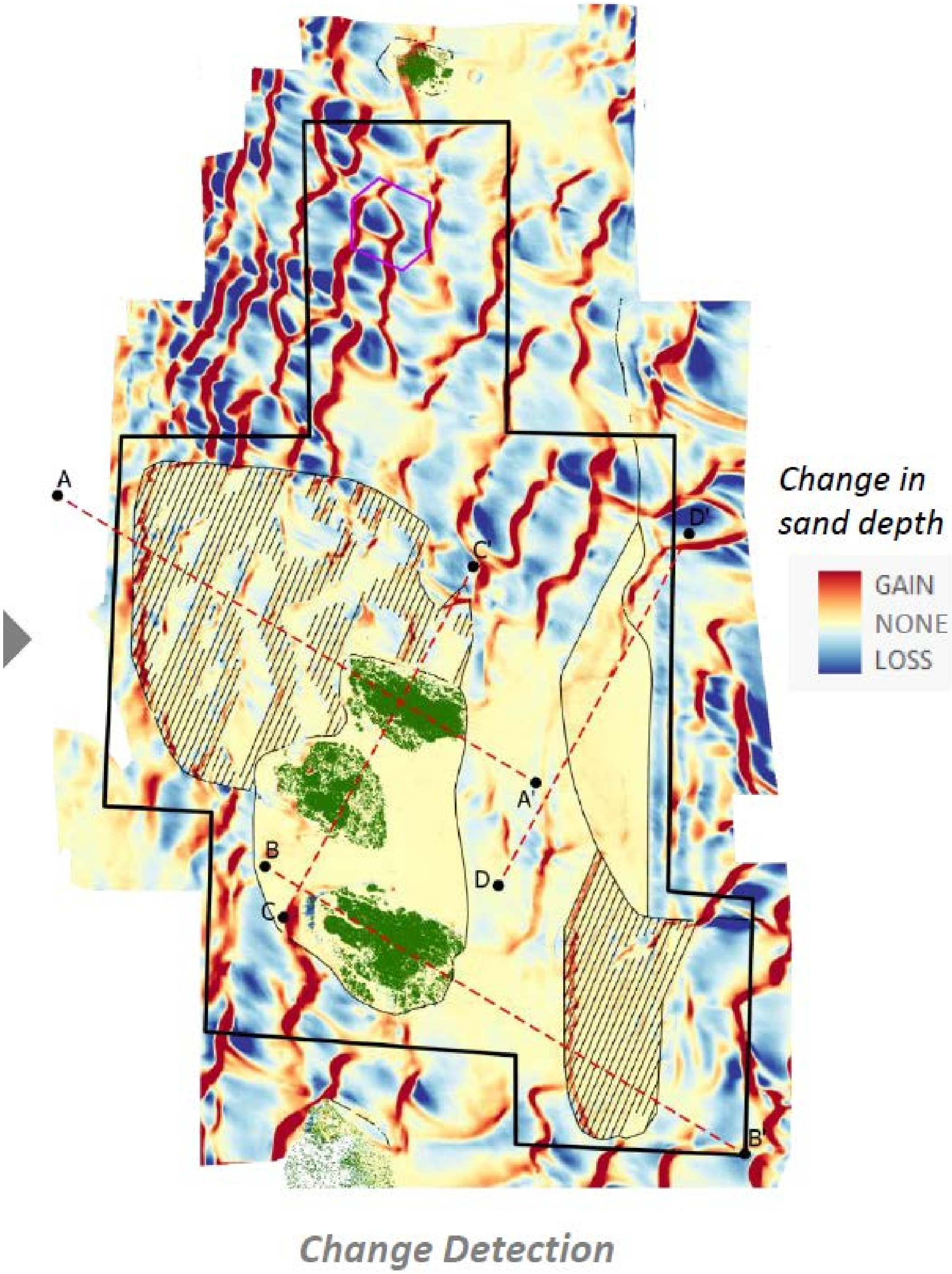

Figure 7. The change in elevation of the dunes as measured by lidar in the presence and absence of the sand fence arrays.

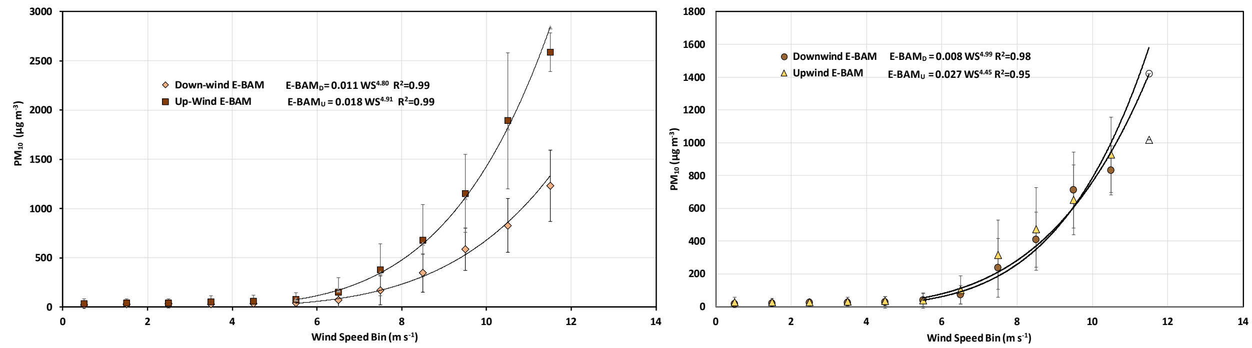

Figure 8. Mean hourly PM_{10} (µg m^{-3}) concentration plotted as a function of mean hourly wind speed (m s^{-1}) for upwind PM_{10} measurements (brown squares) and immediate downwind measurements past the sand fence array (gold diamonds) (left panel). Upwind PM_{10} measurements (gold triangles) and downwind measurements (brown circles) across approximately the same horizontal distance in the absence of fences (right panel). In all cases the data have been filtered for wind direction range 230°-310°), May through September, 2016. Best fit regression lines are for wind speed ≥5.5 m s^{-1} and the error bars represent the standard deviation of the mean for the data that fall into the 1 m s^{-1} wind speed bins.

across the known travel distance for the wind speed and wind direction conditions that existed during the observation period. This would provide a quantification for control effectiveness for PM_{10} emissions for input into the model, rather than a control effectiveness based on sand flux reduction measurements.

The fence arrays emplaced into the ODSVRA in 2018 were very effective at reducing sand transport and the accompanying PM_{10} dust emissions during the monitoring period, and remain one of the best-quantified methods to do so. Using sand fence arrays at the ODSVRA to control sand transport and dust emissions can be used with a high confidence to achieve air quality objectives. This assumes that they are maintained in a condition that approximates that achieved at the time of installation. Their effect on downwind PM_{10}, as measured at CDF for example, will be largely a function of the size of the array and its position in the landscape, and the condition of the array (i.e., close to initial installation condition). Sand fence arrays effect on local conditions of sand transport and dust concentrations within the area of emplacement is now well-established, based on multiple years of measurements.

References

Fryrear, D. W. (1986). A field dust sampler. *Journal of Soil and Water Conservation 41*, 117-120.

Gillette, D. A. (1999). A qualitative geophysical explanation for "hot spot" dust emitting source regions. *Contributions to Atmospheric Physics*, 72 (1): 67-77.

Gillies, J.A., V. Etyemezian, G. Nikolich (2016). Analyses of Environmental Data Associated with the Sand Fence Array ODSVRA, 2016. Report Submitted to California State Parks, ODSVRA, Pismo Beach, CA.

Gillies, J.A., V. Etyemezian, G. Nikolich, R. Glick, P. Rowland, T. Pesce, M. Skinner (2017). Effectiveness of an array of porous fences to reduce sand flux: Oceano Dunes, Oceano CA. *Journal of Wind Engineering and Industrial Aerodynamics, 168*, 247-259, doi: 10.1016/j.weia.2017.06.015.

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* (submitted).

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ATTACHMENT 3

2019 Vegetation Projects Planting List

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2019/20 APCD and Supplemental Restoration Projects -- Plant Propagation Needs					Grower Responsibilities		
Mid-Dune Species	**Code**	**APCD Mid-Dune Site**	**APCD Foredune Site**	**Propagation Total**	**State Parks**	**Grower**	**Cal Poly**
Abronia latifolia	ABLA	75	50	**125**	125		
Abronia umbellata	ABUM	75	50	**125**	125		
Acmispon glaber	ACGL	3400		**3400**	1000	1400	1800
Achillea millefolium	ACMI	5100		**5100**	1500	1900	1700
Astragalus nuttallii	ASNU	175		**175**	175		
Baccharis pilularis	BAPI	175		**175**	175		
Carex sp.	CA??	75		**75**	75		
Corethrogyne filaginifolia	COFI	4250		**4250**	1250	1600	1600
Dudleya lanceolata	DULA	75		**75**	75		
Erigeron blochmaniae	ERBL	4250		**4250**	1950	1300	1000
Ericameria ericoides	ERER	4250	1000	**5250**	1750	2000	2000
Erysimum insulare	ERIN	5000		**5000**	1200	2000	1800
Eriogonum parvifolium	ERPA	5000	1000	**6000**	1900	2100	2000
Eriophyllum staechadifolium	ERST	9300	5000	**14300**	4600	5200	4500
Juncus lescurii	JULE	175		**175**	175		
Lupinus chamissonis	LUCH	13600	300	**13900**	7600	3500	2800
Monardella undulata ssp crispa	MOCR	5000		**5000**	1400	1800	1800
Myrica californica	MYCA	75	100	**175**	175		
Phacelia ramosissima	PHRA	1700		**1700**	700	500	500
Ribes sp.	RI??	175		**175**	175		
Senecio blochmaniae	SEBL	5900		**5900**	1800	2100	2000
Solidago spathulata	SOSP	175	200	**375**	375		
	TOTALS	**68000**	**7700**	**75700**			
Foredune Species	**Code**		**APCD Foredune Site (22A)**	**Propagation Total**			
Abronia maritima	ABMA		300	**300**	300		
Ambrosia chamissonis	AMCH		8000	**8000**	2600	2900	3000
Atriplex leucophylla	ATLE		300	**300**	300		
Camissoniopsis cheiranthifolia	CACH		9500	**9500**	3000	3500	3000
Malacothrix incana	MAIN		2800	**2800**	1100	1200	500
	TOTALS		**20900**	**20900**	**35600**	**33000**	**30000**
GRAND TOTALS (PLANTS PER PLOT)		**68000**	**28600**	**96600**			

2019/20 Seed Collection Estimates							
Dune Scrub Species	**Code**	**Seed (lb)**	**Type**	**Foredune Species**	**Code**	**Seed (lb)**	**Type**
Abronia latifolia	ABLA	5	unclean	*Abronia maritima*	ABMA	125	unclean
Abronia umbellata	ABUM	5	unclean	*Ambrosia chamissonis*	AMCH	150	unclean
Acmispon glaber	ACGL	75	unclean	*Atriplex leucophylla*	ATLE	2	clean
Achillea millefolium	ACMI	50	clean	*Camissoniopsis cheiranthifolia*	CACH	2	clean
Astragalus nuttallii	ASNU	1	clean	*Malacothrix incana*	MAIN	2	fluff
Baccharis pilularis	BAPI	5	fluff		**TOTAL**	**281**	
Corethrogyne filaginifolia	COFI	20	fluff				
Coreopsis gigantea	COGI	2	clean	**GRAND TOTAL**	**918.5**		
Croton californicus	CRCA	1	clean				
Dudleya lanceolata	DULA	0.5	clean				
Erigeron blochmaniae	ERBL	25	fluff				
Eriastrum densifolium	ERDE	3	semi-clean				
Ericameria ericoides	ERER	75	fluff				
Erysimum insulare	ERIN	10	clean				
Eriogonum parvifolium	ERPA	100	semi-clean				
Eriophyllum staechadifolium	ERST	50	clean				
Horkelia cuneata	HOCU	1	unclean				
Juncus lescurii	JULE	2	clean				
Lupinus chamissonis	LUCH	50	clean				
Monardella undulata ssp crispa	MOCR	50	unclean				
Monardella undulata ssp undulata	MOUN	5	unclean				
Phacelia ramosissima	PHRA	50	semi-clean				
Sanicula crassicaulis	SACR	1	clean				
Senecio blochmaniae	SEBL	50	fluff				
Solidago spathulata	SOSP	1	fluff				
	TOTAL	**637.5**					

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ATTACHMENT 4

DRI Memo: Siting the APCD Portable BAM Station Within the ODSVRA

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08-07-2019

Memo: Siting the APCD Portable BAM station within the ODSVRA

From: J.A. Gillies (SAG member)

To: Gary Willey, APCO, San Luis Obispo County Air Pollution Control District

CC: SAG, CARB, Parks

This memo provides information to the SLOCAPCD to aid in their decision on deploying their portable PM monitoring station within the ODSVRA. The usefulness of such a deployment is two-fold: 1) it allows in situ calibration of the MetOne Particle Profilers used to monitor PM patterns across space in the ODSVRA with a Federal Equivalent Method (FEM) monitor (Beta Attenuation Monitor [BAM]) under high PM conditions, which has not been previously available; and 2) it provides a measurement location downwind of the foredune development area to aid in determining the changes in PM that accompany the initiation and development of the foredune restoration project. Information is provided in this memo on security, transport, and measurement location options.

Security

Parks can provide an exclusion fence (4" diameter wooden posts, 4' high, and strung with wire) around the perimeter of the station and the solar power trailer.

Although there are no guarantees against vandalism, historically this has been limited with respect to scientific equipment placed in the ODSVRA. To date, monitoring stations have not had any scientific equipment vandalized, with the only criminal activity being the theft of deep cycle batteries. There have been 3-5 instance of battery theft since 2010. It is recommended that any identifying decals of logos be removed so identification of ownership is not revealed. It is assumed that the APCD has some level of insurance coverage for this unit in case of damage.

Transport

Parks has the capacity (tracked tractor) to transport the monitoring station and solar panel power trailer to the chosen location.

Measurement Location:

In 2018, MetOne Particle Profilers indicated that PM concentrations downwind of where the foredune restoration will be initiated were highest at the monitoring sites identified as LaGrande (LG), followed by Wind Fence (WF) and then Barbecue (BBQ); the 2018 observations are in line with the 2016 observations (see Fig. 1 for monitoring locations). In contrast, PM roses from 2017 indicated that the dust concentration distributions were very similar across the three sites and likely within the noise of the measurement. These observations suggest that the relative magnitude of PM concentrations at these three sites may vary from year to year. This is likely to be more so given that dust control mitigation is being placed at locations that may be upwind of one or more sites, depending on wind directions.

Based on the available PM data and with regard to logistics and security, it is suggested that the APCD monitoring station be placed within relative close proximity to one of these three sites as all three are downwind of the foredune development area. My suggestion is to situate it downwind of the LG site on the eastern side of the fence that divides riding from non-riding, which will provide additional security by restricting access from public OHV activity. Comments are welcome and debate on the location is encouraged.

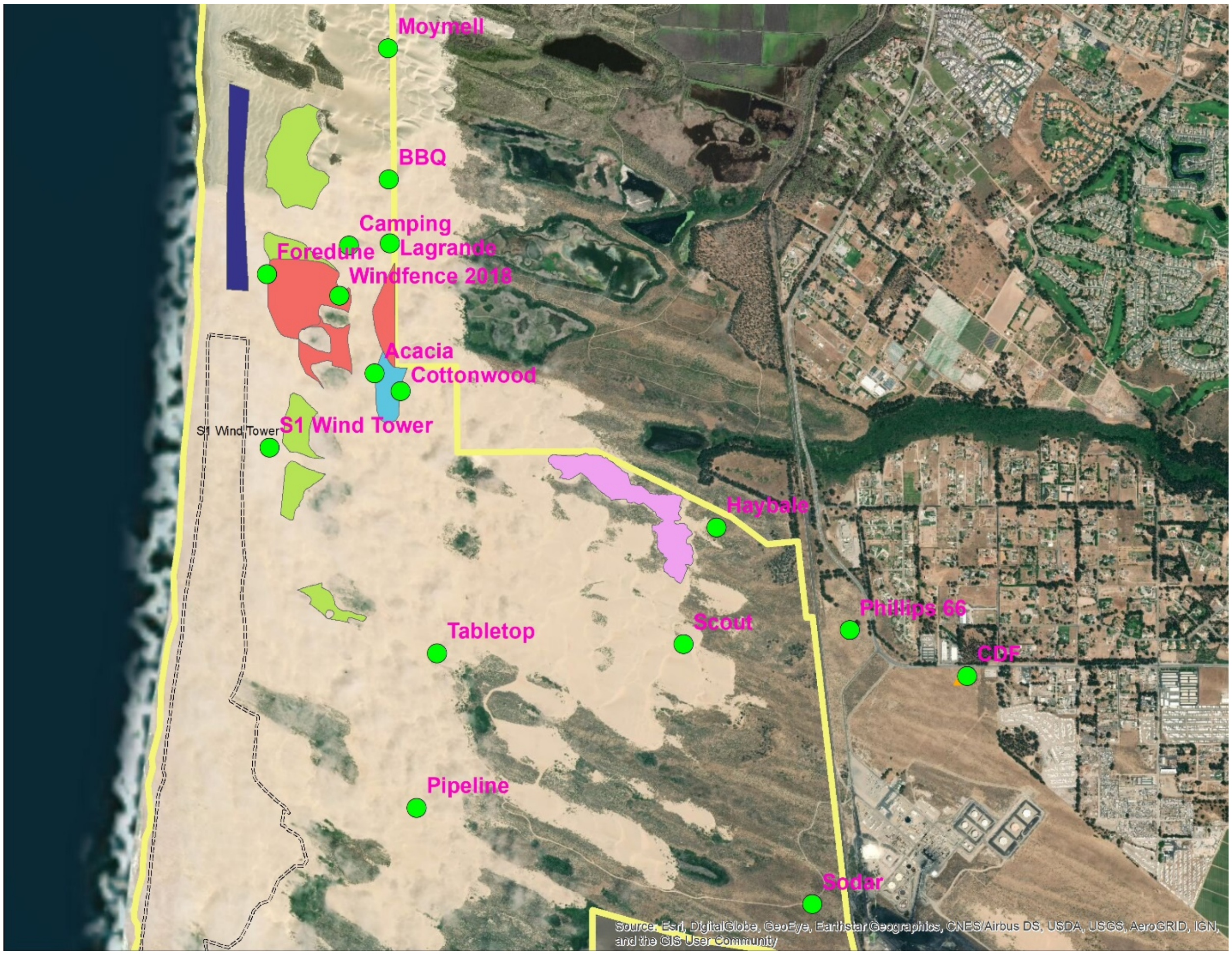

Figure 1. The locations of PM and met stations in 2019. The configuration was the same in 2018, with 2019 adding the stations: Moymell, Tabletop, Scout, Pipeline, and Sodar. The blue rectangle approximates the position of the foredune restoration area.

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ATTACHMENT 5

Dynamic Downscaling for More Accurate Modeling of Wind Fields

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Note: This document was prepared by Dr. J.A. Gillies, Research Professor, Division of Atmospheric Sciences, Desert Research Institute

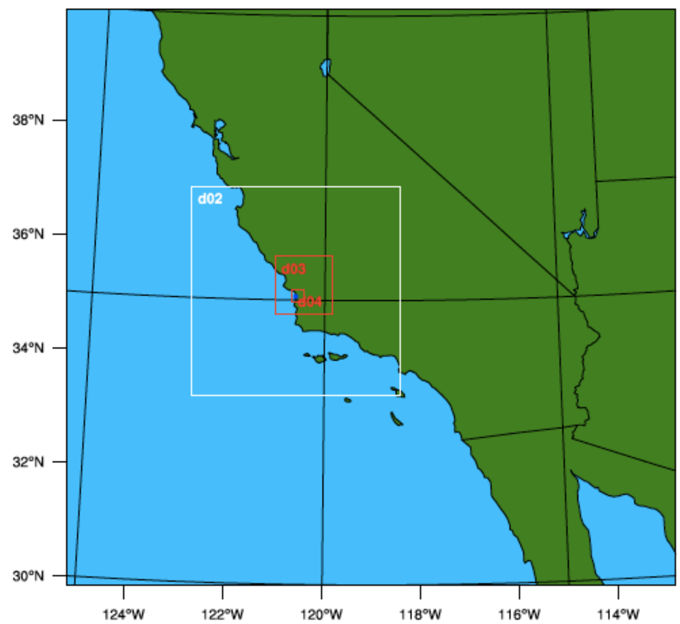
Explore the use of dynamic-downscaling for more accurate modeling of wind fields.

Air quality and dispersion modeling requires accurate and detailed meteorological spatio-temporal gridded fields (four-dimensional). Mejia et al. (2019) have developed a very-fine resolution (20 m grid size) and comprehensive emissions, meteorology and dust dispersion model framework for the Oceano Dunes including the ODSVRA. The meteorological model used in the model system is CALMET, which is a stationary and diagnostic model that interpolates observations using basic physical parameterization constraints such as: minimum divergence of the wind fields, slope effects, sea breeze effects, and basic mixing layer schemes. Mejia et al. (2019) compared CALMET output against surface observations and observed the model is highly sensitive to the spatial distribution of observations and that errors grow in data-sparse areas. CALMET requires upper-air observations, which were based on re-analysis soundings (32 km grid; 10 miles offshore) and Vandenberg radiosonde data (30 miles south). Hence, no upper-air data constrained CALMET inside the integration domain. Given the complexity of flow in this coastal environment and the complex topography of the dunes, CALMET can improve its simulation of winds by using more realistic upper-air structure information in the Oceano Dunes and surrounding area, including a better representation of the mesoscale environment. To achieve this improvement DRI recommends forcing CALMET with output from the Weather and Research Forecasting (WRF) model. The consensus in the literature is that the WRF/CALMET combination results in overall improved performance (Wang et al., 2008, 2009; González et al., 2015). WRF is a state-of-the-art dynamical, non-stationary model that performs better in areas of complex terrain (Horvath et al., 2012; Dorman et al., 2013) than CALMET. Additionally, WRF adequately transfers, adds value and physical consistency to the meteorological information starting from the regional scale (~1000km), to the mesoscale (~10-100 km), to the local environment (~0.1-1 km). This downscaling process is known as dynamical downscaling and it is currently performed by operational and research institutions to improve the representation of the modeled local weather and climate information derived from the forecasting and global climate models.

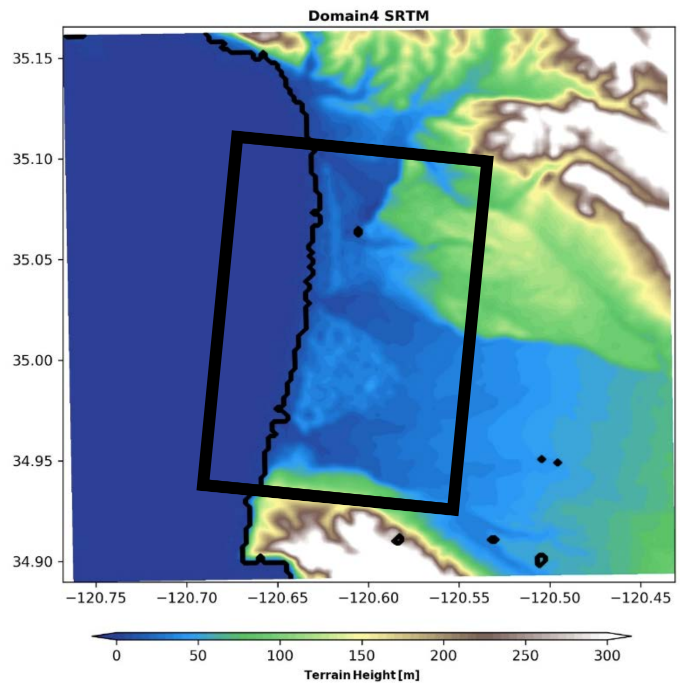
The implementation of WRF/CALMET simulations in future modeling efforts for the Oceano Dunes region is warranted for several reasons, including:

1) Combines the strengths of WRF and CAMET: WRF can improve mesoscale and local weather predictions (down to ~200 m; see domain setup and domain Digital Elevation Model below), and thereby increase efficiency and resolution in CALMET. It is unrealistic to develop the full meteorological simulation using WRF as the model is non-stationary, and non-hydrostatic, which demands immense computer resources.
2) Improves upper-air environment: this is very important because there is a lack of vertical distribution of state parameters (wind, temperature, and humidity) in the Oceano Dunes vicinity; better capture of the vertical distribution of turbulence and winds is crucial for dispersion modeling. This will also be improved with the upper air data from the newly-emplaced SODAR in the ODSVRA.

3) Reducing CALMET extrapolation in data-sparse regions, while relaxing the CALMET stationary assumption. CALMET integrations are too coarse in time (hourly time increments) to simulate short-range dispersion, which may induce some errors.
4) Using WRF in conjunction with CALMET, will, in part, be an action to reduce reducible uncertainties in the modeling related to the assumptions of wind profiles over rough terrain (as noted in the SAG response document).
5) CALMET is diagnostic tool. The addition of WRF to the model framework would serve as a future prognostic modeling tool.



WRF domains to improve modeling of wind fields for the Oceano Dunes local environment. D04 will drive CALMET.



DEM 200 m grid size for WRF d04 and CALMET location (black box; DEM 20 not shown).

Dorman, C.E., J.F. Mejia, and D. Koračin (2013). Impact of U.S. west coastline inhomogeneity and synoptic forcing on winds, wind stress, and wind stress curl during upwelling season, J. Geophys. Res. Oceans, 118, 4036–4051, doi:10.1002/jgrc.20282.

González, J.A., A. Hernández-Garcés, A. Rodríguez, S. Saavedra, S., & J.J. Casares (2015). Surface and upper-air WRF-CALMET simulations assessment over a coastal and complex terrain area. International Journal of Environment and Pollution, 57 (3-4), 249-260.

Horvath, K., D. Koračin, R. Vellore, J. Jiang, & R. Belu (2012). Sub-kilometer dynamical downscaling of near-surface winds in complex terrain using WRF and MM5 mesoscale models. Journal of Geophysical Research: Atmospheres, 117 (D11).

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 (Accepted).

Wang, W., W.J. Shaw, T.E. Seiple, J.P. Rishel, & Y. Xie (2008). An evaluation of a diagnostic wind model (CALMET). Journal of Applied Meteorology and Climatology, 47 (6), 1739-1756.

Wang, W., & W.J. Shaw (2009). Evaluating wind fields from a diagnostic model over complex terrain in the Phoenix region and implications to dispersion calculations for regional emergency response. Meteorological Applications, 16(4), 557-567.

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