Consensus Study Report

HIGHLIGHTS

February 2020

EFFECTIVENESS AND IMPACTS OF DUST CONTROL MEASURES FOR OWENS LAKE

Efforts to control airborne dust from Owens Lake have made significant progress toward meeting air quality standards. However, the goal of controlling dust while also conserving water and minimizing impacts on culture and biological resources remains elusive. This report reviews proposed dust control measures for their potential to achieve that goal.

Since 1913, the City of Los Angeles diverted surface water flowing into Owens Lake for water supply, turning a once large saline body of water into a small brine pool. Under high winds, the exposed lake bed produced large amounts of airborne dust, resulting in the highest concentrations of airborne particulate matter smaller than 10 micrometers (PM10) in the United States. Since 2000, the Los Angeles Department of Water and Power (LADWP), at the direction of the Great Basin Unified Air Pollution Control District (District), has made progress in constructing and implementing dust control measures (DCMs) to meet the National Ambient Air Quality Standards (NAAQS) set by the U.S Environmental Protection Agency (EPA) and other standards set by the state of California. The number of days in Owens Valley that exceeded the EPA's pollutant standards fell from 49 in 2002 to 8 in 2018.

The National Academies established the Owens Lake Scientific Advisory Panel (the Panel) to provide ongoing advice to LADWP and the District as long-term water availability in southern California is projected to decline. Climate change along with changing water allocations from the Colorado River under new drought contingency plans has created a need for modified DCMs to conserve the use of water. The District and LADWP also face other challenges to maintain ecological habitats and mitigate impacts to cultural and environmental resources.

NATURAL RESOURCES AND ENVIRONMENTAL CONTEXT FOR DUST CONTROL

Expected trends of climate change will likely reduce the reliability of DCMs that involve the use of large amounts of water and **availability of water for dust mitigation will be more variable. More water will be needed during dry periods to mitigate dust and maintain habitat and more pressure will be put on the system to support downstream water demands.**

Shallow flooding, the most widespread DCM by surface area at Owens Lake in combination with natural wetlands, created a variety of habitats on the lakebed, including now regionally rare habitats, such as alkaline meadows and shallow flooded areas. The diversity of birds supported by those habitats is based on the engineered conditions that vary in water depth, salinity, and surrounding environs. As highly productive food webs tend to occur in brackish pools, long-term salinity management for maintaining these habitats is particularly important. Maintaining these habitats will become more challenging under climate change; **the value of diverse habitats are important when setting priorities for lake-wide management decisions.**

Local Native American tribes are an integral part of the environment. **Local tribes have expressed concerns about the potential damage to culturally and historically significant sites from the use of heavy machinery and levelling operations typically used during DCM construction. Tribal concerns also include preservation of the natural landscape, because many topographic features and types of ecosystems are highly valued.**

EVALUATION OF DUST CONTROL MEASURES

The Panel assessed fifteen DCMs (see Box 1) that represent a range of mitigation approaches that are either currently being applied at Owens Lake or are at various stages of development. The Panel's evaluation criteria included reported PM10 control efficiency, water use, capital and operating costs, habitat value, protection of cultural resources, durability, reliability, and other factors.

The Panel concluded that no single DCM meets dust control requirements while substantially reducing water use (compared to shallow flooding) and consistently providing value to the habitat. However, **precision surface wetting, shrubs, natural porous roughness, and cobbles appear to be promising strategies—individually or in combination.** Field tests suggest that precision surface wetting may be able to provide mandated control efficiency with reduced water use compared to shallow flooding. Some amount of shallow flooding is needed to support habitat for shorebirds and Snowy plover. The use of shrubs is promising with lower vegetation cover and water use than currently required by the managed vegetation BACM. It may be difficult for shrubs to provide mandated control efficiency with only rain watering. Cobbles and natural porous roughness are promising waterless approaches that have not been tested at Owens Lake. Cobbles theoretically

BOX 1: DUST CONTROL MEASURES

CURRENT BEST AVAILABLE CONTROL MEASURES (BACMS) AND APPROVED BACM MODIFICATIONS[1]

- *Shallow Flooding:* Use of standing water applied onto a dry lake bed.
    - *Dynamic Water Management:* A modification of shallow flooding that allows for later/earlier start/end dates to reduce water use.
    - *Brine with Shallow Flooding Backup*: Application of brine and/or development of a thick salt crust to stabilize the surface.
    - *Tillage with Shallow Flooding Backup*: Mechanically creating a series of plowed ridges and furrows, generally oreinted perpendicular to the predominant wind to enhance roughness and reduce near-surface winds.
- *Managed Vegetation:* Planting locally adapted, native vegetation.
- *Gravel:* Layering gravel on the surface or on top of a permanent permeable geotextile fabric.

OTHER DUST CONTROL MEASURES

- *Cobbles:* Similar to the gravel dust control measure, except the sizes of the stones are larger.
- *Sand Fences:* Vertical barriers up to about five feet in height used to control movement of wind-blown sand.
- *Precision Surface Wetting:* Use of reciprocating sprinklers or perforated whip lines to wet circular areas of the lake bed to maintain a targeted wetted percentage of the soil.
- *Artificial Roughness:* Engineered or natural material placed in arrays on the surface.
    - *Engineered porous material* (such as, cubes or cylinders) usually with a designed geometry and porosity.
    - *Engineered solid materia*l, such as solid-walled plastic bins.
    - *Natural porous material* (such as dead woody vegetation) that can be applied in natural clumps.
    - *Natural solid material*, such as straw bales or boulders.
- *Shrubs:* A modification of the managed vegetation control measure that uses shrubs with the intent of needing less vegetation cover and less water relative to other plants.
- *Solar Panels:* Photovoltaic panels deployed for electricity production that also serve to reduce ground-level wind speeds.

1 The District, in concurrence with US EPA, determines dust control measures to be BACMs for use on Owens Lake.

offer improved dust control and aesthetics compared to gravel, while allowing native vegetation growth. Natural porous roughness offers improved aesthetics and provides moderate value to the habitat.

Recommendation 1: Additional research on individual and hybrid DCMs should be conducted to develop new approaches that use less water, maximize other environmental benefits, and ensure that DCMs maintain performance over the long-term.

IMPROVING METHODS FOR THE EVALUATION OF DUST CONTROL MEASURES

Quantifying PM10 Emissions

PM10 emission rates from individual dust control areas on the Owens Lake bed are estimated using sand flux measurements.[1] However, the relationship between PM10 emissions and sand flux is highly variable in space and time, depending on surface type and conditions and meteorological conditions. Recent advances in instrumentation have allowed the development of low-cost yet accurate sensors of airborne particulate matter. The networking of various low-cost monitoring devices with existing monitors could potentially provide more accurate and precise PM10 measurements with enhanced spatial and temporal resolution. In addition, use of data storage and data analytic methods would provide operational managers real-time information.

Recommendation 2: The District and LADWP should develop and apply additional methods to quantify, with uncertainty estimates, PM10 emissions from individual dust control areas, based on direct measurements of airborne PM10 concentrations. All devices should be calibrated and tested for representative operation under the field conditions encountered on and around the Owens Lake bed.

Monitoring BACM Effectiveness

Tying operational performance of DCMs directly to PM10 control effectiveness would enhance the transparency of air quality management planning, may provide flexibility to develop innovative and hybrid control methods, and could allow adaptive responses for control areas that are experiencing declines in control efficiency. For example, use of a performance evaluation based on PM10 concentrations rather than the current surrogate metric of 37 percent vegetative cover requirement could be used to demonstrate that less vegetative cover could achieve the emission reductions expected. This would improve management options depending on site conditions and vegetation type established.

Current surrogate measures for dust control effectiveness can be evaluated under any wind conditions. The challenge of relying on control-area-specific estimates of PM10 emissions (based on PM10 concentration measurements) is determining how to assess compliance under low to moderate wind conditions.

Recommendation 3: The District and LADWP should evaluate DCM performance based on PM10 emissions from dust control areas, estimated from measurements of airborne PM10 concentrations under a variety of wind conditions.

Air Quality Modeling

Air quality models play a central role in determining the amount of PM10 emission reductions that will be needed to bring about compliance with the EPA's air quality standards. The current modeling approach does not use state-of-the-art dispersion formulations.

1 Sand flux (horizontal sediment transport) is a measurement of the mass of sand-sized particles per unit time at about six inches above a wind-blown surface. Estimating PM10 emissions with sand flux measurements involves the use of a semi-empirical relationship that relies upon the horizontal movement of particles, whose sizes include diameters greater than 10 μm. The variability and uncertainty in the measurements and factors used in that relationship can impart considerable uncertainty to the estimated emissions and resulting air quality model results.

Recommendation 4: Air quality models to demonstrate attainment of the NAAQS for PM10 should incorporate the current understanding of micrometeorology and dispersion, especially during periods of high winds. Furthermore, the uncertainty associated with modeling those processes should be incorporated into plans to attain the NAAQS.

UNDERSTANDING AND ENHANCING BENEFITS OF A SYSTEMS APPROACH TO OWENS LAKE DUST CONTROL

The need to replace aging infrastructure and reduce overall water use provides an opportunity for re-evaluating the distribution and landscape-scale design of DCMs on the lake. More careful matching of DCMs to local site conditions could achieve long-term dust control with lower water use, lower maintenance costs, and improved salinity management. Landscape-based planning also allows for consideration of control-area size and adjacency issues that could result in reduced water and energy use and improved long-term control.

Ultimately, improvements in dust control to reduce PM10 concentrations with lower water use—while protecting environmental resources—will result in tradeoff challenges that are not fully understood today. Such tradeoffs are best evaluated and measured in a systematic way to identify the best selection and application of DCMs and understand how alteration of one DCM can affect system-level performance.

Significant reductions in water use will decrease the areal extent of shallow saline water, which supports a robust food web (e.g., brine flies and shrimp) and provides critical habitat for migrating and breeding shorebirds and waterfowl. Additional information is needed to support the development of a long-term management plan that aims for integrated, spatially, biologically and culturally appropriate PM10 control, while accounting for water use, habitat, and preservation of cultural resources.

Recommendation 5: To support the development of a landscape-based, systems approach with multiple goals, dust control configurations should be assessed within a lake-wide context, considering long-term management of air quality, surface and groundwater, and salinity; protection of cultural resources; and the regional significance of habitat types and other ecosystems services in the Owens Valley.

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For More Information . . . This Consensus Study Report Highlights was prepared by the National Academies of Sciences, Engineering, and Medicine based on the Consensus Study Report *Effectiveness and Impacts of Dust Control Measures for Owens Lake (2020).* Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the National Academies Press, (800) 624-6242; http://www.nap.edu or via the Board on Life Sciences web page at http://www.nationalacademies.org/best.

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