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Breathing Hazard

AIR POLLUTION IN THE SALTON SEA REGION

Executive Summary

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PACIFIC INSTITUTE
REIMAGINING WATER FOR A CHANGING WORLD

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Founded in 1987, the Pacific Institute is a global water think tank that combines science-based thought leadership with active outreach to influence local, national, and international efforts in developing sustainable water policies. Its mission is to create and advance solutions to the world's most pressing water challenges. From working with Fortune 500 companies to disenfranchised communities, the Pacific Institute leads local, national, and international efforts in developing sustainable water policies and delivering meaningful results.

A Haboob traveling northward across the Salton Sea on October 6, 2022.
Photograph courtesy of Rodney Pentoney from Michigan, UPS Airlines Pilot

Executive Summary

The Salton Sea, California's largest lake, has shrunk by more than 70 square miles (19%) in the past 30 years. Colorado River water irrigates more than half a million acres of productive farmland in the Imperial and Coachella valleys, in southeastern California (Figure ES-1). Runoff from these fields sustains the lake but has decreased by almost 20% since the 1990s (Figure ES-2) as a result of agreements transferring water out of the region. Continuing efforts to protect Lake Mead and Lake Powell have incentivized farmers to further reduce their use of Colorado River water, accelerating the decline of the Salton Sea and exposing additional lakebed (known as "playa"). More playa means more dust in an area already suffering from bad air quality and some of the highest respiratory hospitalization rates in the state. Expected additional water use reductions will accelerate the Salton Sea's decline and increase the amount of playa exposed, affecting the health of the 560,000 people in the region.

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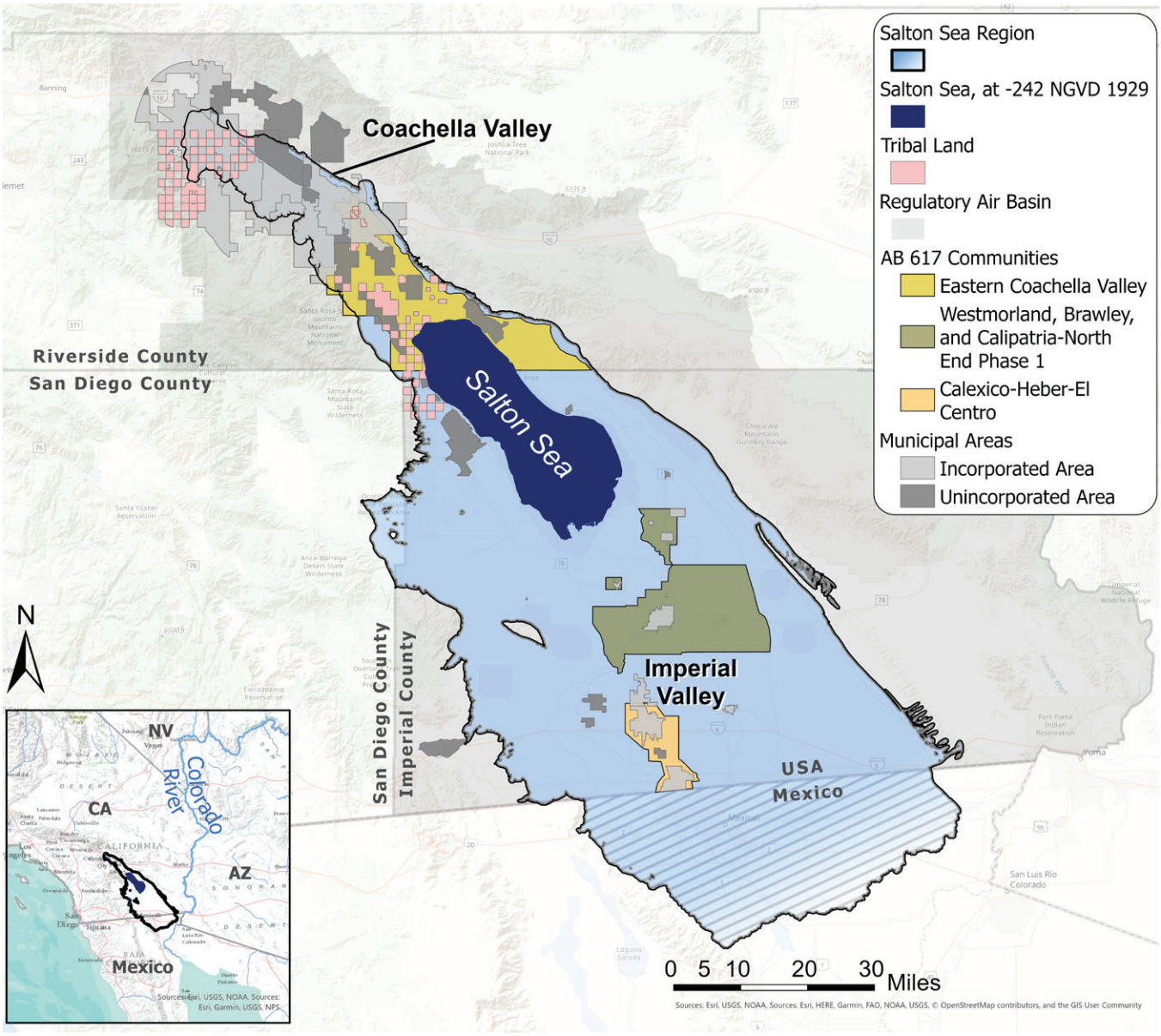
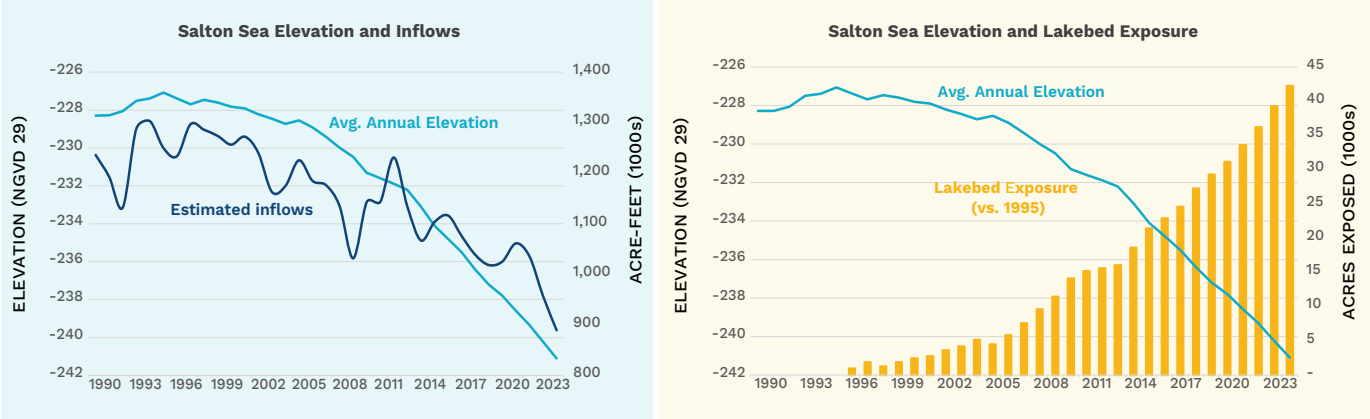
A glossary and abbreviations and the full list of references can be found in the full report, at https://pacinst.org/publication/breathing-hazard-air-pollution-in-the-salton-sea-region/

FIGURE ES-1. The Salton Sea Region and Air Basin



Sources: USGS, ICAPCD, SCAQMD.

FIGURE ES-2. Salton Sea Inflows, Elevation, and Size Reduction, 1990–2024



Sources: USGS, Tetra Tech elevation/area/capacity table.

Research on playa exposure, air quality, and the public health impacts of additional lakebed exposure has generated more information on these topics since the publication of the Pacific Institute's *Hazard* in 2006 and *Hazard's Toll* in 2014. New research suggests that the biological and chemical properties of the pollutants emitted from the playa and from the lake itself, in addition to the size of the dust particles, may disproportionately impair the health of people living in the area.

Air quality research on the Salton Sea region tends to focus on the harmful impacts of the sea itself, minimizing the broader context in which people live, work, and play. This broader context is important. The surrounding desert contributes massive amounts of dust to the region, as do unpaved roads and certain farming practices. Particulates from burning fields and fires further degrade local air quality, as do diesel emissions from truck traffic on freeways north and south of the region. Confined animal feedlots in the Imperial Valley contribute to local emissions, while nitrogen and phosphorus fertilizers may generate additional pollutants. These and other factors, combined with limited local healthcare availability, contribute to high levels of air pollution and poor public health in the area.

The objective of this report is to inform the planning and implementation of dust suppression measures and air quality projects intended to protect public health in the Salton Sea region. We seek to guide local and state efforts by assessing the relative contributions of Salton Sea playa dust to the overall air quality in the region. We did not perform any new measurements or surveys for this report. Instead, we obtained data from a variety of existing sources, including published reports and information on file with various local, state, and federal agencies.

STUDY AREA

Located in southeastern California, the Salton Sea stretches 35 miles between the lower Coachella Valley in Riverside County and the Imperial Valley in Imperial County (Figure ES-1) and currently covers about 300 square miles. The mountain ranges bordering the study area tend to funnel winds from the northwest across the Coachella Valley toward the Salton Sea. Stronger prevailing winds blow from the western desert across the southern portion of the Salton Sea.

We define the Salton Sea study region as the area extending to 200 feet above the valley floor, where emissions tend to stay when the winds don't blow, from slightly northwest of Palm Springs to the international border. The study area is largely open desert (31% barren land and 15% shrub/scrub), 29% intensely irrigated farmland, 12% open water (mainly the Salton Sea itself), and cities and towns.

Median income for households within 10 miles of the Salton Sea shoreline was less than half the state average in 2013 (Singh et al. 2018). As of 2016, 65% of residents of the Eastern Coachella Valley (ECV), north of the Salton Sea, lived below the poverty line (Pick 2017), while the US Census Bureau reports that 17% of Imperial County residents lived in poverty in 2024. A 2010 study found there was only one doctor per 8,407 ECV residents, versus one per 1,090 in California as a whole. Limited access to healthcare, combined with high poverty rates and the presence of undocumented individuals, suggest that asthma and emergency department visits may be underreported.

POLLUTANT DYNAMICS

Dust particles can linger in the atmosphere for hours, days, or even weeks. Wet soils of any type are typically non-emissive, while disturbed dry soils tend to be more emissive than undisturbed dry soils. Fifteen miles-per-hour (mph) winds are often sufficient to generate emissions from dry, unstable or disturbed Salton Sea playa, while 25 mph winds are typically required to generate emissions from stable, undisturbed playa (CNRA 2006). At Mecca, four miles north of the Salton Sea in Riverside County, winds carry materials from the Coachella Valley and, infrequently, California's Inland Empire, west of San Gorgonio pass. Niland, in Imperial County, about five miles east of the current Salton Sea shoreline and about four miles from the former shoreline, is directly downwind from a mile of partially vegetated playa. In 2024, Mecca experienced about 60 hours of winds at or above 15 mph and zero hours at or above 25 mph while Niland experienced about 545 hours of winds at or above 15 mph and about 75 hours of winds at or above 25 mph.

POLLUTANTS AND EMISSIONS

Ozone and dust particles, known as particulate matter (PM), are regulated as "criteria air pollutants" in the region. Roughly 70% of the PM in the region comes from "fugitive emissions," diffuse sources that are difficult to locate or control, typically generated by strong winds. Dust from unpaved roads operations accounts for another 20% of regional PM. In addition, almost 200 toxic air contaminants have been identified in the region.

The chemical components of some PM, such as black carbon emitted by fuel combustion and other sources, pose threats beyond the physical size of the particles themselves. Pesticides, off-road driving, and fires — including agricultural burning, wildfires, incinerators, and landfill fires — all add to the toxic air contaminant mix afflicting the region. Recent research suggests that biological contaminants and hydrogen sulfide (Centeno et al. 2025) are also pollutants of concern. Hydrogen sulfide, a gas people can notice in concentrations as low as one part per billion, has a characteristic rotten egg smell (Batterman et al. 2023). In September 2012, people in the San Fernando Valley complained about the smell after a storm blew the gas 150 miles from the Salton Sea (James 2016). Communities in the Eastern Coachella Valley have also expressed concern about chronic exposure to low concentrations of hydrogen sulfide (Centeno et al. 2023).

The high quantities of nutrients entering the Salton Sea have fed harmful algal blooms. Nutrient loadings have been an issue for more than 25 years (Cohen et al. 1999). On April 23, 2021, a local agency issued a news advisory warning people to avoid contact with the Salton Sea due to an algal bloom with toxic cyanobacteria. Ongoing research at UC Riverside has identified biological elements in aerosols from the lake itself and in some dust as an additional threat. A recent study found a strong correlation between Salton Sea algal blooms and increased hospitalization rates for people in downwind communities (Miao et al. 2025).

This report describes the many forms, phases, and sources of pollutants impairing air quality in the region. These factors vary across time and place. The only existing multi-year estimates of Salton Sea lakebed emissions suggest that they account for less than 1% of total PM emissions in the region. Lakebed emissions also vary: more than 70% come from about 20% of the exposed lakebed, and almost 90% of the total comes from the western and southern parts of the lakebed. There is also a notable difference in dust sources in communities north of the Salton Sea versus those to the south. Dust blown over the Salton Sea accounted for only 0.5% of the total at a monitoring station north of the lake, but nearly five times that amount (2.3%) at a station south of the lake (Miao et al. 2025).

AIR QUALITY

Air pollution is regulated at local, state, and federal levels — with local air districts having jurisdiction mainly over stationary sources, the state air board having jurisdiction mainly over mobile sources, and the U.S. Environmental Protection Agency (EPA) having jurisdiction over specific air pollutants. Both the Coachella and Imperial valleys exceed (are in “nonattainment” of) federal ozone standards more than 10% of the year on average. The Salton Sea Air Basin exceeds the state dust standard about 120 days per year.

REMEDIATION

Local and state agencies have implemented projects and control measures in the study region, reducing emissions and improving air quality. To date, California has constructed more than 3,000 acres of dust suppression projects on exposed Salton Sea playa at an estimated cost of about $49 million. Preliminary estimates suggest that these projects reduce dust emissions from the project sites by more than 75%. The irrigation district in the Imperial Valley has constructed almost 3,000 additional acres of dust suppression projects and has spent about $55 million on its air quality program overall.

PUBLIC HEALTH

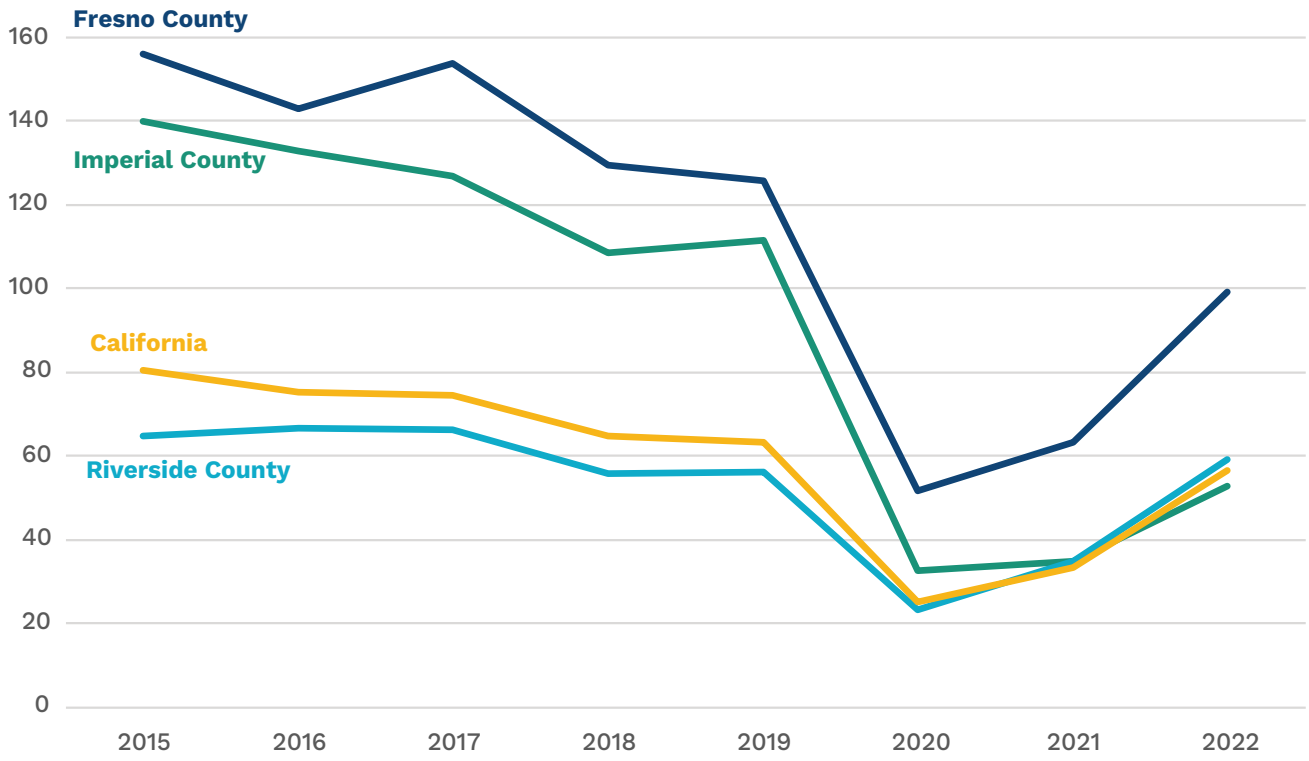
Both short- and long-term exposure to air pollution have been found to increase rates of disease and death. For example, ozone exposure can lead to lung problems and chest pain, while hydrogen sulfide can irritate the eyes, nose, and lungs. Fine dust can lodge deep in the lungs, causing many respiratory issues. Pesticides can affect the nervous system, irritate the eyes or skin, affect the hormone or endocrine systems, and can be carcinogenic (EPA 2015). Recent surveys in the Salton Sea region have found a high incidence of nosebleeds, allergies, and asthma among children, ascribed by caregivers to the Salton Sea, pesticides, and burning trash (Cheney et al. 2023). Black

carbon can carry a host of toxic chemicals (Cassee et al. 2013; Costa 2011) and is a major air pollutant in the ECV. Dust storms, composed of larger dust particles, can reduce visibility, increasing the risk of traffic accidents, injuries, and fatalities.

The various physical, chemical, and biological components of air pollution combine to create a multi-pollutant burden on communities in the study region. The impacts from occupational-related exposure, combined with limited medical services and high costs of healthcare, further burden low-income communities in the region.

Figure ES-3 shows relative rates of children's emergency department visits for asthma among children under 18 years of age in Imperial and Riverside counties, as compared to Fresno County and California as a whole. (Fresno County typically experiences the highest such rates in the state.) Although the Imperial County rate includes children outside the study area, the figure suggests that, prior to the COVID-19 pandemic, the rate for children in the study area was about 75% higher than the state average. Children's rates of hospitalization for asthma-related conditions show a similar pattern. Counties in California's Central Valley — which share many agricultural practices with the study region but lack the Salton Sea's influence — regularly have the state's highest average annual concentrations of fine dust. Imperial County currently has California's 20th worst ranking for particle pollution, according to the American Lung Association's *State of the Air* report.

FIGURE ES-3. Age-Adjusted Pediatric Asthma Emergency Department Visit Rates, 2015–2022



Source: California Department of Public Health
The age-adjusted rate is calculated by dividing the number of emergency department visits for asthma by the estimated population in that county and age group, age-adjusting to the 2000 U.S. Census and multiplying by 10,000. See https://data.chhs.ca.gov/dataset/asthmaemergency-department-visit-rates.

DISCUSSION AND RECOMMENDATIONS

Over the past decade, our understanding of the many factors contributing to air pollution in the Salton Sea region has increased dramatically. State and local governments have increased their efforts to prevent and remediate threats to public health. These efforts include new rules and regulations, dust suppression projects, and the installation of air filters and weatherization of homes. Hospitalization rates for childhood asthma in the Salton Sea region have recently fallen to about the state average, though the reasons for this decline are not clear. Even so, air quality in the region regularly continues to exceed state and federal standards for ozone, particulates, and hydrogen sulfide. Moreover, the Salton Sea will continue to shrink, exposing more emissive playa and exacerbating existing conditions.

Many researchers have noted that high nutrient loadings into the Salton Sea drive the chemical and biological processes generating emissions (Centeno et al. 2023, 2025, Hung et al. 2024). Given the massive amounts of nutrients already in the Salton Sea and its sediments, meaningfully reducing the lake's overly productive biological processes would require a 70-90% reduction in external nutrient loadings (Hung et al. 2024). To date, the pace of regulatory change, together with the associated large-scale political and economic challenges, suggests that **biological and chemical emissions are likely to persist for the foreseeable future**.

Annually, more than 70,000 tons of dust from barren land, and more than 20,000+ tons from unpaved roads, pollute the air in the Salton Sea region. **The magnitude, persistence, and dispersed sources of dust emissions make efforts to control them very challenging and very expensive** (UC Dust 2024). Mobile sources generate thousands of additional tons of harmful diesel particulate matter; though federal, state, and local rules have decreased these emissions, they continue to pose a measurable threat to area residents.

Taken together, the broad range of pollutants in the region, the diffuse and dynamic range of their sources, the expected persistence of factors driving emissions, powerful local stakeholders, and climate-intensified droughts and storms, all suggest that **managing or suppressing emissions at the source will not be sufficient, politically feasible, nor cost-effective**. Local communities have instead adopted a combined approach of source control, such as paving specific, highly emissive sites, and exposure control, such as home weatherization.

Exposure control refers to actions or efforts to reduce adverse public health impacts where people live, work, and play. Reducing or avoiding exposure to air pollution can include:

- Alerting people to expected dust storms and encouraging them to avoid outdoor exertion on days with poor air quality (UC Dust 2024)
- Installing air filters and weatherizing homes
- Limiting indoor air pollution that may be caused by smoking, gas stoves, or other factors (Laumbach et al. 2015)

Exposure control measures, taken individually or in combination, **can improve indoor air quality and reduce exposure to many pollutants, toxins, and pathogens** (Gaston et al. 2021). Exposure control efforts are a more cost-effective and more feasible means of protecting public health than source control.

Paz (2025) describes the fractured nature of governance in the Salton Sea region and notes opportunities for better coordination. **Communication, coordination, and cooperation between the various agencies with air quality jurisdiction in the region could be improved**, particularly between agencies and programs with different mandates and authorities. Such actions could provide meaningful benefits to communities in the region. Optimizing public investment in efforts to protect public health in the region will require dedicated coordination among agency officials, county governments, community-based organizations, and local residents.

We recommend that the California Environmental Protection Agency convene the following parties in order to revisit the 2017 stipulated order establishing milestones for the state's implementation of Salton Sea projects **and identify potential state investments to optimize public health benefits for local communities:**

- California's State Water Resources Control Board
- California's Air Resources Board
- The two local air districts
- Representatives of the three AB 617 communities in the region
- The parties responsible for the 2017 stipulated order
- Air quality and public health experts
- Community leaders and representatives

These experts could identify new approaches, directing some portion of state investments toward exposure control efforts in communities adjacent to the Salton Sea, or use such funds to match and increase other investments in local communities more broadly. An intentional, coordinated effort would enable these leaders and decision-makers to optimize the allocation of limited state and local funding to protect the health of the people who live, work, and play in the Salton Sea region.