Theodore D. Schade, P.E.
1626 Paiute Circle, Bishop, California 93514
(760) 937-3360 tedschade@gmail.com

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SWRCB Clerk

March 10, 2015

Ms. Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814

Submitted via email to: commentletters@waterboards.ca.gov

Subject: Comments Regarding the Status of the Salton Sea and Revised Order WRO 2002-0013
March 18, 2015 Public Workshop

Dear Ms. Townsend,

My name is Theodore D. Schade. I am a registered professional civil engineer and I worked for the Great Basin Air Pollution Control District in Bishop, California for 24 years between 1990 and 2014. I was Great Basin's Air Pollution Control Officer from 2004 until 2014. I spent 24 years studying dust emissions from the dried beds of Owens and Mono Lakes in Eastern California and helped to develop and implement plans to reduce those emissions to levels that will soon meet the requirements of the Federal Clean Air Act.

This letter addresses serious concerns I have regarding air quality in the Coachella and Imperial Valleys and, in particular, the impact that water diversions from those valleys and the Salton Sea will have on future air quality in the basin. This letter will draw a number of parallels between the Salton Sea and Owens Lake, which was once another of California's large inland saline lakes. If these two inland seas are as alike as I believe they are, the decision to divert water destined for the Salton Sea will have significant adverse impacts on the air quality of the Imperial and Coachella Valleys—unless a real plan is developed and implemented in the next few years. Although I will be discussing Owens Lake, much of what happened there and what we learned there is applicable to the Salton Sea.

I started my work on the dust problem at Owens Lake in September 1990. Working with other scientists, we studied the geology, hydrology, biology, archaeology, history and, of course, the meteorology and air quality of Owens Lake and its surrounding area. We worked until the late-1990s to understand the lake's physical properties. Since then we have worked to develop and now implement a solution to the largest single source of particulate matter air pollution in this country.

In the late 1800s, Owens Lake was one of the largest natural lakes in California. It is a basin lake, which means it has no outflow; its size is determined by the amount of fresh water that flows in every year balanced with the amount of water that evaporates. And because there is no outlet, it is a saline lake; the minerals that dissolve from the rocks and soil of the Sierra and White/Inyo Mountains upstream are transported to the lake and then left behind when the fresh water evaporates. With a surface area of more than 110 square miles (GBAPCD 1997, pg. 3-52) and an average depth of 20 to 30 feet, in the 1880s Owens Lake supported two steamships transporting silver ingots from the mines in the Inyo Mountains destined for the growing city and port of Los Angeles (GBAPCD 1997, pg. 3-162). With regard to the wildlife supported by Owens Lake, an early settler reports that the lake was once "alive with wild fowl, from the swift flying Teel to the honker goose…. Ducks were by the square mile, millions of them. When they rose in flight, the roar of their wings… could be heard on the mountain top at Cerro Gordo, ten miles away…." (Kahrl 1982, pg. 35). Very much like the existing wildlife at Mono Lake to the immediate north, the wildlife at Owens Lake sustained itself on billions of insects; at about three times the salinity of seawater, the lake was too salty for fish. But, Owens Lake's fate was sealed in 1913 when the City of Los Angeles completed construction of the Los Angeles Aqueduct. This marvel of early 20th century engineering intercepted the Eastern Sierra snowmelt that previously kept Owens Lake full and diverted the water south 223 miles to the growing City of Los Angeles. By the mid-1920s, Owens Lake had all but disappeared—with no significant input of water and evaporation rates of over five feet per year, the lake became a lifeless, hypersaline brine pool that, depending on rainfall, varies in size from nearly zero to about 30 square miles (GBAPCD 1997, 3-52).

With the lake essentially gone, about 80 square miles of saline lake bed was exposed in just a few years. As the salt water evaporated, salt deposits were left behind. The mix of salts and fine sediments has created a very dynamic surface. Every year, winter rains dissolve the existing salt crust and then, as the water evaporates in the spring and summer, a new salt crust is formed. During the winters and cool springs an efflorescent crust is formed that is very soft and subject to wind erosion (St.-Amand 1987). The resulting dust storms of fine salt and soil particles truly had to be seen to be believed—until about 2006, the largest dust storms in the U.S. occurred at Owens Lake (Reheis). Time-lapse video of dust storms that have occurred over the past few years can be seen on Great Basin's website at: http://www.gbuapcd.org/dustcam/video/index.htm. I encourage you to look at them.

Before further discussing the levels of air pollution caused by the dried bed of Owens Lake, it is necessary to briefly address the air pollutant known as PM-10, what the standards for it are and why it is a health risk.

The term "ambient air quality" refers to the atmospheric concentration of a specific compound or material present at a publicly-accessible location that may be some distance from the source of the pollutant emissions. In the late 1980s, air quality standards for particulate matter were revised to apply only to "inhalable" particles with a size distribution weighted toward particles having aerodynamic diameters of 10 microns or less. This is where the term "PM-10" comes from. The Federal PM-10 Ambient Air Quality Standard is set to control concentrations of inhalable-sized fine particles less than 10 microns in size, or about one seventh the diameter of human hair. The U.S. Environmental Protection Agency uses health risk studies to establish the PM-10 standard—the standard is based on potential impacts to human health.

The U.S. Environmental Protection Agency has set a PM-10 National Ambient Air Quality Standard (NAAQS). The NAAQS requires PM-10 levels to be averaged over a 24-hour period and that average cannot exceed 150 micrograms per cubic meter ($\mu g/m^3$).

It does not matter what these small particles are made of, the fact that they are so small allows PM-10 sized particles to be inhaled deeply into and lodge in our lower respiratory tracts. When breathing through our noses, few particles with an aerodynamic diameter larger than 10 microns reach our lower respiratory tracts. However, our bodies do not have good natural defenses against these very small particles. People who live in or visit areas exposed to elevated levels of PM-10 are at risk to the health problems caused by these very small particles.

Exposure to PM-10 levels above the federal standard may cause sensitive individuals to experience varying degrees of breathing difficulties, some of which may linger beyond the exposure period. In some cases, breathing difficulties due to PM-10 exposure may cause asthma attacks or even contribute to an individual's death. Other health effects, such as eye and nasal irritation, may also occur. Our most sensitive populations are impacted by PM-10 air pollution, including children, the elderly and people with respiratory problems, heart disease or influenza. (SWRCD 1994, §6.4.2 and http://www.epa.gov/pm/health.html)

The emissive surfaces that formed on Owens Lake made it the largest single source of air pollution in the United States. It was the largest source in terms of total tons of particulate matter air pollutants emitted per year and in terms of the levels of Standard exceedances. The 2008 State Implementation Plan (SIP) adopted for the Owens Valley estimates that, prior to the start of implementation of control measures in 2001, Owens Lake bed emitted an average of over 80,000 tons or 160 million pounds of PM-10 per year (GBAPCD 2008, pg. 4-2). Peak 24-hour PM-10 levels as high as 12,038 $\mu g/m^3$ (80 times the Standard) have been measured at a publicly accessible hot spring near the historic shore of Owens Lake and 3,929 $\mu g/m^3$ (26 times the Standard) in the town of Keeler on the eastern edge of the lake bed. High exceedances also occur frequently. In 2002, for example, of the top thirty 24-hour PM-10 levels measured in the entire U.S., 28 occurred at Owens and Mono Lakes—the 26^{th} and 28^{th} highest occurred in El Paso, Texas. Similar high exceedances occurred at Owens Lake every year until about 2006 when significant amounts of controls were in place(GBAPCD 2008, pg. 3-5 and USEPA). Extreme PM-10 levels continue to occur at Mono Lake and will do so until its level raises sufficiently to cover emissive lakebed surfaces (because of the controls deployed onto Owens Lake, Mono Lake now exceeds Owens Lake in the number and severity of PM-10 exceedances).

One of the reasons that Owens Lake was so dusty is that it is one of the youngest dry lakes in the world. Its youth is what makes it different from the scores of other dry lakes found in the western United States. The other dry lakes in the Great Basin have been dry for hundreds to thousands of years—they have had time to naturally stabilize. Owens Lake has been dry for less than a century—it is still in a very dynamic state. Given time, perhaps hundreds of years, Owens Lake would stabilize; we see signs of natural stabilization processes slowly occurring. However, we cannot wait for hundreds of years—the Federal Clean Air Act and the protection of public health demanded that Owens Lake be controlled “as expeditiously as practicable.”

However, due to the hard work of the Great Basin Air Pollution Control District and the City of Los Angeles, the dust at Owens Lake has been reduced by over 90 percent since 2001. In 1998, 2003, 2006 and 2014 the City of Los Angeles and Great Basin entered into agreements that provide for the dust to be controlled by 2017. Based on over two decades of research and testing, Great Basin developed a plan that allows Los Angeles to install any combination of three control approved Best Available Control Measures (BACM) on the areas of the exposed lake bed that emit dust. The approved BACMs include: shallow flooding, managed vegetation and gravel blanket. Shallow flooding simply spreads a thin sheet of water over the emissive area. Managed vegetation uses techniques developed by Great Basin to reclaim the saline soils and establish a protective cover of salt-tolerant saltgrass (*Distichlis spicata*) using drip irrigation technology. Gravel blanket is a two to four-inch thick layer of very coarse gravel that armors the surface and prevents the capillary rise of salt crystals (GBAPCD 2003, Ch. 5).

All three approved BACMs attempt to mimic natural processes that are occurring on Owens Lake. Natural seeps and springs along the historic lakeshore keep the surface wet and non-emissive in many small areas. If the natural seep waters are fresh enough, they may flush the salts from the soil—this allows salt-tolerant vegetation to establish naturally. Where very coarse soil particles occur, such as near the inlet of the Owens River, the fine clay and silt soils are blown away and the coarse sand and gravels are left behind, which help to armor the surface. In addition to these EPA-approved measures, Great Basin and the City of Los Angeles continue to experiment on controls that are both effective and water/cost efficient (GBAPCD 2008, Ch. 7). A November 2014 agreement between the two agencies and resultant court decision allows Los Angeles to use large-scale tillage in combination with shallow flooding to significantly reduce the water use to control dust.

The City of Los Angeles started the first phase of large-scale dust control measure implementation in the fall of 2000. Their initial project was an 8,600 acre (13.5 square miles) shallow flood project that they completed in January 2002. This Phase 1 Project cut lake bed emissions by about 30 percent. Since the first control phase in 2000, there have been eight phases constructed covering a total of 28,800 acres (45 square miles) at a cost of about $1.5 billion. These controls have reduced dust emissions by more than 90 percent. All three BACMs (flooding, vegetation and gravel) have been used to control these emissive areas.

Although PM-10 levels have been reduced about 90 percent, in order to meet the standard, they needed to be reduced 99 percent and, therefore, are still about 10 times higher than the PM-10 standard. In November 2014, after three years of administrative appeals to the California Air Resources Board and lawsuits in state and federal courts, Great Basin and Los Angeles entered into an agreement to control the remaining emissive areas on the lakebed. By 2017, there will be controls on about 31,000 acres (49 square miles) of the lakebed. These controls are expected to finally allow the Owens Lake area to meet the federal PM-10 standard. (http://www.gbuapcd.org/owenslake/2011SCR/StipulatedJudgment20141230.pdf)

The Owens Lake dust control effort will have an ongoing cost in terms of water use and costs. On average, about 320,000 acre-feet per year (ac-ft/yr) of water that naturally flowed into Owens Lake is diverted to Los Angeles (GBAPCD 1997, pg. 7-2). Los Angeles currently returns about 70,000 ac-ft/yr of water from the Los Angeles Aqueduct to the lakebed for dust control. Although this is only 20 percent of the water that naturally flowed into the lake, it is enough to support the domestic needs of about 340,000 Los Angeles residents (based on Los Angeles' use of 185 gallons per person per day).

The water used for dust control obviously has a monetary value. In 2002, the USEPA developed a value for Los Angeles' Owens Valley water of $323 per ac-ft (USEPA 2002). Assuming a 10 percent increase since 2002, the annual cost of the diverted 70,000 ac-ft/yr is about $25 million. In addition, the operation and maintenance of dust controls costs tens of millions of dollars per year.

Finally, to conclude the discussion of Owens Lake, we cannot blame the City of Los Angeles for making the Owens Lake disappear. When it was decided to sacrifice Owens Lake and the environment in the Owens Valley for the growth of the emerging City of Los Angeles, even President Theodore Roosevelt acknowledged that the concerns of the residents in the Owens Valley were "genuine," but their concerns "must unfortunately be disregarded in view of the infinitely greater interest to be served by putting the water in Los Angeles" (Kahrl 1982, pg. 140). One hundred years ago, even President Roosevelt felt that the environment in a remote, sparsely settled valley was not something to be protected and preserved when it interfered with the continued growth of one of the nation's great cities. However, our priorities as a nation have changed since 1906 when Roosevelt wrote those words. Protection of our environmental resources has become a priority, especially in our ever-lessening remote, sparsely settled places. And we could blame Los Angeles if they continued to refuse to fix the problem they have caused. But they finally have not refused—after 100 years of diversions, they finally acknowledge that the air pollution from Owens Lake is caused by their water diversions and they are close to completing the enormous and expensive task of solving their problem.

Now to the Salton Sea. I believe much of what has happened at Owens Lake will happen at the Salton Sea, if the Sea's water supply is simply diverted like Owens Lake's was 100 years ago. I have been invited down to the Salton Sea a number of times since 2000 by the Salton Sea Authority and the Salton Sea Science Office to specifically look at the sea and its potential to emit dust, if its level is lowered. I have reviewed much of the literature relating to potential dust emissions and have read the sections addressing air quality at the Salton Sea in the Imperial

Irrigation District's Water Transfer Project EIR/EIS. I also sat on a panel of experts in 2002 that authored a White Paper titled "The Potential for Fugitive Dust Problems at the Salton Sea if Water Levels are Lowered Significantly from Current Conditions." What I have seen at the Salton Sea and what I have read in the literature concerns me. Although there are a number of differences between the two lake basins, I believe there are enough similarities to justify my concerns.

Both Owens Lake and the Salton Sea contain unimaginable quantities of salt—4 million tons of salt flow into the Salton Sea every year (Salton Sea Authority, 1997). As the waters evaporate enormous salt deposits are left behind. Although theory says the type and mix of salts at the Salton Sea should be more stable than at Owens, at certain times and under certain conditions, there are enough unstable salts at the Salton Sea to cause the formation of the type of emissive surfaces that form at Owens Lake.

At Owens Lake the City of Los Angeles' water diversions caused about 80 square miles (51,000 acres) to be exposed. Sixty percent of this area, or about 50 square miles (32,000 acres), emits dust. However, these 50 square miles of exposed lake bed made Owens Lake the largest single source of PM-10 air pollution in the country. At the Salton Sea over 200 square miles (128,000 acres) of sea bed will be exposed by water diversions. Even if only a fraction of the newly exposed sea bed is emissive, there is the potential for many thousands of acres of emissive area.

Although it is the intent of the Clean Air Act that all our air should be fit to breathe and that everyone should be protected from air pollution, only about 40,000 people live in the sparsely populated Eastern Sierra areas impacted by dust emissions from Owens Lake. This is not the case with the Salton Sea basin. Hundreds of thousands of people living in the Imperial and Coachella Valleys could be impacted by dust storms from the exposed Salton Sea bed. In addition, hundreds of thousands of acres of valuable agricultural lands could be impaired by blowing salt and sand.

The environmental impact documents (EIR/EIS) prepared for the Salton Sea water diversion admit that the proposed transfer would cause thousands of acres of sea bed sediments to be exposed and that these newly exposed areas would have the potential for dust suspension. But they go on to say that the many variables "prevent any reasonable quantitative estimate of emissions and associated impacts from the exposed shoreline." The so-called analysis then goes on to state that, rather than a scientific quantitative estimate, a "qualitative assessment" will be provided. A "qualitative assessment" was inappropriate for the California State Water Board during their Mono Lake decision process; it was also inappropriate for the California Air Resources Board and the USEPA during the development of the air plans for Mono and Owens Lakes. In those cases, extensive research, testing and computer modeling allowed us to reduce the uncertainties in the many variables that affect dust emissions. With uncertainties reduced, we were able to construct air quality models that closely matched actual conditions. There is absolutely no reason why such an effort cannot take place for the proposed Salton Sea bed exposure. Even a crude modeling effort would give an indication of the potential magnitude of the problem. I am certain that such an effort would indicate that the diversions will have air quality consequences.

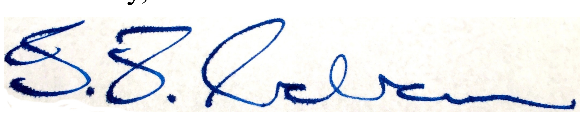
As discussed above, elevated levels of PM-10 are considered to be a health risk not because of what the dust is made of, but rather because the very small particles lodge deeply in our lungs. Toxic materials in the dust only add to the health risk. Elevated levels of naturally-occurring arsenic and cadmium in the sediment at Owens Lake increase the lifetime cancer risk from those toxics by 24 per million (GBAPCD 2008, pg. 3-8). Sediment analyses at the Salton Sea indicate that dust emissions there could potentially contain many more toxic materials, including pesticides and uranium (LFR Levine-Fricke 1999).

At the risk of oversimplifying the many complicated factors that contribute to cause lake sediment dust storms, it is instructive to present a crude “quantitative” estimate of the potential for dust at the Salton Sea. At Owens Lake, about 80 square miles of lake bed is exposed. About 60 percent of the exposed lake bed, or 50 square miles, emits PM-10 (GBAPCD 2008, Ch. 4). As mentioned above, under the worst case, about 200 square miles of Salton Sea bed would be exposed when water is diverted from the sea. Because of different soil and salt conditions than at Owens, maybe only 25 percent of the exposed area at Salton might emit dust. This is still 50 square miles or an area equal to that at Owens Lake that will emit PM-10. Also assume that in the best case, for all the unsubstantiated reasons presented in the environmental impact analysis documents prepared for the transfer, an acre of sediment at the Salton Sea is only one-tenth (10%) as emissive as an acre at Owens Lake (this is likely wishful thinking). This means that instead of annual emissions of 80,000 tons, the annual emissions would be 8,000 tons or 16 million pounds of PM-10 emitted every year. In most cases, PM-10 sources greater than 100 tons are considered to be major sources of air pollution. With regard to peak 24-hour concentrations, if the peaks at the Salton Sea were also only one-tenth as bad as Owens Lake, levels as high as 1,200 $\mu g/m^3$ could be expected. This is eight times higher than the Federal 24-hour Standard of 150 $\mu g/m^3$. No one can say that the water diversions will not cause a serious air quality problem at the Salton Sea without much more study, analysis, research, modeling and testing. And if this work indicates that there could be an air quality problem, a plan to take care of it needs be in place before water diversions begin. Otherwise, in addition to the impacts that airborne salt will have on the valuable agriculture in the Imperial and Coachella Valleys, the health of many thousands of people will be at risk.

In conclusion, for the past 24 years, while working on the Owens Lake dust issue nearly every day, I have often told myself that we cannot blame the City of Los Angeles or even President Roosevelt for allowing Owens Valley water to be diverted and causing the largest single source of PM-10 air pollution in the country. Those decisions were made over 100 years ago by well-intentioned leaders. I have always been certain that such disastrous decisions would never be made in our times, given our change in priorities—decision-makers today would never even consider the possibility of letting such a thing happen again. In my opinion, as someone that has spent his career studying and solving the air quality problems caused by the diversion of water from saline lakes, the diversion of water from the Salton Sea will cause some significant level of air pollution in the Salton Basin. Although there are many unanswered questions, the answers to which would allow an accurate assessment of the magnitude of the problem, the water-diverters and decision-makers have not meaningfully dealt with the potential for serious air pollution. They tell us that there may be significant impacts, yet they make no attempt to quantify the problem or even suggest solutions to what could become an even bigger problem than Owens Lake. Everyone involved with the Salton Sea needs to admit that they could be involved in creating an enormous environmental catastrophe. There must be a commitment of the resources necessary to determine the magnitude of the problem, develop real plans to address the problem, and implement solutions to the problem before it impacts public health and the economy of the Imperial and Coachella Valleys. The water is important, but it cannot come at the expense of the health and livelihood of the public.

Please move quickly and decisively to prevent another Owens or Mono Lake from occurring.

Sincerely,



Theodore. D. Schade

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