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October 19, 2012

Mr. Theodore D. Schade
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, California 93514-3537

Dear Mr. Schade:

Subject: Preliminary Staff Report on the Origin and Development of the Keeler Dunes

Please find enclosed the Los Angeles Department of Water and Power's response to the Great Basin Unified Air Pollution Control District's September 7, 2012, Preliminary Staff Report on the Origin and Development of the Keeler Dunes.

If you have any questions or comments, please contact me at (213) 367-1138, or Mr. Nelson O. Mejia, Manager of Owens Lake Regulatory Compliance, at (213) 367-1043.

Sincerely,

William T. Van Wagoner
Manager of Owens Lake Regulatory
Issues and Future Planning

Enclosure
c: Ms. Tori DeHaven, Clerk of the Board
Mr. Mark Schaaf, Air Sciences
Mr. Nelson O. Mejia

Technical Report

Response to the Great Basin Unified Air Pollution Control District Preliminary Staff Report on the Origin and Development of the Keeler Dunes

PREPARED FOR:
LOS ANGELES DEPARTMENT OF WATER AND POWER

PREPARED BY:

OWENS LAKE
SCIENCE, TECHNOLOGY & REGULATORY PROJECT TEAM

AGREEMENT NO. 47934
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Section 1: Executive Summary

This document presents a detailed technical response to the *Preliminary Staff Report on the Origin and Development of the Keeler Dunes* (Preliminary Staff Report), dated September 7, 2012, and issued by the Great Basin Unified Air Pollution Control District (Great Basin 2012). Although presented as an objective scientific analysis of how the landscape of the Keeler Dunes was created and subsequently developed over time, the Preliminary Staff Report is instead comprised of a series of narrow, biased, and incomplete post-hoc investigations prepared by Great Basin staff and consultants in order to confirm Great Basin's longstanding and well-publicized assumption that the Keeler Dunes developed, and became emissive, *directly* and *solely* as a result of the water diversion actions of the City of Los Angeles, acting by and through its Department of Water and Power (LADWP), at Owens Lake. The Preliminary Staff Report's conclusions that the Keeler Dunes are anthropogenic in origin and that sand from the Owens playa is the *sole* cause of the recent expansion of the dunes are neither objective nor supported by accurate, complete, and reliable scientific data. Therefore, the Preliminary Staff Report cannot serve as the basis for Great Basin to declare that the Keeler Dunes are anthropogenic in origin, issue future control orders to LADWP, or otherwise attribute responsibility to LADWP for mitigating dust emissions from the Keeler Dunes.

As outlined briefly below, and discussed more fully in this Technical Report, the Preliminary Staff Report and appendices contain numerous legal, scientific, and technical flaws that render the report unreliable and its conclusions scientifically indefensible. These defects include, among other things, the following:

- The results of the Preliminary Staff Report were predetermined by Great Basin to: (i) confirm its prior assertions about the cause of emissions from the Keeler Dunes; (ii) establish a platform for Great Basin to issue future control orders against LADWP for other off-lake emission sources; and (iii) ensure that Great Basin's primary source of funding – LADWP – remains in place and under Great Basin's regulatory thumb for the foreseeable future.

- The Preliminary Staff Report's analysis of the origins and development of the Keeler Dunes is premature and unnecessary because according to the Final 2008 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (2008 SIP) the Owens Valley Planning Area (OVPA) is expected to achieve attainment with federal PM_{10} standards without the implementation of dust controls on the Keeler Dunes.

- The historical document research presented in Section 4.1 and Attachment A of the Preliminary Staff Report is incomplete and misleading as it: (i) fails to address documents confirming the existence of sand dunes and sand/dust

storms in the vicinity of Keeler prior to the City's water-gathering activities in the early part of the twentieth century; (ii) ignores the potential impacts of anthropogenic activities in and around the Keeler Dunes and other natural events that affected sand erosion and dust emissions; (iii) relies on anecdotal accounts of blowing sand, a lack of references to "Keeler Dunes," and the relative absence of written accounts describing dune features to support its position that the dunes developed after construction of the Los Angeles Aqueduct; and (iv) misapplies and misinterprets historical survey data to serve its predetermined needs.

- The ground-based photo analysis presented in Section 4.2 and Attachment B of the Preliminary Staff Report is inaccurate and unreliable and provides no evidence regarding the causes for the changes observed in the Keeler Dunes over the past fifty years. In addition, the oldest photographic "recreations" fail to account for discrepancies in focus, film speed, exposure, timing, lighting, and other atmospheric effects and, in any event, show no discernible differences between the "before" and "after" photographs.

- The aerial photograph and satellite imagery analysis presented in Section 4.3 and Attachment C of the Preliminary Staff Report depict the various changes at the Keeler Dunes over the past several decades; however, the analysis is admittedly incomplete and provides no evidence – *only biased speculation and unsubstantiated assertions* – about the causes that led to the observed changes. Great Basin's analysis is focused narrowly on the Keeler Dunes themselves and fails to include any discussion or investigation of potential sand sources (besides the Owens River delta) and transport pathways that could have contributed to the development of the Keeler Dunes.

- The geomorphic mapping analysis included in Section 4.4 and Attachment D of the Preliminary Staff Report sheds no light on the issue of how the emissive aeolian sand in the Keeler Dune field fits into the larger geologic and geomorphic context of the area. The investigation raises questions about the sources of aeolian sand deposits in the Keeler Dunes that it deliberately fails to address, omits discussion and analysis of potential non-Owens Lake sand sources, and utilizes incomplete and/or inapplicable maps to support Great Basin's predetermined conclusion that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa over the past several decades.

- The chronology and stratigraphy analysis presented in Section 4.5 and Attachment E of the Preliminary Staff Report reflects a similarly flawed methodology and speculative findings, as evidenced by, among other things, its

reliance upon (admittedly) incomplete Optically Stimulated Luminescence (OSL) data, and its omission of critical data and discussion about potential local sources of sand and emissions.

- The surface change analysis set forth in Section 4.6 and Attachment F of the Preliminary Staff Report contains limitations and omissions that undermine and, in fact, contradict Great Basin's purported findings. Contrary to Great Basin's assertions, the applicable data suggest that sand from the western part of the Keeler Dunes, as supplemented by the Swansea Dunes and alluvial fan deposits, may be responsible for the relatively recent migration and expansion of the Keeler Dunes.
- The dune transect and movement analysis included in Section 4.7 and Attachment G of the Preliminary Staff Report does not, just as the preceding investigations and analyses do not, support Great Basin's position that the Keeler Dunes developed as a result of an influx of sand from the Owens playa within the past 50 years resulting from the lake level change on Owens Lake.

Based on the foregoing, LADWP recommends that Great Basin stay the Governing Board hearing on the final version of the Preliminary Staff Report indefinitely in order to allow Great Basin staff sufficient time to address the serious flaws with the Preliminary Staff Report outlined in this Technical Report. Great Basin staff should not republish the Preliminary Staff Report until such time as these issues have been adequately addressed and the report is, in fact, what it purports to be – an objective, comprehensive analysis of the origin and development of the Keeler Dunes.

Section 2: The Preliminary Staff Report Is a Pretense for Great Basin to Issue LADWP Control Orders for Keeler Dunes

The purpose of the Preliminary Staff Report is, ostensibly, to determine whether and to what extent the Keeler Dunes developed naturally or as the result of anthropogenic actions (i.e., LADWP's water-gathering activities) so that, ultimately, the appropriate parties may be held responsible for controlling dust emissions arising from the dunes. Thus, although the Preliminary Staff Report does not itself authorize or require the implementation of dust controls on the Keeler Dunes, it is a necessary prerequisite for Great Basin to issue future dust control orders, which, as the Preliminary Staff Report notes, are expected to follow the December 13, 2012, public hearing on the final report (Preliminary Staff Report, p. 4).

Great Basin's conclusion in the Preliminary Staff Report that the Keeler Dunes are anthropogenic in origin and attributable entirely to a massive influx of sand from the Owens River delta caused by the City's water-diversion activities at Owens Lake is neither surprising nor supported by the evidence set forth in the Preliminary Staff Report. The results of the Preliminary Staff Report were predetermined by Great Basin in order to ensure that its primary source of funding – LADWP – remains stable and secure after LADWP has implemented controls on all applicable areas of the Owens lakebed, and the OVPA has achieved attainment with the federal National Ambient Air Quality Standards (NAAQS).

2.1 The Results of the Preliminary Staff Report Were Predetermined by Great Basin

Great Basin has always assumed, based on admittedly circumstantial evidence, that the Keeler Dunes developed and became emissive as a result of LADWP's water-gathering activities. As noted in the Preliminary Staff Report itself, Great Basin stated in both the 2003 and 2008 SIPs – *without having undertaken any scientific or technical investigation* – that the Keeler Dunes are an anthropogenic dust source formed as a result of exposure to material originating from the Owens Lakebed that became emissive after the lake became dry (Preliminary Staff Report, pp. 3-4). Only after making these assertions – in public documents approved by the Great Basin Governing Board and currently pending approval by the U.S. Environmental Protection Agency (EPA) – did Great Basin decide to begin a post-hoc investigation into whether the statements are, in fact, truthful and accurate (*id.*). Great Basin could not conclude in the Preliminary Staff Report that the dunes are naturally occurring or that multiple sand sources contributed to their development because to do so would be an acknowledgement that it had created and relied upon false assumptions in order to mislead the public and the U.S. Environmental

Protection Agency (EPA) about the origins of the Keeler Dunes and, more importantly, LADWP's role in their development.

If an agency predetermines its scientific analysis by committing itself to an outcome, it is almost certain that the agency failed to take a hard look at the consequences of its actions due to its bias in favor of that outcome and, therefore, has acted arbitrarily and capriciously (*Wyoming v. U.S. Dept. of Agric.*, 661 F.3d 1209, 1264 (10th Cir. 2011) [discussing predetermination in NEPA analysis]). In the context of the National Environmental Policy Act (42 U.S.C., §§ 4321, et seq.) (NEPA), predetermination occurs when an agency "irreversibly and irretrievably commits itself to a plan of action that is dependent upon the [analysis/investigation] producing a certain outcome, before the agency has completed that" analysis (*Id.*; see also *Davis v. Mineta*, 302 F.3d 1104, 1112-1113 (10th Cir. 2002) [holding Department of Transportation had "prejudged the NEPA issues" associated with highway-construction project]; *Forest Guardians v. U.S. Fish & Wildlife Serv.*, 611 F.3d 692, 713 (10th Cir. 2010), citing *Davis* and stating "[w]e [have] held that ... predetermination [under NEPA] resulted in an environmental analysis that was tainted with bias" and was therefore not in compliance with the statute]).

Although the Preliminary Staff Report is not itself a NEPA document, the same principles of predetermination and bias under NEPA apply with equal force and effect. This is particularly so given that Great Basin and the U.S. Bureau of Land Management (BLM) are currently preparing environmental documents under both NEPA and the California Environmental Quality Act (Pub. Res. Code, §§ 21000, et seq.) (CEQA) relating to the Keeler Dunes ***before*** the Great Basin Board is presented with a scientifically sound analysis and makes a finding that the Keeler Dunes are an anthropogenic dust source caused by LADWP's water-gathering activities. LADWP anticipates and expects that the conclusions set forth in the Preliminary Staff Report and appendices will be incorporated by Great Basin and BLM into the final Keeler Dunes EIR/EIS, and that these documents, collectively, will be used by Great Basin as the justification for issuing dust control orders for the Keeler Dunes.

Great Basin committed itself to a finding that the Keeler Dunes were created, developed, and became emissive as a result of LADWP's water-gathering activities at Owens Lake, and that no other cause – natural or anthropogenic – played a role in this process. This predetermination resulted in a report, the Keeler Dunes Preliminary Staff Report, tainted with bias and premised upon false, misleading, and/or incomplete scientific analyses in order to enable Great Basin to meet its predetermined goals of holding LADWP responsible for implementing dust controls on the Keeler Dunes.

2.2 The Results of the Preliminary Staff Report Are Funding-Motivated

As discussed above, the results of the Preliminary Staff Report were predetermined in order to confirm Great Basin's prior stated assumption that the Keeler Dunes developed and became emissive as a result of LADWP's water-gathering activities at Owens Lake. In fact, Great Basin's long-term existence and financial viability depends on this assumption being true because LADWP provides 90 percent of Great Basin's annual operating budget. No other air quality agency in the United States similarly depends upon a single member of the regulated community as its primary source of funding.

Great Basin knows that LADWP's dust control obligations at Owens Lake will end once the controls are installed for Phase 7a, and not coincidentally, the primary source of funding for its annual operating budget. In order to sustain its budget at current levels, Great Basin is venturing out beyond the lakebed to identify new sources of dust emissions, such as the Keeler Dunes, and to devise ways to link those sources of emissions with LADWP's activities at Owens Lake. As evidenced by the inadequacies, omissions, and mischaracterizations throughout the Preliminary Staff Report and its underlying investigations, which are discussed more fully in Section 4 of this report, there is no line – scientific or geographic – Great Basin will not cross in order to keep LADWP on the financial hook at significant, unjust, and unnecessary public expense to the City of Los Angeles and its nearly four million citizens.

Section 3: Great Basin Lacks Legal Authority to Issue Control Orders to the City for Keeler Dunes

3.1 The Clean Air Act Does Not Require Control of Natural Sources

In adopting the Clean Air Act, Congress recognized and acknowledged that there may be areas where the federal National Ambient Air Quality Standards (NAAQS) may never be attained because of PM_{10} emissions from naturally occurring, non-anthropogenic sources, and that the imposition of control measures and/or other mitigation requirements in such areas may not be justified. Therefore, under Clean Air Act section 188, subdivision (f), Congress provided a means for EPA to waive a specific date for NAAQS attainment, and thus the requirement to install the emission controls necessary to achieve attainment, where EPA determines that natural, non-anthropogenic sources of PM_{10} contribute significantly to the violation of the standards in the area (42 U.S.C. § 7513, subd. (f)).

Similarly, under the Clean Air Act's Exceptional Event Rule, EPA has authority to disregard data from naturally occurring high wind events that are, by definition, not reasonably controllable or preventable (42 U.S.C. § 7619 [Clean Air Act § 319]; *see also* Treatment of Data Influenced by Exceptional Events, 72 FR 13560-01). States are not required to prepare and implement regulatory strategies when the air quality is affected by events beyond their reasonable control (72 Fed. Reg. at 13561-62; 42 U.S.C. § 7619(b)(1)). These provisions establish and confirm the Clean Air Act's requirement that only man-made sources of dust emissions be controlled.

The Preliminary Staff Report fails to provide substantial, or any, evidence to support Great Basin's position that the Keeler Dunes are not natural and developed as a result of LADWP's water-gathering activities. The Keeler Dunes may be attributed in whole or part to natural processes, and as such, a nonanthropogenic source of emissions in the Owens Valley that, as noted below, Great Basin specifically excluded from its attainment strategy in the 2008 SIP. There is therefore no obligation under the Clean Air Act to control nonanthropogenic dust emissions from the Keeler Dunes.

3.2 The OVPA Will Achieve Attainment Under the 2008 SIP and 2017 Attainment Strategy *Without* the Implementation of Additional Controls on Keeler Dunes

The Preliminary Staff Report states that the 2008 SIP requires control of the dust emissions from the Keeler Dunes on or before December 31, 2013, in order to demonstrate attainment of the federal NAAQS within the OVPA by 2017 (Preliminary Staff Report, p. 1). This is not correct. According to the 2008 SIP, LADWP's control of 43 square miles of Owens Valley playa – standing alone – is expected to be sufficient to achieve attainment of the PM_{10} NAAQS by 2017. Great Basin excluded emissions from

the Keeler Dunes from the modeling simulations it used in the 2008 SIP to assess attainment of the federal NAAQS (2008 SIP, § 6.4).

Great Basin cannot issue orders to LADWP to implement dust controls on the Keeler Dunes without EPA first finding that the current mitigation measures have failed to achieve attainment by the 2008 SIP's projected attainment date of 2017. LADWP has implemented controls on approximately 42 square miles in the OVPA (including Phase 8), and is currently in the CEQA process regarding controls on an additional 3.1 square miles (Phase 7a). There has been no finding by either EPA or Great Basin that attainment will not be achieved with these current controls nor could such a finding be made until, at the earliest, 2017. Consequently, there is no legitimate or legal basis for Great Basin to order LADWP to install additional controls on Keeler Dunes at this time, or to lay the groundwork for such control orders to be issued in the future on the basis that doing so is necessary to achieve attainment under the 2008 SIP.

3.3 Any Attempt to Impose Control Requirements on LADWP Using the Preliminary Staff Report Will Violate Section 42316

Under Health and Safety Code section 42316 (Section 42316), Great Basin has limited authority to require LADWP to undertake reasonable measures to mitigate the air quality impacts of its activities in the "production, diversion, storage, or conveyance of water" within Great Basin's jurisdiction. Section 42316 contains three limiting conditions: (1) mitigation measures ordered by Great Basin must be reasonable; (2) mitigation measures ordered by Great Basin must not affect the City's water-gathering activities; and (3) Great Basin must establish through "substantial evidence" that LADWP's water-gathering activities cause or contribute to an alleged air quality violation.

Any directive from Great Basin must comply with the express limitations stated in Section 42316. All actions taken by Great Basin under Section 42316 are strictly limited to the authority granted under that statute (Gov. Code, § 11342.2). Thus, any action taken by Great Basin that enlarges or conflicts with Section 42316 is invalid (*Id.*; *Planning & Conservation League v. Dep't of Fish & Game* (1997) 54 Cal.App.4th 140, 483-84 [an administrative agency may not abridge or enlarge its authority or exceed the powers given to it by the statute – the source of its power]).

The Preliminary Staff Report broadly (and incorrectly) assumes – *without any technical or scientific data or support* – that LADWP's water-gathering activities led to the creation and development of the Keeler Dunes and caused it to become emissive. The Preliminary Staff Report does not address or satisfy any of the conditions contained in Section 42316. Nor can the supporting data and investigations included in Attachments A-G to the Preliminary Staff Report be reasonably interpreted to satisfy those conditions because, under Section 42316, LADWP's water-gathering activities must be causing *specific areas*

identified in the dunes to cause or contribute to a monitored violation of the NAAQS and, according to the 2008 SIP, LADWP's control of 43 square miles is sufficient to achieve attainment of the PM_{10} NAAQS by 2017.

The Preliminary Staff Report merely serves as the pretext for an unauthorized expansion of the authority purportedly granted to Great Basin under Section 42316. Therefore, any dust control orders issued as the result of the Preliminary Staff Report would be invalid under, and a violation of, Section 42316.

Section 4: There are Significant Technical Defects with the "Investigation" and Preliminary Staff Report

4.1 Great Basin Conducted a Limited and Biased Investigation

Great Basin did not conduct a comprehensive and objective investigation of the origin and development of the Keeler Dunes. Rather, Great Basin conducted a fairly narrow investigation intent on "proving" that the sand in the Keeler Dunes could only have originated from the Owens playa, and that the recent development and expansion of the Keeler Dunes could only have been caused by a massive influx of sand from the Owens playa since the most recent lake elevation change, which began in about 1918 (Saint-Amand et al. 1986). By limiting the scope of its analysis to a few biased investigations and omitting critical data and discussion, Great Basin crafted the Preliminary Staff Report so as to arrive at the unsupported conclusion that LADWP is entirely responsible for the origin and development of the Keeler Dunes, and therefore all the dust produced within the roughly 1.5-square-mile area identified by Great Basin as the "Keeler Dunes."[1]

By conducting such limited investigations, Great Basin overlooked or paid scant attention to the contributions of sand from other non-Owens-Lake sources, including: sand deposited from periodic lake elevation changes dating back to the late Pleistocene epoch; the exposed shoreline caused by the lakebed shift that occurred during the 1872 earthquake; ancient shoreline sand deposits (remnants of which line the slope above the current Keeler Dunes); flash-flood sediments deposited at the toe of the Slate Canyon alluvial fan; the desert surfaces lying north and south of the Slate Canyon alluvial fan; the once-buried-but-now-exposed ancient sand deposits underlying the active dunes and alluvial fan; the Swansea Dunes; Swansea Bay via the Swansea Dunes; and the alluvial fan above the Swansea Dunes. All these sources could have contributed to the origin and development of the current Keeler Dune field; however, the Preliminary Staff Report fails to include a single study or analysis designed to assess the contributions from these sand sources. Because LADWP believes that Great Basin will ultimately use the results of its investigation to assign responsibility for controlling dust emissions from the Keeler Dunes, this type of study is imperative to the Preliminary Staff Report. The lack of any analysis of non-Owens Lake sand sources is a glaring deficiency of the Preliminary Staff Report that calls into question the integrity and scientific value of Great Basin's entire investigation.

[1] The Keeler Dune complex consists of old vegetated dunes, active sand dunes, sand sheets, and alluvial fan surfaces. The active dunes comprise less than one-quarter of the total area. There is a subtle bias associated with labeling the entire area "Dunes." The map of the "Keeler Dunes" presented in the Preliminary Staff Report is, in fact, a map of the Slate Canyon alluvial fan.

Great Basin was similarly biased in its investigation by assuming that the sole cause of the development and expansion of the Keeler Dunes observed over the last five decades was the most recent lake elevation change, which began in about 1918 (Saint-Amand et al. 1986). Nowhere in the Preliminary Staff Report is there a single discussion or analysis designed to understand the various disturbances that could have triggered the recent expansion of the dune field. Several disturbances are possible, including: flash flood scouring and deposition, rangeland fire, road construction, grazing, agriculture in the Owens Valley, and climate change, among others. It is scientifically indefensible for Great Basin to assume at the outset that the sole cause of the Keeler Dunes is the recent lake level change on Owens Lake, and then to tailor the scope of its investigation to support this conclusion.

Great Basin is also biased in its investigation by attributing all the dust arriving at the Keeler PM_{10} monitor to the Keeler Dune field. Nowhere in the Preliminary Staff Report is there a single discussion or analysis attempting to apportion the amount of dust arriving in Keeler to the various dust sources distributed throughout the area, including those sources listed earlier in this section. Great Basin did not install a PM_{10} monitor at the upwind edge of the dune field and so has no way to recognize, much less account for, the dust contributions from upwind sources. Great Basin's operating assumption is that all the dust that arrives at Keeler is from the Keeler Dunes. Upwind, non-Owens-Lake sources can and do contribute substantially to the dust concentrations recorded in Keeler. The dust arriving in Keeler is not solely from the Keeler Dunes. Great Basin cannot ignore this fact by simply burying its head in the sand.

Great Basin's investigation fails to meet the basic requirements of a scientific study designed to understand the origin and development of the Keeler Dunes. Because Great Basin was clearly and flagrantly biased in the way it conducted its investigation, the findings cannot be used to attribute responsibility for implementing controls on the Keeler Dunes to any person or entity, including LADWP. There is simply not enough proof.

In addition to the foregoing scientific and legal issues, LADWP has a number of specific technical concerns with each of the seven areas of investigation undertaken by Great Basin, as outlined in the sections that follow.

4.2 The Historical Document Research Is Incomplete and Misleading

The historical document research presented in Section 4.1 of the Preliminary Staff Report is incomplete, failing to identify any historical reports documenting the existence of dunes around Keeler, which led Great Basin to conclude erroneously that: "*the Keeler Dunes were not present prior to the desiccation of Owens Lake*" (Preliminary Staff Report, p. 16). This purported lack of information, however, does not support the Preliminary Staff Report's inference that the Keeler Dunes did not exist prior to the most recent lake

elevation change, which began sometime around 1918 (Saint-Amand et al. 1986). Inferences based on a lack of observations are not evidence (*See Eramdjian v. Interstate Bakery Corp.* (1957) 153 Cal.App.2d 590, 602 ["[an] inference cannot flow from the nonexistence of a fact; it can be drawn only from a fact actually established."]).

Section 4.1 of the Preliminary Staff Report appears to be out of step with the rest of the document, which generally acknowledges that sand deposits (even dunes) existed in the area of the current Keeler Dune field prior to the most recent drying of Owens Lake. The Executive Summary (p. iii) describes the presence of "former dunes" and "older vegetated and non-emissive[2] dunes" within the boundaries of the current active Keeler Dune field dating back to "as early as about 1,700 years ago." The discovery of ancient sand deposits is clear evidence that the Keeler Dunes existed prior to the most recent lake elevation change.

Nothing in this section of the Preliminary Staff Report may be taken as evidence that the Keeler Dunes did not exist prior to the most recent lake elevation change.

4.2.1 The Historical Document Review is Incomplete

Great Basin's review of historical documents in the Preliminary Staff Report is incomplete for several reasons, as described below:

1. Great Basin overlooked some of the most relevant accounts of sand and dust storms in the Owens Valley prior to the start of the twentieth century. For example, there are numerous local newspaper articles documenting the occurrence of large dust and sand storms in the southern Owens Valley and the region of Owens Lake beginning in and around 1870 (Inyo Register 1904; Inyo Independent 1870, 1871, 1873, 1874, 1875, 1882, and 1896: Salas 2006).

2. The Preliminary Staff Report contains no discussion about the potential anthropogenic effects of agriculture, cattle grazing, and human-caused fires on sand erosion and dust emissions in the southern Owens Valley. All these anthropogenic impacts increased in the region between the mid-1860s and early 1900s (Farquhar 1966; Kahrl 1982; Sauder 1990, 1994).

3. The Preliminary Staff Report indicates that the region between the Keeler Dunes and the historical shoreline was disturbed by humans during historic times,[3] but it failed to discuss the potential impacts of anthropogenic activities in and around the Keeler Dunes. Moderate to high surface disturbance (e.g., fire, road construction, grazing) may produce accelerated surface erosion and sand motion.

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[2] The statement that the "older" Keeler Dunes were vegetated and non-emissive has no basis in fact. No evidence was presented in the Preliminary Staff Report to support this statement.

[3] Since about 1860.

4. The Preliminary Staff Report did not mention the 1872 earthquake and the impact this event had on altering the floor of Owens Lake to expose additional shoreline along Swansea Bay and elsewhere around the lake. This is another potential source of sand that was ignored by Great Basin in its studies on the origin and development of the Keeler Dunes.

4.2.2 The Historical Record Search Overlooked At Least One Document Specifically Mentioning the Keeler Dunes

In its own informal survey of historical documents pertaining to the Keeler Dunes, LADWP found one pre-1913 report that specifically mentions the presence of dunes in the vicinity of Keeler, California. A report by Elliot (1904), documenting a 1902 survey of mammals in southern California by Mr. E. Heller, mentions in three places the presence of dunes around Keeler (emphasis added):

- Page 281: "*From here Mr. Heller went to Keeler, on the east shore of Owen's Lake, at an altitude of 3,622 feet. For a half-mile or more before the lake is reached is a level expanse of white, sandy soil, containing a large amount of soda and other salts, which have been deposited as the waters receded. To this sandy margin and alkali soil several species of mammals are confined and owe their coloring, apparently, to the composition of the soil. Just back of the water's edge is a considerable expanse of bare mud and deposit of soda, etc., and beyond this occurs a growth of salt-grass about a hundred yards wide, succeeded by tracts of loose sand, with a scattered growth of Atriplex bushes,*[4] *which gradually give way to* ***small sand dunes*** *and creosote bushes.*"

- Page 289, regarding the habitat of *Citellus leucurus vinnulus*, a species of desert ground squirrel: "*In Owens Valley, at the base of the range, they were less common, but generally distributed to the base of the Sierras, where they evidently do not ascent the slope much beyond 6,000 feet. About Keeler, on the shore of Owens Lake, they were abundant in the* ***sand dunes*** *and creosote vegetation.*"

- Page 302, in a statement concerning the habitat of the Keeler pocket-rat,[5] *Dipodomys merriami nitratus*: "*The* ***sand dunes near Owens Lake in the vicinity of Keeler*** *were perforated with the tunnels of this local form.*[6] *As the animal recedes from*

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[4] *Atriplex* (greasewood) still grows in abundance on the sand dunes near Keeler, as well as elsewhere around Owens Lake.

[5] The Keeler pocket-rat was first described by C. H. Merriam in 1894, with the type locality listed as "Keeler, east side of Owens Lake, Inyo County, California" (Smithsonian Institution 1912, page 278).

[6] The habitat preferences of *Dipodomys merriami* explain E. Heller's observations of the Keeler pocket-rat in sand dunes in 1902. According to Brown (1973), various kangaroo and pocket-rats of the genera *Dipodomys* are seed-eating desert rodents that occupy sand dune habitats through the West, including those in the Owens Valley. These rodents are well adapted to sand dune habitats, having "efficient kidneys that enable them to maintain water balance on relatively dry diets, and fur-lined cheek pouches used for collecting and transporting seeds. In addition, the kangaroo rats and kangaroo mice are saltatorial and largely bipedal, which apparently enables them to forage efficiently over large areas and to avoid predators in open terrain."

the hot sandy shores of the lake, it becomes less reddish, and it is evident that the typical form does not extend more than fifteen or twenty miles from the shore line."

This 1904 report, which was missed (or ignored) by Great Basin staff in their review of historical documents, contains indisputable evidence that sand dunes existed in the vicinity of Keeler prior to the City's water-gathering activities in the early part of the twentieth century. Any claims by Great Basin that the Keeler Dunes did not exist prior to the most recent lake elevation change are baseless and without merit.

In addition, Heller's description of the "hot sandy shores" around Owens Lake is also significant in that the pre-water diversion unvegetated shoreline of Owens Lake is a potential source of sand for the Keeler Dune field construction. Great Basin failed to investigate or address this issue (along with all other non-Owens Lake sand sources discussed *supra*) in the Preliminary Staff Report and underlying appendices.

4.2.3 Anecdotal Accounts of Blowing Sand by Train Operators is not Evidence

The Preliminary Staff Report (p. 13) also describes anecdotal accounts of "blowing sand" by train operators during the period from 1940-1960 between mileposts 573 and 575, which is in the vicinity of the current Keeler Dunes. If the Keeler Dunes did not exist at that time (the existence of blowing sand implies the existence of dunes), then what is the purpose for including this information in the Preliminary Staff Report? Notwithstanding this fact, observations of "blowing sand" provide no information on the frequency of occurrence, the volume of sand that was moving, or the direction(s) it was moving. These anecdotal accounts offer no insight into the origin and development of the Keeler Dunes.

Furthermore, the absence of anecdotal accounts of "blowing sand" or other issues with the train line before 1940 does not mean that these events did not occur. The lack of written accounts prior to 1940 cannot be used to infer (as Great Basin has attempted to do in the Preliminary Staff Report) that activity in the Keeler Dunes began sometime during 1940-1960 (*See Eramdjian, supra,* 153 Cal.App.2d at p. 602).

Great Basin also noted that it did not find any specific references to the name "Keeler Dunes" before 1987, which would seem to suggest yet another date for the emergence of the Keeler Dunes. The absence of evidence does not infer that the dunes did not exist, or were too small to be recognizable, until the 1980s. Published survey documents, ground-based photographs, numerical ages of older dune sands and archaeological sites, and satellite images all attest to the fact that dunes existed in the area long before the 1980s, long before 1940-1960, and long before the most recent lake level change on Owens Lake.

4.2.4 The 1855-57 Cadastral Survey by A.W. Von Schmidt Cannot be Used to Infer the Presence or Absence of Dunes

The Preliminary Staff Report references a report by Stine (2012), which examined information from an 1855-1857 cadastral survey[7] of the eastern Sierra by Alexis W. Von Schmidt (Von Schmidt Survey). Stine's interpretations are inappropriate and incorrect for several reasons, as described below.

1. Stine (2012) extrapolated the Von Schmidt Survey data far beyond their reasonable capability by attempting to inferentially "tease out" one single geomorphic feature that was not classified in the survey: dunes. Geomorphic mapping was not one of the objectives of the Von Schmidt Survey. The objectives of the Von Schmidt Survey were three-fold (Stine 2012): (1) to extend the Mount Diablo Base Line eastward across the Sierra, (2) to establish the township and range system over the eastern Sierra in the newly established State of California, and (3) to "meander" (that is, to map the configuration of) the major water bodies of the eastern Sierra, including Mono and Owens Lakes. Geomorphic mapping was not part of the cadastral survey, and Von Schmidt made no effort to map or otherwise describe the most prominent topographical features along his route, such as canyons, prominences, alluvial fans, or dune fields. The Von Schmidt Survey was a coarse description of landform. A. W. Von Schmidt was a surveyor and civil engineer (Reimer 1961), and his survey was more designed for civil engineering purposes than to provide a detailed description of geography and topography. Stine (2012) has attempted, incorrectly, to infer facts and conclusions that were not part of the Von Schmidt Survey.

2. The landform classifications in the Von Schmidt Survey were too general (only two classifications: "rolling" and "level"), and they were applied over too small an area of the landscape (only along township lines, spaced six miles apart), to accurately identify the presence of dune formations. Also, as noted above, Von Schmidt's survey did not include a separate classification for dunes.

3. Stine (2012) compared Von Schmidt's classifications across the Mono Lake dune field (which existed then, as now) against the topography of the current dune field and concluded that Von Schmidt grouped dune formations in "rolling" but

[7] http://www.blm.gov/wo/st/en/prog/more/cadastralsurvey.html
Cadastral surveys: "create, mark, define, retrace, or reestablish the boundaries and subdivisions of the public lands of the United States. They are not like scientific surveys of an informative character, which may be amended due to the availability of additional information or because of changes in conditions or standards of accuracy. Although cadastral surveys employ scientific methods and precise measurements, they are based upon law and not upon science. Cadastral surveys are the foundation upon which rest title to all land that is now, or was once, part of the Public Domain of the United States."

not "level." This is a gross exaggeration and misapplication of the Von Schmidt Survey data. Von Schmidt did not include dunes in either one of his two classifications, so Stine's claim that dunes can be inferred retrospectively based on his (Stine's) single example at Mono Lake is without merit. Many of the Von Schmidt cadastral survey lines lying within the area described by Stine (2012) as part of the Mono Lake dune field are classified as "level." The USGS topographic base map used by Stine (2012; Figure 1) indicates the presence of dunes in these areas, so it is difficult to understand Stine's claim that Von Schmidt did not include dune formations in the "level" classification. Furthermore, Stine failed to provide any details about the Mono Lake dune field (i.e., aerial extent, height, area of mapped older dunes vs. younger dunes) to support his "calibration."

In short, Stine's interpretations of Von Schmidt's survey data are speculative at best and do not constitute substantial evidence.

Nothing in Section 4.1 of the Preliminary Staff Report provides substantial evidence that the sand in the Keeler Dunes originated on the Owens playa since the most recent lake elevation change. Nor does Section 4.1 contribute to an understanding of the causes of the recent expansion and migration in the Keeler Dune field.

4.3 The Ground-Based Photo Analysis Does Not Provide Evidence Regarding the Origin and Development of the Keeler Dunes

The photographic "recreations" (i.e., scene replications of historical photographs) presented in Section 4.2 and Attachment B of the Preliminary Staff Report are inaccurate and unreliable, and provide no evidence that the Keeler Dunes largely formed within the past five decades, or that the sand in the Keeler Dunes originated solely from the Owens playa, as claimed elsewhere in the Preliminary Staff Report. These photographs were admittedly altered and as such, cannot be relied upon as evidence in any proceeding.

The 15 scene comparisons purport to show that the dunes likely came into existence "after 1960, at least for the southern Keeler Dunes." The photographs are unreliable because they do not show discernible differences between the "before" and "after" photographs, and they are inaccurate because the labels of "active" and "inactive" are not descriptive of what is contained within the actual photographs. Furthermore, in the case of the earliest historical photographs, Great Basin is attempting to compare black and white images with modern color images. Differences in focus, film speed (graininess), exposure, timing, lighting, and various atmospheric effects (dust, UV light) can greatly affect the appearance of the faint, distant features shown in both photographs.

The shortcomings of each photographic pair are discussed below:

Figure 4.2-2: Inyo Development Company Photograph

The historical image is a heavily toned black and white image taken before 1920, with lower apparent resolution than the modern color image showing the same scene. The Preliminary Staff Report notes that on the historical image "there are a few minor dunes present along the historic shoreline" and that "there are no dunes or open sand deposits visible on the Keeler Fan above the historic shoreline." This statement is not supported by the images for two reasons: (1) the dune features along the historical shoreline look roughly the same in both the "before" and "after" photographs; and (2) the historical image is in black and white, and so grainy that it is not possible to resolve more distant features on the alluvial fan for comparison with the modern image.

The labels of "no active dunes" and "active Keeler Dunes" are misleading. Nothing in either photograph indicates the level of dune activity.

Figure 4.2-3: North End of Keeler with View to the Northwest

The historical photograph, taken in 1940, purports to show the absence of active dunes on the Keeler fan. However, the "before" and "after" photographs both show the same hummocky dune field with mounds of roughly the same size, shape, and amount of vegetation cover. In fact, if anything, these images show that the dune field changed very little between 1940 and 2012.

Here, too, the labels of "no active dunes" and "active Keeler Dunes" are misleading. Nothing in either photograph indicates the level of dune activity. Small patches of barren sand cannot be used to infer that the dune is "active."

Figure 4.2-4: View from State Highway 136 toward the Southwest across Keeler Fan

This pair of photographs was reportedly taken from State Highway 136, looking toward the Southwest across the Keeler Fan and Owens Lake. The historical image, taken in 1953, shows in the foreground a field of hummocky sand and gravel interspersed with mounds of larger rocks (probably from past flash-flood events), and covered with creosote bush (*Larrea tridentata*) or associated low shrub vegetation. Vegetated dunes appear to be seen near the shoreline.

The modern image is similar, but shows much less vegetation and much more free sand on the surface.

Although the photographs are intended to show that something caused the landscape to change dramatically after 1953, it cannot be determined from the photo what caused the change or even when the change occurred. Great Basin's claim that the surface changes were caused by the most recent lake elevation change (a claim made elsewhere, and

many times, in the Preliminary Staff Report) is both groundless and biased. Nothing in any of the "before" or "after" photographs suggests the cause or the timing of the disturbance; the photographs simply show that a change to the dunes has occurred, the cause of which is unknown.

Figure 4.2-5: Panorama of Same View Shown in Figure 4.2-4

Figure 4.2-5 is a magnified version of Figure 4.2-4. This set of images is intended to show that the landscape has changed since 1953, but the photographs do not offer any insight into the cause of the change or when the change occurred. It is incorrect to simply assume that the change was caused by a large volume of sand entering the Keeler Dunes from the Owens River delta sometime in the last 50 years, as stated elsewhere in the Preliminary Staff Report.

For these reasons, Section 4.2 and Attachment B of the Preliminary Staff Report provide little insight into the origin and development of the Keeler Dunes.

4.4 The Photograph and Satellite Imagery Analysis Does Not Support Great Basin's Position

The aerial photograph and satellite images presented in Section 4.3 and Attachment C of the Preliminary Staff Report provide no evidence to better understand the type, timing, and intensity of surface disturbances that led to the observed changes in the Keeler Dunes over the past 50 years. The narrow scope of the investigation and the numerous speculative statements made throughout this section highlight the bias in Great Basin's belief that sand from the Owens playa is the *sole* cause of the recent expansion of the Keeler Dunes, assuming arguendo such an expansion occurred.

Section 4.3 and Attachment C of the Preliminary Staff Report contain numerous errors and unsubstantiated claims regarding the origin and development of the Keeler Dunes, including those listed below:

1. Page 29: Great Basin's analysis of aerial photographs and satellite images focused solely on the Keeler Dunes. The analysis did not extend (as it should have) to other sand sources that might be linked to the development of the Keeler Dunes, including the Owens River delta, Swansea Bay, the Swansea Dunes, and the North Sand Sheet. If Great Basin's ultimate conclusion is correct — that the recent expansion of the Keeler Dunes was triggered by a large influx of sand from the Owens River delta over the last 50 years, burying vegetation and abrading the fragile silt-capped older dune surfaces — then some evidence of this migration should be apparent in the images, from the playa to the shoreline, then across the shoreline barrier dunes and associated vegetation, and finally into the Keeler Dunes. However, Great Basin does not indicate where and how the sand from the playa migrated into the Keeler Dunes, and no such evidence

can be found in any of the aerial and satellite images presented by Great Basin. The lack of sand migration features is especially telling along the shoreline, where the shoreline barrier dunes and mature shrub vegetation would have presented a serious obstacle to sand migration, causing the dunes to develop in that area first before overwhelming the barriers and marching inland to the Keeler Dunes. It is scientifically indefensible to suggest that sand from the Owens playa should skip across all natural barriers (e.g., shoreline dunes and late Holocene lacustrine lake plains) to be deposited in the Keeler Dunes and nowhere else.

Great Basin's failure to objectively investigate the aeolian sand migration pathways greatly undermines their claim that sand transport from the Owens playa ultimately led to the recent expansion of the dune field. The lack of evidence in the aerial and satellite images completely undermines Great Basin's claim.

2. Page 30: The Preliminary Staff Report presents "wind roses"[8] using data from Great Basin's A-Tower, which is located on the playa about one mile west of Swansea and two miles west-northwest of the central part of the Keeler Dunes. Great Basin should have also presented wind roses for the Keeler Tower, which is located one-half mile south of the most actively mobile dunes in the Keeler Dune complex. The winds at the Keeler Tower are lighter and more variable than at the A Tower, and the wind roses will show those differences. Most importantly, Great Basin should have used and reported the meteorological data it has been collecting over the past three years from its dozen or so sites within the Keeler Dunes. These data are crucial for understanding the direction of sand transport into and through the Keeler Dunes.

3. Page 39, Sand Supply: Great Basin makes the statement that "The significant expansion of the Keeler Dunes areal extent and the increase in the number of identifiable dunes from the late 1950's to the 1990's required addition of sand from outside the dune field." This statement is speculation, unsupported by any evidence presented in the Preliminary Staff Report. In fact, Great Basin *cannot* know whether the expansion required a sand supply from outside the dune area because their investigation failed to consider several other possible sources: (1) the potential supply of sand from the deflating dunes themselves; (2) the flash flood sediments of silt, clay, and sand deposited immediately northwest of and within the central regions of the Keeler Dune complex; (3) potential changes in the internal moisture content of the Keeler Dunes; or (4) the various disturbance mechanisms that could have exposed the soil surfaces within the Keeler Dune

[8] A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time.

field to wind and water erosion, including flash flooding (both scouring and deposition). In short, Great Basin failed to perform any of the studies necessary to determine if the sand supply could have been produced locally.

4. Page 39, Sand Supply: Great Basin acknowledges that the "washes draining the Inyo Mountains to the east of the Keeler Dunes" are a potential source of sand for dune development, but then argues (without supporting evidence) that "the volume of additional material involved is much larger than is possible from the east given the extremely ephemeral nature of the flow in the washes draining the Inyo Mountains." Great Basin further discounted the Inyo Mountain "washes" as a potential source on the basis of their limited mineralogical analysis, stating that the mineral composition of sand and gravel from the Inyo Mountains was different from the mineral composition of material in the Keeler Dunes. However, Great Basin presented no evidence to support this assertion. In fact, outside of the Owens delta, Swansea Dunes, and Keeler Dunes, Great Basin did not collect any soil samples for mineralogical analysis, not even from the upper part of the Keeler alluvial fan that Great Basin previously identified as a potential sand source.

   Flash floods might well be considered "ephemeral" (short-lived), but that does not mean that they are not frequent or intense, moving large volumes of sediment down the fan and settling at the toe of the slope in the vicinity of the Keeler Dunes. The Keeler alluvial fan drains Slate Canyon, an extensive and locally significant (second-largest in the Owens Valley) drainage on the east side of Owens Valley. Flash floods occur in the Owens Valley once every three years on average (Kattelmann 1992). Great Basin's assumption that the volume of material from the fan was not large enough to form the dunes could only have been made if Great Basin was operating under another erroneous assumption – that the material required for dune formation arrived in the last 50 years and not before then. There is no such requirement. Periodic changes in the lake elevation, combined with frequent inputs from flash flooding in Slate Canyon, have likely contributed a large volume of sand in the vicinity of Keeler Dunes. All that is required for dune formation is some local disturbance of the soil surface, which Great Basin failed to investigate or address in the Preliminary Staff Report.

   Great Basin restricted its mineralogical investigation to the Swansea Dunes, Keeler Dunes, and Owens River delta, and then hastily concluded that sand from the Owens River delta was *solely responsible* for the recent dune field expansion. Great Basin provided no corroborating evidence to support such a bold assertion. Great Basin should have conducted a more thorough and objective investigation of the potential contributions from sand sources, including those on the Slate

Canyon alluvial fan, before hastily concluding that the Owens playa – and no other source – is responsible for the recent expansion of the Keeler Dunes. Great Basin's investigative approach is substantially flawed and biased.

5. Page 39: Great Basin also erred by suggesting (paragraph 2) that because the predominant winds are from the NW-NNW, that the main source of the sand must also be from the NW-NNW. Again, Great Basin's bias in attempting to implicate the Owens playa is clear. Winds are not the only transporter of sand and sediment material, and there is no reason to believe that the material used to form the dunes had to be transported within the "last 50 years." Winds may be chiefly responsible for creating the classical dune shapes and subsequently migrating dunes, but other vectors of transport, including water, can also be important (perhaps even more important) in moving a large volume of material. Great Basin assumed that wind was the chief conveyor of sand into the Keeler Dunes without any supporting data or analysis. Great Basin's evidence is, at best, circumstantial.

6. Page 40: The Preliminary Staff Report makes the claim that "the sand transport pathway to the [Keeler] dunes **begins** in the area of one of the distributaries of the Owens River delta" (emphasis added). This self-serving statement is groundless. Great Basin presented no data or analysis demonstrating that the sand in the Keeler Dunes "begins" anywhere, much less on a selected portion of the Owens River delta.

7. Page 40: Figure 4.3-8 includes a blue arrow at 104 degrees azimuth, which Great Basin states is the predominant sand transport direction. This concept is problematic for two reasons. First, the reliance on net vectors to explain the direction of sand transport is unsophisticated because net vectors assume ideal unrestricted flows in all directions, and they do not account for directional surface resistances that lead to differential patterns of erosion and deposition. Net vectors provide, at best, an indication of the unrestricted transport direction, not the actual transport direction. Second, the pattern of sand ripples that can be seen in the Corona image indicates that the predominant direction of travel is toward the southeast, parallel to the southern Keeler Dunes shoreline. This is the same general direction that the southern Keeler Dunes are observed to be migrating. Great Basin's claim that the predominant sand transport direction is 104 degrees azimuth is scientifically indefensible.

8. Page 41: Figure 4.3-9 contains numerous flaws. First, the percentage of roadway that is covered by "sand" does not provide any indication of the volume of sand moving across the highway, or even the direction of movement. Second, Great Basin improperly assumes that the material covering the roadway is windblown

sand; however, the material could also be flashflood sediment from Slate Canyon. In fact, the highest incidences of "sand" covering the highway in Figure 4.3-9 coincide exactly with two major flash flood events in Keeler, one in 1982 and another in 1986 (Kattelmann 1992). Third, the text does not explain why the percent cover decreased from its high in the 1980s to near background levels in the year 2000, before any dust control measures had been installed on the playa. Finally, the figure shows no change in the percent "sand" cover after 2001, the year dust control measures were first installed on the playa. This last point undermines Great Basin's claim that the Shallow Flood dust control measures effectively "dried up" the sand supply from the playa. If the installation of dust control measures had truly dried up the sand supply from the playa as Great Basin claims, then a substantial reduction in "sand" covering the roadway should have been observed after 2001; in fact, no reduction occurred.

In sum, the percentage of the roadway covered by material provides no information on the source, type, or volume of material, and therefore provides no relevant information regarding the origin and development of the Keeler Dunes.

9. Attachment C, Page 1: Lancaster (2012) states that there is currently a "companion investigation underway" that analyzes the Keeler Dunes from a geomorphic and geologic perspective and that will provide more detailed information about the broader history of the Keeler Dunes "over a longer period of time." Great Basin should have delayed publication of the Preliminary Staff Report until this "companion investigation" is completed so as to ensure that the final report reflects all available data and the most comprehensive, detailed analysis of the origin and development of the Keeler Dune field possible.

10. Attachment C, Page 13: Lancaster (2012) states that "thinning or shifting of the sand cover" was occurring in the western margin of the Keeler Dunes and that this thinning was "clearly visible." However, the Lancaster (2012) report does not fully evaluate the possible importance of this observation, or the possible causes of the "thinning."

11. Attachment C, Page 17: Lancaster (2012) states that a "continuous sand sheet between the dunefield and the Owens River delta" existed but presents no evidence to support this claim.

12. Attachment C, Page 17: Item 5 states that "Erosion became especially prominent following the construction of the shallow flood irrigation areas on the lake bed in the area of the former North Sand Sheet, resulting in widespread thinning of sand on the trailing (upwind) margin of the Keeler dunefield and exposure of alluvial fan deposits." This statement implies a causal link between Shallow

Flooding and dune erosion; however, Lancaster (2012) presents no supporting data or analysis to describe this linkage.

13. Attachment C: As indicated earlier in this response, the Lancaster (2012) model describing the growth of the Keeler Dunes in historical times did not consider locally derived sand eroded within the Keeler Dune system. Without this, the Lancaster growth model is incomplete.

14. Attachment C, Page 24, Conclusions: The Lancaster (2012) report states that the "dunefield is still developing and has not yet reached an equilibrium with sand supply and wind conditions." This conclusion is not supported or even discussed previously in the report.

15. Attachment C, Page 24, Conclusions: The Lancaster (2012) report does not provide sufficient evidence to support its finding that the pre-historical Keeler Dunes deposits were "shoreline dunes" that are fundamentally different from the modern "desert dunefield," or why this difference is important from the standpoint of dune development.

16. Attachment C, Page 25, Conclusions: The Lancaster (2012) report states that: "The Keeler Dunes are characterized by a low vegetation cover …" and by a "…supply of sand and a degree of dune mobility that exceeds the capacity of the natural vegetation to establish and maintain itself." Lancaster (2012) speculates that the high sand flux caused the reduction in vegetation density, but provides no supporting data or analysis.

17. Attachment C, Page 25, Conclusions: Lancaster (2012) states that: "…in pre-diversion times, the delta would have been largely subaqueous and this sand would have been unavailable for wind transport." This conclusion, which is repeated in the Preliminary Staff Report, is unsupported by any evidence. In fact, Owens Lake was sufficiently low numerous times during the late 1700s and late 1800s to expose regions of the Owens delta (Li et al. 2000).

18. Attachment C, Page 25, Conclusions: Lancaster (2012) states that: "Even in period of drought that lowered lake levels, aeolian sand and dunes were likely restricted to the immediate vicinity of the shorelines." Again, Lancaster (2012) presented no evidence to support this assertion, such as climate data, Owens Lake surface elevation data, plant species, and other related topics. The report does not provide sufficient supportive data and analysis to indicate how Owens Lake behaved during the late Holocene period. Here again, if sand was migrating from the playa to the Keeler Dunes, it would have crossed the shoreline dunes, deflating any claim that sand was somehow "restricted to the immediate vicinity of the shorelines."

Nothing in this section of the Preliminary Staff Report provides substantial evidence that the recent expansion of the Keeler Dunes was caused by the import of sand from the Owens River delta in the last 50 years.

4.5 The Geomorphic Mapping Analysis Does Not Support Great Basin's Position

Section 4.4 and Attachment D of the Preliminary Staff Report summarize work by the Desert Research Institute, intended to provide an understanding of how the emissive aeolian sand in the dune field fits into the overall geologic and geomorphic context of the region. Although much information is presented in this section of the Preliminary Staff Report, none of it supports Great Basin's assertion that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa over the last 50 years.

LADWP technical comments on this section are as follows:

1. Attachment D: The report entitled "Geomorphic Mapping of the Keeler Dunefield and Surrounding Areas" (Bacon and Lancaster 2012)[9] states on page iii that mapping was conducted to "identify possible source areas of sand for the Keeler dunefield." Potential sand sources were not addressed in Bacon and Lancaster (2012).

2. Page 45, Figure 4.4-1, Geomorphic map of the northern and northeastern margins of Owens Lake:

    a. The map appears to have misidentified surface sediment origins on the Lone Pine Mesa area located north of Swansea Bay as Delta Bar and Plain deposits. Regardless of their origin, the report does not discuss the Lone Pine Mesa region as a possible source of aeolian sand, which was supposed to be one of the key motivations for the Geomorphic Report, dated September 10, 2012 (Appendix D). For example, recent migrating aeolian sands on the delta plain area, which are currently being transported toward the south, are shown in photographs on Figures A-5 and A-7.

[9] The Bacon and Lancaster (2012) report appears to have been added to the Preliminary Staff Report after it was initially published by Great Basin. The cover page of the report is labeled "Final Draft" and is dated September 10, 2012, approximately 3 days after the Preliminary Staff Report was first posted to Great Basin's website on September 7, 2012. To LADWP's knowledge, Great Basin never issued any public notice stating that it had supplemented the Preliminary Staff Report with additional information. Furthermore, the references section of the Preliminary Staff Report (Section 6.0) identifies this report as "Bacon, S.N., and N. Lancaster, 2012*a*." (Emphasis added.) This necessarily begs the question of whether there is a "2012*b*" report that is still being prepared by Great Basin or, alternatively, that has simply been omitted from the Preliminary Staff Report.

b. The map shows extensive aeolian sand deposits exposed in Swansea Bay but fails to discuss the possible significance of this observation in terms of the development of the Keeler Dunes.

3. Page 46, Geomorphic map of the Keeler Dune field:

    a. This map fails to distinguish between the Older and Younger Keeler Dune deposits, which again suggests insufficient analysis of the origin of the original (Older) Keeler Dune deposits by Great Basin.

    b. To provide insights into the development of the Keeler Dunes, the aeolian sand deposits should have been partitioned into additional mapped units. For example, the Older Keeler Dune deposits could have been mapped, along with areas where modern active sands are deposited over Older Keeler Dunes (vegetated mounds).

    c. The numerical age data provided elsewhere in the Preliminary Staff Report for the Keeler Dune deposits were not utilized for this map, which again suggests that the Older and Younger Keeler Dune deposits were not fully evaluated by Great Basin in time for the Preliminary Staff Report.

    d. The map shows lacustrine lake plain deposits dated as 1872 AD at elevations greater than 3,597 feet, which is highly questionable.

    e. This map should be relabeled as a Geomorphic Shoreline Map because it primarily focuses on Owens Lake shorelines and provides almost no insights regarding the development of the Keeler Dunes.

    f. A cross-section with exaggerated vertical scale would be useful, particularly at the critical region of the Keeler Dunes where lacustrine, dune, flood, and alluvial fan deposits all exist.

Very little of the work presented in Section 4.4 and Attachment D of the Preliminary Staff Report achieves the goal of producing a better understanding of how the emissive aeolian sand in the dune field fits into the overall geologic and geomorphic context of the region. There are many descriptions of features but no insights into the origin and development of the Keeler Dunes from a geomorphic standpoint. None of the evidence presented in this section supports Great Basin's hypothesis that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa over the last 50 years.

4.6 The Chronology and Stratigraphy Analysis Does Not Support Great Basin's Position

Section 4.5 of the Preliminary Staff Report, which is based on the report in Attachment E by Lancaster and Bacon (2012), contains information related to: (1) age-dating of sands in the Keeler Dunes, (2) a mineralogical analysis purporting to identify the location of the sands, and (3) elevation measurements of the identified shoreline features to describe the chronology and stratigraphy of the Keeler Dunes. LADWP has identified a number of problems with the methodology and findings of this work, as described below.

1. Page 51 and Attachment E, Page 2: Lancaster and Bacon (2012) admit that the Optically Stimulated Luminescence (OSL) age-dating analysis is incomplete. The Great Basin public hearing should not be scheduled until LADWP has received the updated analysis and has been given sufficient time to review the analysis and prepare a written response for the public record.

2. Page 51, Age-Date Sampling: The Preliminary Staff Report states that age-dates were obtained from OSL and radiocarbon analysis. However, neither the Preliminary Staff Report nor any of the attachments contain a description of the radiocarbon dating methodology, or a discussion of the effects of secondary carbonate contamination on the accuracy of charcoal sample dates.

3. Page 51, Age-Date Sampling: The presence of "young" sands from OSL dating does not infer that the sand was derived from the Owens playa. Many other sources of "young" sand are possible, including but not limited to *in situ* sand deposits that have been recently exposed due to some form of surface disturbance.

   OSL dating showing the presence of older sands is evidence that the Keeler Dunes existed prior to the recent lake elevation change.

4. Page 52, Age-Date Results: Taking the OSL numerical dates at face value, four of seven samples are older than 172 years before present (BP), providing strong evidence that sand deposits pre-dated the recent lake elevation change. However, OSL numerical age dates that are less than 300 years old are generally considered to be inaccurate.

5. Page 53, Figure 4.5-1: It is apparent from the sample locations shown in Figure 4.5-1 that Great Basin and its consultants obtained soil samples from at least 13 sites on City-owned land without the City's prior authorization during the period from 2010 through 2011. Trespass likely occurred at the following sites: OL-11-001, OL-11-002, OL-11-004, OL-11-005, OL-11-006, OWN 10-02, OWN 10-03, OWN 10-04, OWN 10-05, 12-29-11-1, 12-29-11-2, OSL-1, and OSL-2. Unauthorized access also appears to have occurred with the installation of sand

motion and meteorological monitors (sites 9814, 9815, 7723, and 7246; Section 4.6 of the Preliminary Staff Report) as well as during the dune transect study (Section 4.7 of the Preliminary Staff Report). The Great Basin Governing Board should not allow the APCO, or his staff, to utilize or rely on data that was collected through unlawful means, including intentional or unintentional trespass on LADWP property.

6. Great Basin identified numerous fine-grained flood deposits within the older and modern Keeler Dunes, but did not analyze these deposits to evaluate whether or not they were possibly a local sand source for the dunes and/or a local source of dust emissions.

7. Page 60: Mineralogical and Particle Size Results: Great Basin lists the "drainages in the Inyo Mountains to the east of Keeler Dunes" as a potential source of sand, but Lancaster and Bacon (2012) did not collect any samples on the Slate Canyon alluvial fan for mineralogical analysis to confirm their suspicion. Later, Lancaster and Bacon (2012) dismiss the "washes" as a potential source with general statements about the lithography of the Inyo Mountains, but again provided no data or analysis to support their claim.

8. Although Lancaster and Bacon (2012) obtained numerical ages for the Older Keeler Dune deposits (i.e., pre-historical), they made no attempt to evaluate the significance of these ages in terms of the development of the dunes over the past 2,000 years. However, they do indicate that the older dunes were likely controlled by regional climate. They did not discuss what natural processes occurred during climatic variations to contribute to the development of the older and modern Keeler Dunes. The report suggests that multiple pulses of sand were periodically blown in from the lake to form the Older Keeler Dunes, but it did not correlate this model to past variations in the climate and surface elevation of Owens Lake.

9. Lancaster and Bacon (2012) speculated that the flood deposits identified in the Older Keeler Dune sediments were climatically controlled (i.e., deposited during the Little Ice Age), but they also indicated that flood deposits occurred in 1968. It seems highly speculative that flood deposits are climatically controlled, and much more likely that floods occur within the Keeler Dunes area (toe of the Slate Canyon alluvial fan) much more frequently than suggested by the Preliminary Staff Report.

10. Great Basin's findings are internally inconsistent with respect to the evaluation of the Older Keeler Dunes. On the one hand, Great Basin states that these dunes formed along shorelines in some sections, while in other sections Great

Basin indicates that the Older Keeler Dunes were southeast-migrating crescent dunes, similar to the Younger Keeler Dunes (compare Attachments C and D).

In sum, although Section 4.5 of the Preliminary Staff Report presents some descriptive information about the dune field dating and stratigraphy, the investigation is so incomplete and biased that it is not possible to draw any conclusions about the origin and development of the Keeler Dunes. The evidence presented does not support Great Basin's assertion that the recent dune field development was caused by sand originating from the Owens River delta over the past 50 years.

4.7 The Surface Change Analysis Does Not Support Great Basin's Position

The surface change analysis presented in Section 4.6 of the Preliminary Staff Report, and the report in Attachment F by Ono et al. (2012), contains numerous limitations and omissions. The results do not support the conclusion that the recent dune field development was caused by sand originating from the Owens River delta over the past 50 years. If anything, the results show that the Owens playa was *not* a large contributor to the origin and development of the dunes.

LADWP's detailed comments on the surface change analysis are as follows:

1. Page 67, Figure 4.6-2: This figure shows the irregular grid pattern used in the sand motion monitoring for 2009-2012. Ono et al. (2012) assigned the various areas associated with each of the sand motion monitoring sites, but they provided no description for why or how the assignments were made. This assignment is important, as it affects the details of the sand flux contours presented later in the section.

2. Page 68, 2000 to 2001 Surface Change: The sand-motion modeling for the pre-dust control period (2000-2001) contains several flaws that undermine Great Basin's findings and conclusions:

    a. The pre-dust control sand-motion modeling is based on only two years of data: 2000 and 2001. This sample size is too small to support conclusions about the long-term pattern of sand motion into and around the Keeler Dunes in the period following the most recent lake level change.

    b. The modeling is based on a sparse sampling grid, with sample points spaced 1 km apart.

    c. The sampling grid included only two points within the Keeler Dunes, and no points along the northern shoreline of Swansea Bay, one of the potential pathways (from an investigational standpoint) for sand movement into the Keeler Dunes. Again, the sample size is too small to

support any conclusions about the long-term pattern of sand motion into and around the Keeler Dunes in the period following the most recent lake level change.

3. Page 68, 2000 to 2001 Surface Change: Great Basin states in paragraph 2 that (in reference to Figures 4.6-3, -4, and -5): "The largest deposition area corresponds to area [sic] along the eastern shoreline of the playa and the southern portion of the Keeler Dunes." LADWP observes the following:

    a. The results show that the net sand transport direction on this portion of the playa is toward the southeast and parallel to the shoreline, with only a single point showing a component into the Keeler Dunes. These results refute Lancaster and Bacon's (2012) claim in Section 4.3 (page 40, Figure 4.3-8) that the predominant sand transport direction was along a 104-degree pathway from the Owens River delta to the Keeler Dunes.

    b. The only monitoring point showing sand flux into the Keeler Dunes is site #7199, located northwest of the dunes along the shoreline at the 3,596-foot elevation. This monitoring point is located within the exposed shoreline fringe that existed prior to the start of water diversions in 1913; therefore, all of the fluxes measured at this site are not attributable to the City's water-gathering activities. Furthermore, there is no evidence that sand was being transported across this point from locations farther out on the Owens playa.

    c. Site #7199 is also situated adjacent to an expanse of recently deposited sand and silt, which was created when Caltrans diverted flash-flood waters from Highway 136 beginning in the early 1950s. Here too, the evidence suggests that the fluxes recorded at #7199 are *not* the result of the City's water-gathering activities.

    d. Great Basin did not assess whether the influx of sand from #7199 was sufficient to cause the observed changes in the Keeler Dunes over the past 50 years. It is not enough to simply show the direction of sand motion into the Keeler Dunes; Great Basin must also demonstrate that the influx of sand was sufficient to produce the observed changes. It did not do this.

4. Page 72, 2009 to 2012 Surface Change: The sand-motion modeling for the post-dust control period (2009-2012) contains several flaws that undermine Great Basin's findings and conclusions:

    a. The sand-motion modeling for the 2009-2012 period did not use any of the on-site meteorological data collected at its sites within the Keeler

Dunes. The analysis was performed data from the A-Tower, located two miles away on the Owens playa.

b. The post-dust control sand-motion modeling is based on only three years of data: from July 2009 through June 2012. This sample size is too small to support conclusions about the long-term pattern of sand motion into and around the Keeler Dunes in the period following the most recent lake level change.

c. The sampling grid omitted two important sand motion monitoring sites (#9811 and #9812, installed January 6, 2011) located north of the Keeler Dunes within the Swansea Dune complex. Both sites show high sand activity (1,400 grams at #9812 in 2010-11) from the direction of the Swansea Dunes, as well as from an expanse of sand lying immediately to the south of the monitors. Inclusion and analysis of these data are vital for understanding the direction of sand motion into the Keeler Dunes. Great Basin provided no explanation for why it omitted these sites; nor were the sites mentioned anywhere in the Preliminary Staff Report.

d. The sampling grid included no points along the northern shoreline from Lizard Tail to the Keeler Dunes, one of the potential pathways (from an investigational standpoint) for sand movement into the Keeler Dunes.

e. The sampling grid included no points above the shoreline (off-lake) between Lizard Tail and Keeler Dunes, another potential pathway (from an investigational standpoint) for sand movement into the Keeler Dunes, which is supported by the vectors shown in Figures 4.6-8, -9, and -10.

5. Page 72, 2009 to 2012 Surface Change: Great Basin states in paragraph 2 that (in reference to Figures 4.6-6, -7, and -8): "The overall pattern observed has the highest erosion along the western portion of the dune area extending from the vicinity of the Northern Dune southeastward along the western edge of the deposit. Sand deposition is seen in the southeastern end of the dunes and in the eastern half of the sand deposit. These patterns are consistent with general observations made on the ground and in Lancaster (2012) and HydroBio (2012) that there has been significant deflation of material on the west and spreading and migration of the active Keeler sand sheet and dunes to the east and southeast, respectively." With respect to these statements, LADWP notes that:

   a. The results would seem to suggest that a causal link exists between the installation of Shallow Flood controls and the onset of significant erosion and deposition in the Keeler Dunes; however, Great Basin offers no explanation for why this should be the case.

b. Nothing in this section provides evidence that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa during the last 50 years. In fact, the available data suggest that sand deflating from the western part of the Keeler Dunes (not the playa) partially or entirely fueled the expansion of the dunes toward the southeast. Great Basin is silent on this point and failed to include additional evidence (from #9811 and #9812) pointing toward a possible influx of sand from the Swansea Dunes.

6. Page 78, Summary: Paragraph 1 makes the completely unsupported claim that: "These patterns provide additional confirmation that, since 2000, material is moving southeastward off the northeast portion of the Owens Lake bed and up onto the alluvial fan in the area of the Keeler Dunes...(from Ono et. al., 2012)." There is no support for this statement anywhere in this section. In fact, the gap in Great Basin's sampling grid between Lizard Tail and the Keeler Dunes renders the modeling incapable of determining whether there is a sand transport pathway between these two areas. The pre-construction modeling analysis did not reveal the presence of a sand transport pathway from the northeast portion of the playa, either.

In sum, nothing in Section 4.6 of the Preliminary Staff Report supports Great Basin's claim that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa within the past 50 years. The available data suggest that sand from the western part of the Keeler Dunes, perhaps in conjunction with sand from the Swansea Dunes, fueled the recent expansion of the Keeler Dunes toward the southeast.

4.8 The Dune Transect and Movement Analysis Does Not Support Great Basin's Position

Section 4.7 and Attachment G of the Preliminary Staff Report are largely descriptive in nature, summarizing the development and rate of movement of the dunes over the past 10 years. Nothing presented in this section supports Great Basin's position that the recent expansion of the Keeler Dunes was caused by an influx of sand from the Owens playa within the past 50 years. If anything, the available data from elsewhere in the Preliminary Staff Report suggest that sand from the western part of the Keeler Dunes, with input from the Swansea Dunes and alluvial fan deposits, fueled the recent expansion and migration.

Section 5: Conclusion

The Preliminary Staff Report is a biased, incomplete, inaccurate, unreliable, and scientifically indefensible account of the "origin and development of the Keeler Dunes." Great Basin omitted, ignored, misinterpreted, and/or misapplied critical data and failed to perform key analyses necessary to provide a complete and comprehensive understanding of how these dunes formed and developed over time. The report cannot be used to justify any conclusions about the formation of the Keeler Dunes or, more importantly, to assign responsibility for controlling the dunes to any person or entity, including LADWP.

Great Basin must stay the Governing Board hearing on the final version of the Preliminary Staff Report *indefinitely* in order to allow Great Basin staff sufficient time to address and correct the serious flaws with the Preliminary Staff Report outlined in this Technical Report and to ensure that all pending investigations are completed and incorporated into the final report.

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