RESPONSE TO COMMENTS RECEIVED

ON THE

SEPTEMBER 7, 2012

PRELIMINARY STAFF REPORT ON THE ORIGIN AND DEVELOPMENT OF THE KEELER DUNES

By

Great Basin Unified Air Pollution Control District

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November 16, 2012

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List of written comments received by the District

The comment period extended from September 7, 2012 to October 26, 2012. Comments were received from the following:

1. City of Los Angeles Department of Water and Power, October 19, 2012

(No other written comments were received.)

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DISTRICT RESPONSES TO COMMENTS FROM THE LADWP

District Introduction

The District Governing Board will hold a public hearing on December 13, 2012 to discuss the origin and development of the Keeler Dunes and directed District staff to complete a preliminary report (Preliminary Staff Report) to be made available to all interested parties along with the technical analyses, data and other materials from the completed studies. District staff completed the Preliminary Staff Report that presents the results and provides discussion on the issue of the origin and development of the Keeler Dunes. The report and supporting technical attachments were made available for review and comment on September 7, 2012.

Announcement of the availability of the Preliminary Staff Report and technical materials was distributed to all participants of public workshops (held on January 20, 2011 and August 24, 2011) on the Keeler Dunes as well as those that have requested to be on the District's distribution list. Additionally, an announcement of the Preliminary Staff report and the schedule for comments was published in the *Inyo Register* and on the District's website. The comment period for the Preliminary Staff Report originally ended on October 19, 2012 but was extended one week to October 26, 2012 to provide additional time for comments. The only written comments received by the District were from the Los Angeles Department of Water and Power (LADWP) on October 19, 2012. The District has carefully considered and evaluated each comment made by the LADWP.

The following are the Great Basin Unified Air Pollution Control District's (District's) comments, responses and additional analyses regarding the LADWP's document titled "Response to Great Basin Unified Air Pollution Control District Preliminary Staff Report on the Origin and Development of the Keeler Dunes" dated October 19, 2012. The LADWP's document was submitted as comments on a Preliminary Staff Report made by the District dated September 7, 2012.

The District responses to the comments from the LADWP were written by District staff as well as members of the team of experts that the District has retained to conduct detailed scientific research on the Keeler Dunes. Each comment by the LADWP was carefully evaluated and considered. In order to address some of the comments made by the LADWP and to provide a more thorough analysis of the origin of the dunes, the District has revised the Preliminary Staff Report and most of the associated Technical Attachments. The revised materials are presented as the Final Staff Report and Technical Attachments on the Origin and Development of the Keeler Dunes (November 2012). All materials are available on the District's website: (http://www.gbuapcd.org/keelerdunes/originanddevelopment)

The District must raise an important point before responding in detail to the LADWP's comments on the Preliminary Staff Report. The LADWP submitted a number of comments that do not relate to the materials presented in the Preliminary Staff Report. These include argument of issues and legal interpretation of local, state and federal air pollution control laws. The District responds to these issues as a courtesy and for a complete record. In no way does the District's response to non-technical issues indicate the District agrees they relate to the determination on the origin and development of the Keeler Dunes.

Format of District Comments

In order to assist the reader, the District quotes sections of the LADWP's comments and encloses the quotes in boxes like this:

LADWP COMMENT [Example]

> 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.

DISTRICT RESPONSE

The District's response to those comments is shown as text outside boxes.

DISTRICT RESPONSES TO COMMENTS FROM THE LADWP

Section 1. Summary

LADWP COMMENT

> 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.

DISTRICT RESPONSE

As presented in the District's Preliminary Staff report and Technical Attachments, the District conducted multiple broad-ranging scientific investigations and detailed research over a four year period (2008-2012) focused on how the Keeler Dunes formed and the changes that have occurred in the nature of the landscape over time. The investigations were originally conducted collaboratively with the LADWP per the 2006 Settlement Agreement (GBUAPCD and LADWP, 2006) and 2008 SIP (GBUAPCD, 2008). All of the work that the District has conducted in the dunes has been presented to the public through Public Meetings (held on January 20, 2011 and August 24, 2011) and in the September 7, 2012 Preliminary Staff Report and Technical Attachments. Over a year ago, the LADWP said they were conducting their own investigations in the dunes. The LADWP has not provided results or information to the District as to the nature of the work.

In the review and comments on the District's Preliminary Staff Report, the City does not provide any technical information on the work they have conducted and does not provide any data to support their comments regarding the District's work. The District has a team of prominent expert scientists that have conducted rigorous research and investigations aimed at providing an answer as to the origin and the development of the Keeler Dunes. The results presented in the Preliminary Staff Report are well supported and collectively conclude that the active Keeler Dune field was formed as a direct result of the desiccation of Owens Lake and the exposure of the lake bed to wind erosion.

Detailed responses to comments from the LADWP on specific components of the District's research are provided in the following response sections.

LADWP COMMENT

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 PM10 Planning Area Demonstration of Attainment State Implementation Plan (2008 SIP) the Owens Valley Planning Area (OVPA) is expected to achieve attainment with federal PM10 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.

DISTRICT RESPONSE

The District has carefully reviewed and considered the comments from the LADWP on the Preliminary Staff Report and finds that the conclusion that the active Keeler Dunes formed as a result of exposure of the bed of Owens Lake is strongly supported by the results of the scientific research. This conclusion was not predetermined by the District; instead it was thoroughly researched and tested during the course of the scientific investigations. As discussed in more detail, in the following sections, the District employed basic scientific methodology in conducting the research. Per that method, the District formulated a hypothesis on how the Keeler Dunes formed based on general observations made within the area. The scientific method requires that a hypothesis be ruled out or modified if it is incompatible with data and results from the research such that it is a valid description of nature. However, this was not the case with the District's research. Instead, the results of the research support and confirm the original hypothesis.

As stated in the Preliminary Staff Report and other previous documents such as the 2003 SIP (GBUAPCD, 2003) and the 2008 SIP (GBUAPCD, 2008), the initial working hypothesis by the District was that the Keeler Dunes deposit formed from material transported from the bed of Owens Lake. The research conducted by the District and its team of expert scientists was designed to determine if this hypothesis was correct or if the dunes formed in a different manner. A broad spectrum of investigations were conducted to research the origin of the dunes ranging from a historical search of documents, references, maps, and photos of the Owens Lake and Keeler area, to an analysis of air photos and satellite imagery, to detailed geomorphic and geologic mapping, to numerical age date and mineralogical analyses, to an analysis of sand motion in the area. The broad nature of the investigations tested the working hypothesis on the origin of the dunes from not one, but three different time perspectives: historical, prehistoric, and recent. After careful evaluation and consideration of the results, the District finds that the results of the investigations support the initial hypothesis and that the active portion of the Keeler Dunes formed from material that was transported from the exposed Owens Lake bed.

The Preliminary Staff Report is a technical document that presents the results of seven different investigations regarding the origin of the Keeler Dunes. As the Preliminary Staff Report does not contain any legal arguments, the comments from the LADWP regarding the legal aspects of dust control implementation in the Keeler Dunes are not relevant to the District's conclusion regarding the origin and development of the dunes.

Detailed responses addressing the LADWP's specific comments on the Preliminary Staff Report are provided in the following sections.

Section 2: The Preliminary Staff Report was NOT a Pretense for Great Basin to Issue LADWP Control Orders for Keeler Dunes

LADWP COMMENT

> 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).

DISTRICT RESPONSE

The 2008 SIP (GBUAPCD, 2008) requires control of the Keeler Dunes PM_{10} emissions by March 2014. The District is working to meet that deadline by developing a dust control strategy and conducting the required environmental impact analyses (through CEQA and NEPA). These environmental documents are currently in preparation and should be available for review and comment in early 2013. The emissions from the Keeler Dunes require control regardless of their origin since the high PM_{10} concentrations exceed both Federal and State air quality standards and directly impact the health and safety of local residents. The District's investigations were conducted independently from one-another and without a pre-determined result.

The comments by the LADWP that the results of the work were funding-based are surprising and are not supported by facts. The funds for the Keeler Dunes work over the past couple of budget years (2010-2011 and 2011-2012) has not come from the LADWP but came directly from the District. The District assesses the LADWP annually under Section 42316 of the California Health and Safety Code for dust control work resulting from the City of Los Angeles' on-going water gathering activities. The District anticipates that the fee assessment under Section 42316 to the LADWP will remain relatively constant and at the same general level as the current fee assessment following completion of the Owens Lake dust controls. This is due to the fact that the District is currently at a staff level designed for monitoring and compliance enforcement. The future fee assessments to the LADWP are not dependent on implementation of the dust controls in the Keeler Dunes.

2.1 The Results of the Preliminary Staff Report Were NOT Predetermined by Great Basin

LADWP COMMENT

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.

DISTRICT RESPONSE

The District conducted the investigations into the origin of the Keeler Dunes using standard principles of scientific research. The investigations were designed to be as objective as possible to reduce biased interpretations of the results. The District documented and shared the methodology and all data of the work that has been conducted so that it is available for scrutiny by other scientists and interested parties. The origin of the Keeler Dunes was researched openly through multiple investigations looking not only at recent and historical information but also geologic and geomorphic data and relationships to test the hypothesis that the dunes are anthropogenic. In fully disclosing the results of the District research, the District was seeking comments from interested parties and agencies on the completed work. Additionally, since the LADWP has been conducting separate investigations in the dunes, the District anticipated that the LADWP would provide results of their work. However, the comments from the LADWP do not discuss the work that they have conducted.

The PM_{10} emissions from the Keeler Dunes directly affect the health and safety of local residents and visitors to the area and as such require control regardless of their origin and how they developed with time. This is in keeping with the 2003 and 2008 SIPs (GBUAPCD, 2003 and GBUAPCD, 2008) and the commitment made for the control of the dunes in order to meet attainment within the Owens Valley Planning Area. The District in no way pre-determined the results of research and instead conducted multiple detailed scientific investigations to answer the question regarding the origin and development of the Keeler Dunes. If the results of these investigations showed that the active Keeler Dunes were natural then the District was more than willing to accept that conclusion regardless of statements made in previous documents. However, the results of the research speak for themselves and support the conclusion that the current active Keeler Dunes are a recent geomorphic feature that formed primarily from aeolian deposition of sediment from the dried bed of Owens Lake.

For at least the past 15 months the LADWP has been conducting its own investigations in the dunes. The District expected the LADWP to provide data and information from these investigations for consideration by the District in the process. However, instead of providing the results or information of their research, the LADWP only provides general unsubstantiated comments on the District's research. In fact, the LADWP does not even acknowledge that they have conducted research on the dunes or even the nature of their work.

2.2 The Results of the Preliminary Staff Report Are NOT Funding- Motivated

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The District is the agency with the legally responsibility to enforce State and Federal air quality laws. The Owens Valley Planning Area (OVPA), which encompasses the southern Owens Valley including Owens Lake and the Keeler Dunes, is designated as a federal Serious Non-Attainment Area for PM_{10}. The PM_{10} emissions prior to implementation of dust controls on the bed of Owens Lake were such that the monitored PM_{10} concentrations in the OVPA were the highest in the United States. The main source causing these high PM_{10} concentrations was the dust sources exposed from the desiccation of Owens Lake following diversion of its tributary water sources. As such, the District has ordered the LADWP to mitigate the PM_{10} emissions from the sources identified on the lake bed with a resulting improvement in PM_{10} concentrations of approximately 90%. However, there are additional sources of dust that still need control and are also related to the diversion and export of water from the Owens Valley by the LADWP. These sources cause multiple exceedances of the Federal and State PM_{10} air quality standards each year. The District is legally obligated to enforce the air quality laws and require control of these sources in order to meet attainment within the OVPA. The District's mandate is clean air within the OVPA for the health and safety of the residents and visitors.

The LADWP is incorrect is stating that "LADWP's dust control obligations at Owens Lake will end once the controls are installed for Phase 7a". The LADWP are required to maintain and operate all dust controls on the lake bed indefinitely in the future in order to meet compliance criteria and to continue to control the dust emissions from the lake bed that are caused by their on-going water gathering activities. The District does not and will not fund dust control operations and maintenance, this is the responsibility of the LADWP.

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

LADWP COMMENT

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 PM10 emissions from naturally occurring, nonanthropogenic 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 PM10 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.

DISTRICT RESPONSE

It is incorrect that the Clean Air Act does not require control of natural sources. PM_{10} violations attributed to a natural source that directly impact the health and safety of the local population need to be controlled. Violations from a natural source can be treated as a natural event and a Natural Events Action Plan would be developed and implemented in accordance with the USEPA rule on Exceptional Events. In the situation of the Keeler Dunes, it is clear from monitoring data that the emissions from the dunes directly affect that health and safety of the residents in the community of Keeler and visitors to the area as well as employees of the LADWP working on the Owens Lake dust control project and therefore need to be controlled regardless of their origin.

The LADWP is incorrect in their interpretation of the Exceptional Events Rule. In order for a dust event to qualify as an exceptional event, two separate conditions must be met:

(i) that BACM for windblown dust was in place and properly maintained to the extent possible at the time of the event, and
(ii) that unusually high winds were the cause of the exceedance.

In the case of the Keeler Dunes, Best Available Control Measures (BACM) are not currently in place, so the Exceptional Events Rule would not apply. In the future, after BACM is implemented and if unusually high winds overwhelm the control measure, then a Natural Events Action Plan (NEAP) would still be needed to provide additional measures to safeguard public health should such an event recur.

The District conducted rigorous detailed scientific research on the origin and development of the Keeler Dunes. This work was conducted by a team of noted expert scientists over a multi-year period. Extensive data and information were collected and analyzed throughout the investigations with the results of the work presented in the Preliminary Staff Report and supporting Technical Attachments. The results of this extensive research provide strong support for the conclusion that the Keeler Dunes formed as a direct result of the historic desiccation of Owens Lake following water diversions within the Owens Valley.

LADWP COMMENT

> **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 PM10 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.

DISTRICT RESPONSE

The LADWP is incorrect in claiming that the 42 square miles of controls of existing controls plus the additional 3.1 square miles of committed controls are sufficient to achieve attainment of the PM_{10} NAAQS in the OVPA or that the District must wait until 2017. The 2008 SIP (GBUAPCD, 2008) states that:

> "*The District will work with the City and other federal, state and local agencies to develop a plan to control dust emissions from the Keeler dunes. If additional PM_{10} control measures are required for the Keeler dunes, they will be ordered by the District before January 1, 2012 and implemented by the responsible parties before January 1, 2014 in order to demonstrate attainment of the federal standard by 2017*" (GBUAPCD, 2008, page 7-6).

PM_{10} monitoring and air quality modeling conducted by the District since 2008 clearly show that controls are required in the Keeler Dunes to mitigate the exceedances of the PM_{10} air quality standards in the community of Keeler and that the PM_{10} NAAQS will not be met until those controls are in place. As a result, the District is required to order the control of the emissions from the dunes in order to meet the attainment within the OVPA and the requirements in the 2008 SIP. While the District did not order the controls for the dunes by the January 2012 date given in the 2008 SIP, it is currently conducting the required CEQA and NEPA environmental analyses such that the emissions from the dunes should be controlled in order to meet the federal standard by 2017.

LADWP COMMENT

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 PM10 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.

DISTRICT RESPONSE

It is incorrect that that ordering the LADWP to control the dust emissions from the Keeler Dunes will violate California Health and Safety Code (CHSC) Section 42316. It is also incorrect that the District has no other authority over the LADWP (other than that granted by Section 42316). Section 42316 grants the District the authority to require the LADWP to pay fees and mitigate its air pollution. Section 42316 only prohibits the District from interfering with the DWP's water-gathering activities. It does not exempt LADWP from complying with air pollution rules, requirements and laws. The LADWP is subject to many District rules, provisions of the CHSC, and the Clean Air Act. Great Basin is authorized to enforce all applicable District rules, Part 4 of the CHSC (which includes Section 42316) and some provisions of the Federal Clean Air Act (e.g., asbestos regulations). The statement "any action taken by Great Basin that enlarges or conflicts with Section 42316 is invalid" is incorrect and the cited case has no bearing on the District's mandatory requirement for control of the PM_{10} emissions from the Keeler Dunes. As with the 2011 and 2012 Supplemental Control Requirement Determinations, the LADWP fails to acknowledge the local- and state-enforceable requirements of the 2008 SIP and 2010 Coso Junction Maintenance Plan.

Section 4: There are NO Significant Technical Defects with the "Investigation" and Preliminary Staff Report

LADWP COMMENT

> **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]
>
> [footnote omitted]

DISTRICT RESPONSE

The District has carefully reviewed and considered the comments from the LADWP on the Preliminary Staff Report and finds that the conclusion that the active Keeler Dunes formed as a result of exposure of the bed of Owens Lake is strongly supported by the results of the scientific research. This conclusion was not predetermined by the District; instead it was thoroughly researched and tested during the course of the scientific investigations. As discussed in more detail, in the following sections, the District employed basic scientific methodology in conducting the research. Per that method, the District formulated a hypothesis on how the Keeler Dunes formed based on general observations made within the area. The scientific method requires that a hypothesis be ruled out or modified if it is incompatible with data and results from the research such that it is a valid description of nature. However, this was not the case with the District's research. Instead, the results of the research support and confirm the original hypothesis.

As stated in the Preliminary Staff Report and other previous documents such as the 2003 SIP (GBUAPCD, 2003) and the 2008 SIP (GBUAPCD, 2008), the initial working hypothesis by the District was that the Keeler Dunes deposit formed from material transported from the bed of Owens Lake. The research conducted by the District and its team of expert scientists was designed to determine if this hypothesis was correct or if the dunes formed in a different manner. A broad spectrum of investigations were conducted to research the origin of the dunes ranging from a historical search of documents, references, maps, and photos of the Owens Lake and Keeler area, to an analysis of air photos and satellite imagery, to detailed geomorphic and geologic mapping, age date and mineralogical analyses, to an analysis of sand motion in the area. The broad nature of the investigations tested the working hypothesis on the origin of the dunes from not one, but three different time perspectives: historical, prehistoric, and recent. After careful evaluation and consideration of the results, the District finds that the results of the investigations support the initial hypothesis and that the active portion of the Keeler Dunes formed from material that was transported from the exposed Owens Lake bed.

The Saint-Amand et. al. (1986) reference cited by the LADWP only provides a partial review of historic Owens Lake level changes (starting in 1905). The LADWP is referred to Lee (1915), Gale (1915) as well as data collected by LADWP over the years for a complete record.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The District did evaluate the other potential sources of sand for the active Keeler Dunes besides sand transported from the Owens River via the bed of Owens Lake. The results of that detailed evaluation are discussed in our responses to the LADWP's comment section 4.4 and in the report by Lancaster and Bacon (2012b). In summary of that evaluation: based on the timing of sediment influx and dune growth, mineralogy, volume of sand required, and sediment transport direction the sources suggested by the LADWP (listed in the text box above) are not feasible sources for the active recently formed modern Keeler Dunes.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The results of the series of detailed research investigations on the Keeler Dunes conducted by the District over the past four years conclusively demonstrate that the growth and development of the Keeler Dunes since the 1940s was the result of the movement of sediment off of the lake bed onto the Keeler Fan. The modern formation of the Keeler Dunes sand deposit is clearly evident both through historical research and through analysis of the geology and geomorphology.

It is clear from water level records of Owens Lake (Lee, 1915 and Gale 1915) that the historic drop in lake level began in the late 1800's. The drop in water level of the lake was first attributed to water diversions associated with agricultural development in the Owens Valley but was then replaced by the City of Los Angeles due to water export to Los Angeles via the Los Angeles Aqueduct and the purchase of property and associated water rights in the Owens Valley. The Saint-Amand et. al. (1986) reference cited by the LADWP only provides a partial review of historic Owens Lake level changes. The LADWP is referred to Lee (1915), Gale (1915) as well as data collected by LADWP over the years for a complete record.

The District did evaluate the other potential sources of sand for the active Keeler Dunes besides sand transported from the Owens River via the bed of Owens Lake. The results of that evaluation are discussed in our responses to the LADWP's comment section 4.4 and in Lancaster and Bacon (2012b). In summary of that evaluation: based on the timing of sediment influx and dune growth, mineralogy, volume of sand required, and sediment transport direction the disturbances suggested by the LADWP are not feasible sources for the active recently formed modern Keeler Dunes.

The District designed the research work on the origin of the Keeler Dunes to investigate the issue from multiple different angles ranging from looking at the recent sand transport and dune movement data, to conducting detailed geomorphic and geologic investigations, to an analysis of historic photos, documents and satellite imagery. The research is comprehensive and the scientific methodology used is sound with the results indicating that the modern Keeler Dunes formed from material transported from the Owens Lake bed onto the adjacent Keeler Fan following the historic desiccation of Owens Lake.

LADWP COMMENT

> Great Basin is also biased in its investigation by attributing all the dust arriving at the Keeler PM10 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 PM10 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.

DISTRICT RESPONSE

The purpose of the Preliminary Staff Report was to present the results of research conducted by the District on the origin and development of the Keeler Dunes and not to provide an analysis of the PM_{10} and sand motion monitoring conducted by the District. As such, a discussion on the apportioning of dust measured at the Keeler air quality monitoring station is irrelevant and it was not included in the Preliminary Staff Report. The intent of providing a brief summary of PM_{10} monitoring data in the beginning of the report was to provide some background on the Keeler Dunes projects. The LADWP is referred to the 2008 SIP and the Dust ID program protocol (Attachment C, GBUAPCD, 2008) for a discussion on the PM_{10} concentrations measured at Keeler and their apportionment to sources on the bed of Owens Lake, the Keeler Dunes, or other off-lake sources.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The District employed basic scientific methodology in conducting the research. Following that method, the District formulated a hypothesis on how the Keeler Dunes formed based on general observations made within the area. The District then designed a series of research investigations to provide data and information to test this hypothesis. The scientific method requires that a hypothesis be ruled out or modified if it is incompatible with data and results from the research such that it is a valid description of nature. However, this was not the case with the District's research. Instead, the results of the research support and confirm the original hypothesis.

The District has a team of prominent expert scientists that conducted rigorous research and investigations aimed at providing an answer as to the origin and the development of the Keeler Dunes. A broad spectrum of investigations were conducted to research the origin of the dunes ranging from a historical search of documents, references, maps, and photos of the Owens Lake and Keeler area, to an analysis of air photos and satellite imagery, to detailed geomorphic and geologic mapping, age date and mineralogical analyses, to an analysis of sand motion in the area. The broad nature of the investigations tested the working hypothesis on the origin of the dunes from not one, but three different time perspectives: historical, prehistoric, and recent.

After careful evaluation and consideration of the results, District staff finds that the results of the investigations support the initial hypothesis and that the active portion of the Keeler Dunes formed from material that was transported from the exposed Owens Lake bed. The results presented in the Preliminary Staff Report are well supported and collectively conclude that the active Keeler Dune field was formed as a direct result of the desiccation of Owens Lake and the exposure of the lake bed to wind erosion.

LADWP COMMENT

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 KeelerDunes 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.

> [footnote omitted]
>
> 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.

DISTRICT RESPONSE

The District agrees with the LADWP that the results of the Historical Documents search conducted by Sapphos are not conclusive regarding the presence or absence of the Keeler Dunes. However, it was necessary to conduct the research to find out if there were historical documents available that could provide information about the dunes and the landscape present in the past 100 to 150 years. It was also important to include the research in the Preliminary Staff Report.

In their comments on the Preliminary Staff Report, the LADWP provide a reference (Elliot, 1904) that the District did not find in their historical documents research. The District has reviewed this reference and has included in it the Final Staff Report. The District found Elliott (1904) and the included descriptions of the fauna and conditions around Owens Lake interesting and appreciates being made aware of this reference. A more detailed review of Elliott (1904) and its significance with respect to the origin and development of the Keeled Dunes is provided below.

LADWP COMMENT

> **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).

DISTRICT RESPONSE

1. The historic research conducted by the District and by Sapphos Environmental Inc. (Sapphos, 2011) focused on the vicinity of Keeler and the Keeler Dunes in an effort to find documents and references as to the nature of the landscape in the area where the Keeler Dunes are located. Accounts of dust in the southern Owens Valley or Owens Lake region are not relevant to this work unless they specifically refer to the area of the Keeler Dunes. The general mention by the LADWP of accounts in the *Inyo Register* and *Inyo Independent*

by overall year (and not by specific date) is insufficient as to the nature of the newspaper accounts.

LADWP COMMENT

> 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).

DISTRICT RESPONSE

2. Once again, the historic research conducted by the District and by Sapphos (Sapphos, 2011) focused on the vicinity of Keeler and the Keeler Dunes in an effort to find documents and references as to the nature of the landscape in the area where the Keeler Dunes are located. This work was not intended to analyze potential effects of activities within the overall southern portion of the Owens Valley. An analysis of the various potential sand sources for the Keeler Dunes is provided in the report by Lancaster and Bacon (2012b).

   The primary agriculture and cattle grazing activities in the southern Owens Valley occurred north of Owens Lake using water from the Owens River or tributary streams flowing from the Sierra Nevada Mountains. The lack of a suitable water supply and overall poor soil conditions along the eastern portion of Owens Lake precluded agriculture and significant cattle grazing in the vicinity of Keeler. The activity that was present along the eastern side of Owens Lake in the vicinity of Keeler and the Keeler Dunes was primarily related to the various mines in the Inyo and Coso Mountains and salt mining on Owens Lake.

LADWP COMMENT

> 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.
> [footnote omitted]

DISTRICT RESPONSE

3. The Inyo Development Company had an operations facility along the historic shoreline of Owens Lake northwest of Keeler and south and west of the central portion of the existing Keeler Dunes. This facility was established circa 1898-1899 to process soda ash from salt mined off of the bed of Owens Lake. The majority of operations were located on the bed of

Owens Lake and involved flooding solar evaporation ponds with water from the lake. The ponds were allowed to evaporate over the summer until trona formed on the bottom. In the fall, the ponds were drained and the trona was harvested and brought to shore. Some of the trona was shipped directly out of the area on the narrow gauge railroad while the rest was processed at the processing facility into soda ash and then shipped to market. The solar ponds themselves, while technically "disturbed" can be considered as stable since they were either filled with water from the lake or covered with a thick evaporative salt crust. Limiting the amount of insoluble material (i.e. soil particles or sand) is critical to the success of salt mining since such impurities reduce the quality of the resulting soda ash, thus migrating sediment into the solar panels would have caused the trona mining operation to fail. Most of the transportation from the solar ponds on the lake bed to the shore was done via a narrow gauge railroad (most of the lines were 24-inch gauge instead of 36-inches like the Carson and Colorado).

In addition, the salt processing facility is located in the wrong location to have been a source of sand for the current Keeler Dunes. The prevailing sand transportation direction in the vicinity of the Keeler Dunes is to the southeast. Thus any material that may have been transported would have traveled either along the shoreline or toward Keeler. Furthermore, the local terrain between the Inyo Development Co. facilities and the Keeler Dunes consists of a stable surface containing thick vegetation that does not contain evidence of significant sand migration thus eliminating a direct pathway between the mining facilities and the current Keeler Dunes. Based on historic photos and imagery this stable vegetation band appears to have existed at least from circa 1920 to the present (Grimm (2012) and Lancaster (2012)).

The District is unaware of any rangeland fire or road construction activities that could provide sufficient material to supply the sand for the Keeler Dunes. There are very few roads in the area with the main roadways being paved. There were some reported structure fires in the community of Keeler. Based on the size of the fires and the required sand transportation direction to the dunes, it is impossible for these events to have supplied the dunes with sand. A more detailed analysis of the various potential sand sources for the Keeler Dunes is provided in the report by Lancaster and Bacon (2012b).

LADWP COMMENT

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.

DISTRICT RESPONSE

4. The position of the shoreline of 1872 was stranded approximately 3 feet (1 m) above a new lake level created by the March 26, 1872 Owens Valley earthquake. This vertical change in elevation corresponds to approximately a 200 foot lateral shift to the west in the lake position. An analysis of the various potential sand sources for the Keeler Dunes is provided in the report by Lancaster and Bacon (2012b).

LADWP COMMENT

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

[footnotes omitted]

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.

DISTRICT RESPONSE

The District reviewed the report (Elliot, 1904), mentioned by LADWP, on the mammalian survey by Heller in 1902 of the Mojave and Colorado deserts and Death Valley. This report was not found by the District in its search of historical documents. There are four specific references in Elliott (1904) that mention Owens Lake, Keeler, and sand dunes. Three of these references are provided by the LADWP in their comments (see text box above). The fourth reference is provided below and describes the habitat for a rare species of pocket mouse, *Perognathus pericalles*:

> *"This beautiful little species* [Perognathus pericalles] *was evidently quite rare, as the two examples secured were the only ones seen. It shows to a remarkable degree the influence exerted upon color that the neighborhood of Owens Lake exerts in producing the rich, deep cream buff hue' of its pelage. It was found among the sand dunes at the edge of the lake, to which it appeared to be restricted."* (Quote from Elliott, 1904, page 307)

The District does not dispute that there were sand dunes in the Owens Lake area prior to the modern desiccation of Owens Lake. In fact, the District states quite clearly in the Preliminary Staff Report that many of the Holocene shorelines as well as the recent historic shoreline contained a series of shoreline dunes. What is clear from the habitat descriptions from Heller, 1902, is that these shoreline dune features were a vegetated natural dune system and were not the same as the active dust producing Keeler Dunes. The two can be distinguished not only by the presence of plants and habitat for mammals but also by the relatively restricted occurrence along the shoreline.

These spatially restricted vegetated dunes are incapable of supplying sufficient sand for the observed recent growth and migration of the current Keeler Dunes. An analysis of the various potential sand sources for the Keeler Dunes is provided in the report by Lancaster and Bacon (2012b).

LADWP COMMENT

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.

DISTRICT RESPONSE

Train timetables from the Southern Pacific Company from September 27, 1931 (Turner, 1974) and April 24, 1932 (Myrick, 2007) provide the narrow gauge train schedules between Mina, Nevada and Keeler, California. On these timetables from the 1930s there is no warning of sand along the route. However, in comparison, the Southern Pacific Timetable 179 from April 25, 1954 for the Keeler Branch[1] between Laws and Keeler specifically warn train operators to “Look out for drifting sand between MP [milepost] 573 and 575” (Morris, 2010). Morris (2010) also states that the stretch of track from Dolomite to Keeler that was originally constructed with 35 pound rails was replaced with heavier 62 pound rails due to drifting sand. The Keeler train station is located at milepost 576.5 such that the “blowing sand” warning from 1954 corresponds to the location between Swansea and the northern portion of the Keeler Dunes. No mention of blowing sand or issues with the train line was found from before the 1940 to 1960 period. From this information it is apparent that the Southern Pacific Company did not feel that sand moving across the railroad line was a problem (or at least not sufficient for a warning on the time table) in 1931 and 1932 suggesting that sand deposition and transportation in the area increased in subsequent years thus necessitating the warning in 1954.

The District agrees that this is not direct evidence that the dunes were not present before 1954, however, given the preponderance of additional information from other investigations, it supports the overall conclusion made in the Preliminary Staff Report that the Keeler Dunes are a modern feature that formed following desiccation of Owens Lake.

[1] The narrow gauge line from Mina to Laws was abandoned in 1943 leaving only the Keeler Branch from Laws to Keeler.

The District states clearly in the Preliminary Staff Report and associated Technical Attachments that there were areally restricted vegetated dunes present along the historic and some of the Holocene shorelines in the Keeler area prior to the modern desiccation of Owens Lake. These dunes are distinct in character, extent, and age from the modern Keeler Dunes that require dust controls. The distinction between the modern emissive dunes and the shoreline and older dunes is discussed in detail in the final report by Lancaster and Bacon (2012a).

LADWP COMMENT

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 survey7 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.

[footnote omitted]

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.

DISTRICT RESPONSE

1. It is important to note that the term "tease out" used in the LADWP's comments and shown in quotes is not a phrase used by Stine (2012), and it should not be attributed to him. Similarly, the quoted term "extrapolate" used by the LADWP is used incorrectly in the opening sentence of LADWP's point #1.

   Broadly speaking, the goals of von Schmidt's cadastral survey were indeed threefold, as noted in Stine (2012), and as quoted therefrom by the LADWP. But as part of the second of those three goals--"to establish the township and range system..."--von Schmidt was obligated by contract to characterize the nature of the topography across which he ran his section lines. Thus, along each established section line the land surface had to be described as either "level," "rolling," "hilly," "hilly and broken," "steep and broken," "mountainous," etc. No claim is made in Stine (2012) that von Schmidt mapped or described individual landforms, or that he "provided a detailed description of geography and topography." It is his characterization of the land as level, rolling, etc. that is of significance and potential value in inferring the presence/absence of sand dunes on the Owens shorelands in the mid-1850s.

LADWP COMMENT

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.

DISTRICT RESPONSE

2. Regarding von Schmidt's land classifications being "too general" and only two-fold ("rolling" and "level"): It is incorrect to say that von Schmidt used only "rolling" and "level" to classify the land. As noted in the response to comment 1 above, von Schmidt and other surveyors employed numerous adjectives to describe the land, and von Schmidt did use those numerous terms at various points in his work on the east side of the Sierra (the adjectives are specified in the "Manual of Instructions to Regulate the Field Operations of Deputy Surveyors" of 1855, as well as in Field Operations Manuals of prior years). "Level" and "rolling" were the two terms that he used when describing the lands immediately adjacent to lakes, and so those are the two that figure prominently in Stine's (2012) report.

   Regarding LADWP's assertion that von Schmidt's land characterizations "were applied over too small an area of the landscape (only along township lines, spaced six miles apart)": This is incorrect. The lines along which von Schmidt provided a characterization of the land are not the township boundaries (which are indeed six miles apart), but rather the section boundaries, which are one mile apart (see the section in my report entitled "Primer on cadastral surveys"). Within an entire six-square-mile township there are 84 individual mile-long section lines for which there is a land characterization. This provides a grid far more intricate than that envisioned by the LADWP in their comments, and sufficiently intricate for inferring the presence/absence of historic dunes and other geomorphic features on the Owens shorelands.

LADWP COMMENT

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 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.

DISTRICT RESPONSE

3. The DWP seems to be of the impression that the north-Mono dune field is an area of continuous dunes. It is not. Over large areas of the field there are broad gaps between generations of dunes; and there are smaller areas within each generation where dunes are not present. Regarding dune generations, see below.

   It is incorrect to say that Stine (2012) "concluded that von Schmidt grouped dune formations in "rolling" but not "level" (and thus incorrect to state that there was "gross exaggeration and misapplication of the Von Schmidt Survey data"). What Stine (2012) did (and does) conclude is that where von Schmidt's section lines on the north-Mono shorelands transected dunes, and/or berms, and/or dissected alluvial fans, he generally characterized the ground surface as "rolling"; where his north-Mono section lines transected shorelands that lacked littoral embankments, dunes, and dissected alluvial fans, he generally characterized the ground surface as "level."

   Regarding the DWP's statement that "the Mono Lake dune field ... existed then [the mid-1850s], as now ...": True enough, as pointed out in Stine (2012). But as also stated in the report, there are important differences between the nature of the dune field that existed in the mid-1850s, and the nature of the dune field of today. To elaborate: There are three generations of dunes in what is informally called the north-Mono dunefield (Stine, 1987). The oldest and highest generation ("G-1") formed as Mono Lake withdrew from a highstand (the "Dechambeau Ranch Highstand," at elevation of 6,499 feet) approximately 3,800 years ago. The second oldest (and second highest) generation of dunes ("G-2") began to form approximately 300 years ago, as the lake withdrew from a somewhat lower highstand (the "Clover Ranch Highstand," at elevationof 6,456 feet). The youngest (and lakeward-most) generation of dunes ("G-3") began to form shortly after July of 1919, as the lake withdrew from its "Historic Highstand" of 6,428 feet.

While the G-3 dunes post-date the von Schmidt surveys (i.e. those dunes did not yet exist at the time of his work in the mid-1850s), the G-1 and G-2 dunes were present when he surveyed the north-Mono shorelands. Moreover, there are good reasons to conclude that those older generations of dunes have shifted in position only insignificantly (vis-à-vis the present study) since the time of the von Schmidt surveys. This is particularly true of the G-1 dunes, which are anchored by vegetation, and in many places blanketed by the 600-year-old Mono Craters tephra (indicating stability for at least the past six centuries). Their positions as seen on aerial photographs from the past decade appear to be virtually identical to those seen on the first aerial photos of the Mono Basin, taken in 1929. The G-2 dunes are somewhat less stable, with their leading (northeastern) edges having advanced a short distance (from a few tens, to a few hundreds, of feet) since 1929. This small amount of movement has no significant bearing on the relationship between von Schmidt's section lines and the topography over which they were surveyed.

The overall conclusion that can be drawn from the relationship between von Schmidt's section lines and the topography of the north-Mono dunefield is this: Where his lines crossed areas of dunes, and/or areas of berms, and/or dissected alluvial fans, von Schmidt by in large designated the land surface as "rolling;" where his lines crossed shorelands that lacked dunes, berms, and dissected alluvial fans, he generally designated the land surface as "level."

LADWP COMMENT

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:

DISTRICT RESPONSE

Recreating historic photos with modern views is an accepted and increasingly common and useful method of comparison of landscapes and their change over time (Boyer et. al., 2012; Klett, 2010; and Klett, 2011). Rephotography has been used by researchers across a wide variety of disciplines and applications ranging from art to science (Web et al., 2010; Margolis et al., 2011). And one of its consistent and successful uses in the natural sciences has been to illustrate and document landscape change. The technique of rephotography can effectively evaluate and document landscape change and has been employed as such since it was first used to do so in the late 1800's by glaciologists as a method to monitor glaciers. There are numerous contemporary examples (Web et al., 2010) that show the utility of and just how rephotography is invaluable in documenting and evaluating all types of landscape change ranging from subtle to prominent. And even though it has expanded to become a prominent method in documenting numerous types of landscape change, rephotography still relies on the same basic method.

The general methodology of rephotography is simple and relies on the fundamental principle of photography and the concept that every vantage point is unique. The general method has the following ordered steps: research for historic photographs, identify and relocate the unique vantage point of the historic photograph, place a camera at that point, match and repeat the original view, and take a rephotograph. The degree of precision of the rephotograph to accurately repeat the historic photograph, is directly related to ability to locate and reoccupy the unique historic vantage point.

The result is two photographs representing the same visual information of a view from two different points in time. The two photographs are on different ends of the interval of time that is between them. And when placed side by side, it invites examination and evaluation of the relationships of objects within the view, it invites questions of what is present, and what is absent, and what has changed. Rephotography is a technique that has an incredible ability to illustrate and document change (Klett, 2010).

A review of the history of photography shows that it is a medium of changing technology. But the basics of photography have not changed over the 150 plus years since camera systems were first introduced. Photography, in essence, is a form of visual communication that utilizes technology to capture and record light at a point in time. The process of photography is based on the science of optics, and the laws of physics and chemistry. And as such there is a fundamental principle of photography that remains constant no matter the technology: objects reflect light that is focused by a lens onto some sort of light sensitive material where the light is recorded at a specific moment in time. This constant principle that is utilized by different technologies to capture light and communicate visual information enables comparisons to be made between photographs made at different times or by different technologies. A photograph becomes a record of visual information at a specific point in time of light reflecting from objects of a particular view taken from a specific vantage point. This remains true no matter what technology is used to make the photograph. The visual information remains the same even if the manner in which it is represented changes. This is how it is possible to compare black and white photographs to color, or how it is possible to compare a photograph made from a negative with a primitive pin hole camera to one made with a more contemporary digital camera.

The historic photos and their recreations found in the Preliminary Staff Report and the associated Technical Attachment (Attachment B) were presented to demonstrate the change in the area of the Keeler Dunes from the time of the original photo to the present. Due to the limitations of presenting the photos on paper or on a pdf page, the readers were encouraged to view the photos in higher resolution on a computer for their own interpretation of the changes over time. The labels added onto the photos in the Preliminary Staff Report were provided to assist the reader in the discussion in the text of the report.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The LADWP is correct that the dunes along the historic shoreline appear to be similar from the pre- 1920 photo to the modern photo. The historic shoreline dunes in this portion of the lake remain largely unchanged in form and appearance. However, even considering the lower resolution of the historic photo in comparison with the modern photo, the change in the overall condition of the alluvial fan above the lake and shoreline dunes is clearly evident. The labels added to the photos in the Preliminary Staff Report are not misleading and accurately indicate the conditions visible on the photos.

LADWP COMMENT

> 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."

DISTRICT RESPONSE

The label of "active" on the re-photos was not inferred but made based on information collected on the ground at the time of the photo. The area indicated in the Preliminary Staff Report as showing "active Keeler Dunes" point to the southeastern front of the Keeler Dunes that is migrating toward the community of Keeler. This dune front is not visible in the 1940 historic photograph. Both photos show the vegetated stable older dunes in the mid-ground.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The LADWP is correct in their statements concerning difference in the landscape shown in Figure 4.2-4 of the Preliminary Staff Report. The photo taken in July 2012 clearly shows that there was a significant change on the alluvial fan with the creation of an extensive sand deposit since 1953 and a corresponding decrease in vegetation. Although the photos by themselves do not provide information on the cause of the change, taken along with the results from other investigations it is clear that the change occurred due to expansion and migration of the Keeler sand deposit over time. These changes are discussed in detail in Lancaster (2012).

LADWP COMMENT

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.

DISTRICT RESPONSE

There were two images taken in 1953 from the same vantage point as the train traveled into Keeler. Figure 4.2-4 in the Preliminary Staff Report provides one of these two images and its re-photo view from July 2012. Figure 4.2-5 of the staff report has taken both of the 1953 historic photos and made a panorama of the photographed view. This panorama was then compared to the July 2012 view from the same location. The photos taken in July 2012 clearly show that there was a significant change on the alluvial fan with the creation of an extensive sand deposit since 1953 and a corresponding decrease in vegetation. Although the photos by themselves do not provide information on the cause of the change, taken along with the results from other investigations it is clear that the change occurred due to expansion and migration of the Keeler sand deposit over time. These changes are discussed in detail in Lancaster (2012).

LADWP COMMENT

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:

DISTRICT RESPONSE

The analysis of air photos and satellite imagery gathered over a period of 66 years clearly show that the landscape in the location where the Keeler Dunes now lie has changed significantly over the historic time period of study. The expansion of the Keeler Dunes in historic times is well documented not only by use of air photos and imagery but also by on the ground photos and observations. District responses to each comment made by the LADWP are provided below.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

1. The focus of the investigations discussed above was on documenting the changes in the Keeler dunefield since the 1940s – hence the information and the extracts from aerial photographs and satellite images presented were directed to this purpose. Determining the cause of these changes was a secondary objective. However, the District recognizes the importance of determining the sand transport pathways from the delta and/or lake bed to the dunes and provide a summary of our assessment of transport pathways below. A more detailed evaluation is provided in the final report by Lancaster and Bacon (2012).

   The variable quality and coverage of the images used present difficulties in interpretation and delineation of the exact pathway by which sand was transported to the dunefield prior to the construction of the dust control measures on the bed of Owens Lake. The wind regime of the area also involves two main wind directions NW and SSE-SSW, so that sand may be transported to the dunes by winds from different directions (see Figure 4.4-1 under response to comment 2, below).

Lancaster and Bacon (2012b) assess the sand transport pathways from the Owens River delta. From this it appears that the major transport pathway for sand from the Owens River delta is from NW to SE and involves the area of the North Sand Sheet, which extends for some 5 km (3 miles) southeast from the southern part of the delta. The upwind (NW) margin of the emissive portion of the sand sheet varies considerably from year to year. The active sand sheet was very large in 1970-1975 and 1982, following years of significant flooding in the Owens River. Although the quality of the images is poor, it appears that the sand sheet was also very extensive in the period 1947-1954. While there is a component of transportation from the North Sand Sheet into the dunes, it appears that the primary transport pathway to the Keeler Dunes lies to the north of the North Sand Sheet based upon a projection of the sand transport vector. This area (also referred to as the Lizard Tail source area) is marked by highly variable sand cover, based on examination of aerial photographs for different dates. Sand cover was relatively high in 1954, 1965, and 1982. Varying exposure of playa sediments suggests that this area may be a zone of deflation from the lake plain developed prior to 1872. This is a current area of active sand transport, as indicated by sand trap data from the period 2006 to 2012.

The primary zone of sand input to the Keeler Dunes was located west of the northern part of the dunefield and extended for a distance of approximately 1.5 km (1 mile) from NW to SE. This zone is north of the extent of the shoreline dune associated with the historic shoreline (see geomorphic map in Bacon and Lancaster, 2012) and is devoid of phreatophytic vegetation, thus presenting an unobstructed pathway for sand transport from the lake bed to the dunes.

LADWP COMMENT

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.

[footnote omitted]

DISTRICT RESPONSE

2. The purpose of presenting the wind data record from the A-Tower in Section 4.3 of the Preliminary Staff Report was to illustrate the sand-moving wind regime of the NW part of Owens Lake. This pattern is best shown by the data from the A-Tower site. Note that the analysis using the A-Tower data presented in the Preliminary Staff Report are for sand transport potential – not winds. However, in the surface change analysis from the sand flux data for monitoring sites on the North Sand Sheet and the Keeler Dunes (see Section 4.6 of the Final Staff Report and Attachment F) for the 2000-2001 and 2009-2011 periods used wind data from the closest meteorological site to calculate the net sand transport across the area and the amount of surface erosion and deposition.

   The wind rose for both the District's Keeler meteorological and the A-Tower sites are provided here as Figure 4.4-1. The wind pattern at Keeler and the A-tower are generally similar, however, the winds on the lake bed (A-Tower) are noticeable stronger and have more pronounced directional components than those measured in Keeler. Both sites have two main general sectors from which the winds blow, from the northwest and from the south-southeast. This is particularly evident for high winds (wind speed ≥ 9 m/s, shown as orange and red on the wind roses) needed for sand transport. Winds from the northeast and the west sectors are infrequent.

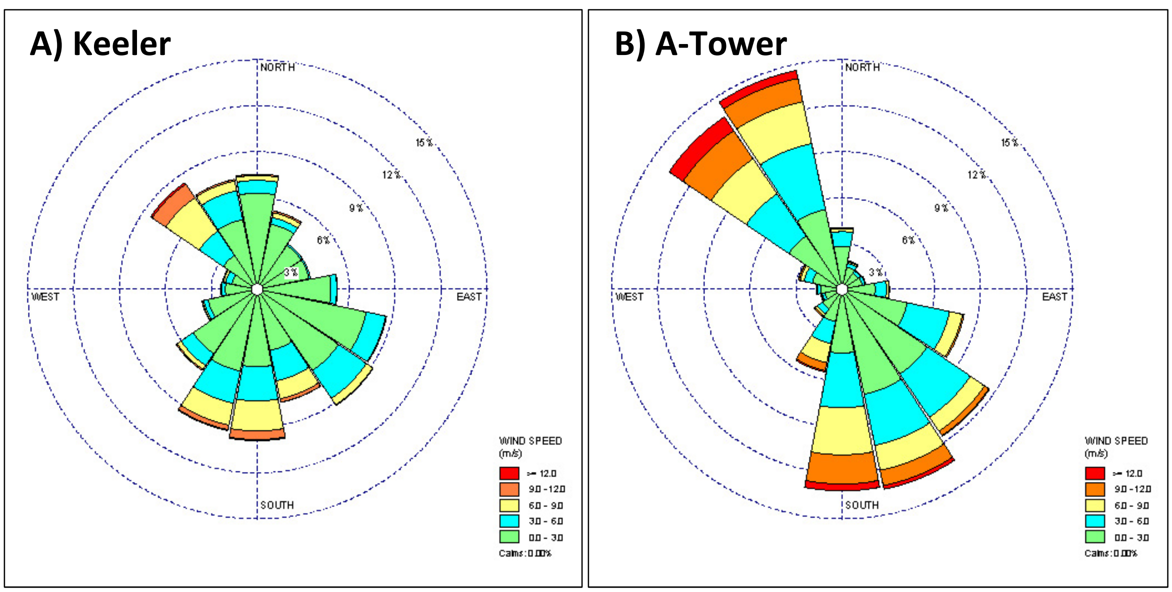

Figure 4.4-1. Wind roses from A) Keeler meteorological station and B) A-Tower from August 1990 to October 2011. Date measured at a height of 10-meters.

Only three of the District's monitoring sites within the Keeler Dunes collect wind data. These sites were installed in January 2011 such that the data record is only 20 months as compared to over 20 years for the A-Tower and Keeler sites. The three sites with wind data in the Keeler Dune deposit are not standard in that the wind data are measured at a height of either 2 or 4 meters above the surface rather than the standard 10 meters. The wind roses for these sites are provided in Figure 4.4-2. Notice that the wind pattern distribution shows a northeast to east downslope component from the Inyo Mountains during low wind speeds. The dominant wind directions during moderate to high wind events (those needed for sand transport) is from the same dominant setors as that observed from the A-Tower and Keeler. These data were used in the surface change analysis of Ono et. al (2012).

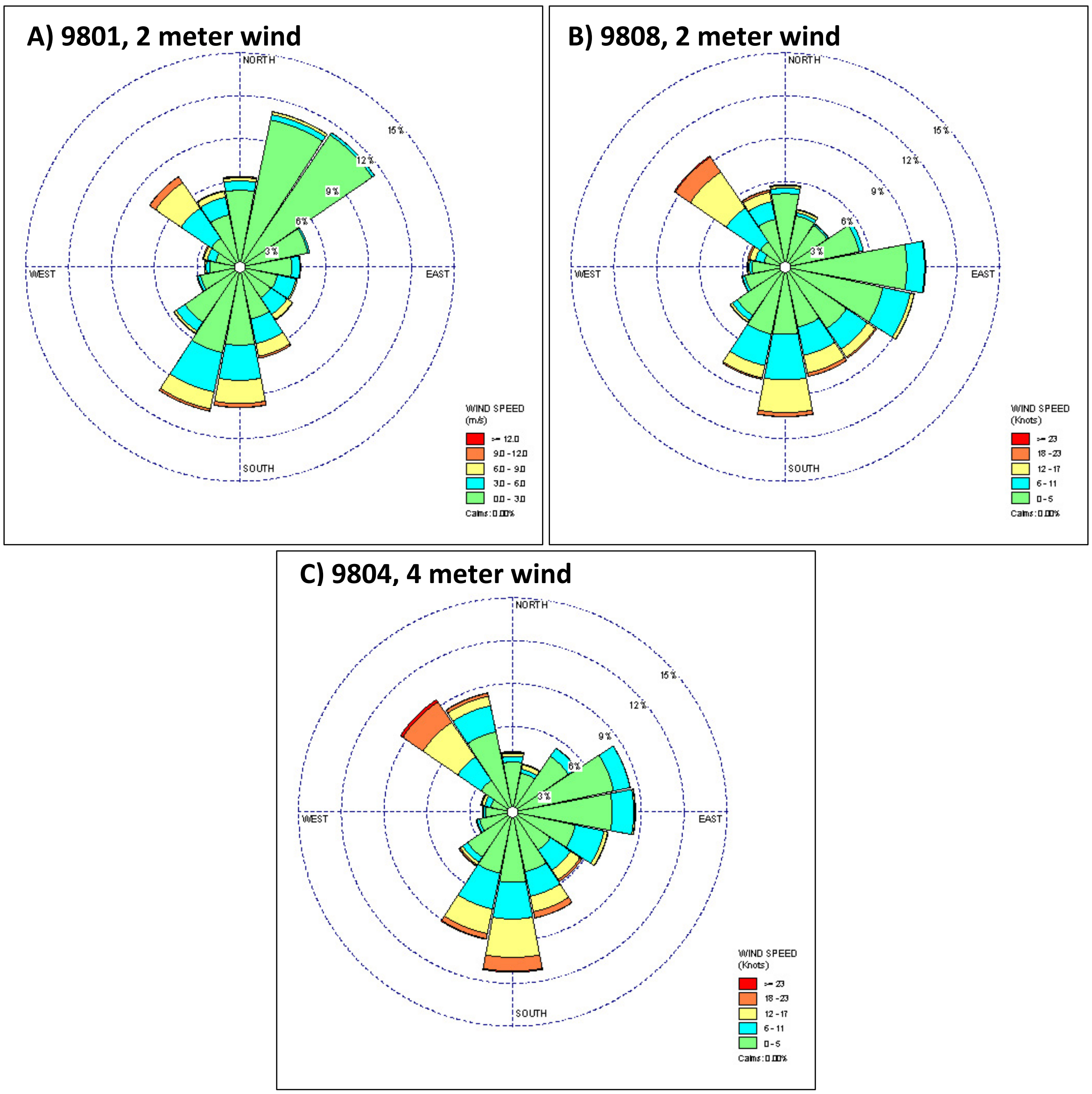

Figure 4.4-2: Wind rose plots from the District's monitoring sites in the Keeler Dune deposit from January 2011 to September 2012.

LADWP COMMENT

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 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.

DISTRICT RESPONSE

3. The evidence presented in support of an addition of sand from outside of the dunefield is in the estimate of dunefield area (Figure 4.3-6a of the Preliminary Staff Report and Figure 10a from Lancaster, 2012) and sand volume, which increased from 0.1 sq. miles in 1954 to 0.26 sq. miles in 1975, and 0.32 sq. miles in 1998. The estimated sand volume at these times was 215,426; 521,558, and 647,954 m^3 respectively. This represents a more than doubling of area and sand volume between 1954 and 1975.

   The possible alternatives to an external source of sand suggested above are not, in our opinion, physically reasonable. The LADWP suggests four possibilities as sources of sand for the Keeler Dunes. Each one of these is briefly discussed here:

   (1) deflation of the existing dunes – The dunes existing prior to 1954 were small in area (0.1 sq miles) and volume (215,426 m^3) and could not have provided sufficient material for the observed increase in dunefield area and volume. If they were deflated to provide sand for additional areas of dunes, then they should have decreased in area or disappeared, which did not occur until the 21st century.

   (2) deposits of flash floods - The observed flash flood sediments deposited in and around the Keeler Dunefield are primarily composed of material of silt size – which does not form dunes. The total area of the silt deposit sediments is approximately 30,000m^2 – and most of the silt deposits are less than 10 cm thick, so the volume of material deposited (3000 m^3) is orders of magnitude less than that required to produce the observed expansion in dunefield area and volume.

(3) potential changes in the internal moisture content of the Keeler Dunes - No part of the Keeler Dunes is affected directly by the local water table, so any internal moisture is likely derived from rainfall, which may have an effect on sand availability and mobility as a result of changes in vegetation cover. Examination of the available aerial photographs does not show any evidence for changes in vegetation cover over the period of record, except for destruction of perennial greasewood plants in some areas.

(4) various disturbance mechanisms that could have exposed the soil surfaces within the Keeler Dune field to wind and water erosion - There is no evidence for significant disturbance of the area of the Keeler Dunes by any natural or anthropogenic activity such as off road vehicle activity or grazing in the period of record.

LADWP COMMENT

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.

DISTRICT RESPONSE

4. The results of mineralogical analyses on sand originating from the Inyo Mountains (Keeler Fan) are compared to the composition of the sands found in the Keeler Dunes, Swansea Dunes, Owens Lake bed and Owens River in Figure 4.4-3, below, and Lancaster et. al. (2012). The distinct mineralogical composition of the sand from the Inyo Mountains is clearly evident. The Inyo derived material has a much higher proportion of quartz and calcite and a corresponding lower proportion of feldspar supporting the position that the majority of sand in the Keeler Dunes is derived from the Owens River, with a very minor addition of material from the Inyo Mountains.

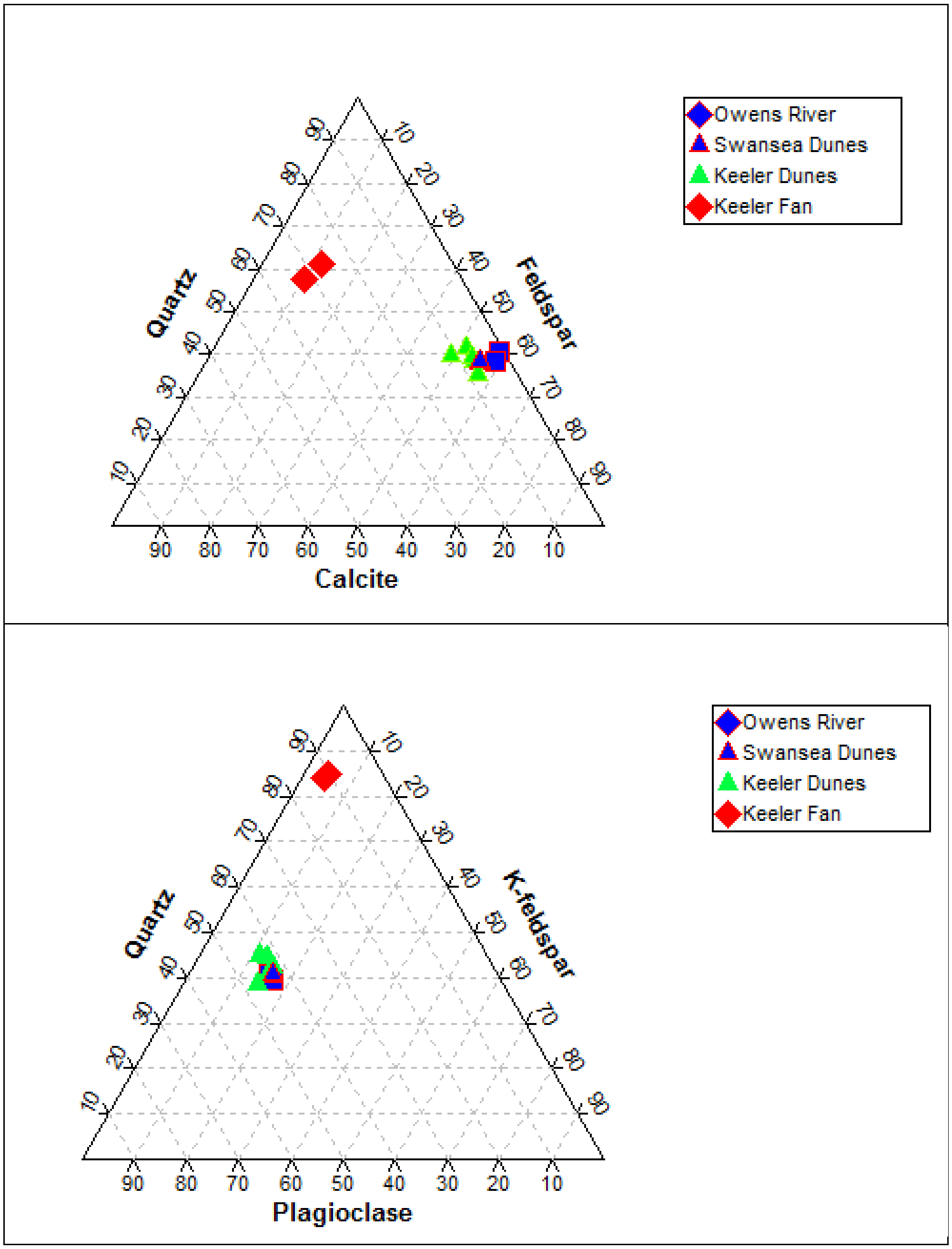

Figure 4.4-3: Ternary diagrams showing proportions of Quartz, K-feldspar and Plagioclase and Calcite in analyzed samples. (from Lancaster et. al., 2012)

LADWP COMMENT

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.

DISTRICT RESPONSE

The potential contribution of material from the Inyo Mountains is documented through additional sampling as documented in the revised report on sand mineralogy (Lancaster et. al., 2012). Figure 4.4-3 (above) illustrates the contrast in composition between sand from active washes on the Keeler Fan and sand from the Keeler and Swansea dunes, as well as the Owens River. The overall similarity in bulk mineralogy between the samples from the Keeler and Swansea dunes, as well as the Owens River area strongly indicates that the majority of sand in the Keeler Dunefield is derived from the Owens River, with a very minor addition of material from the Inyo Mountains.

The relative proportions of quartz, K-feldspar and plagioclase in the sands from the Owens River, as well as the Keeler and Swansea dunes indicates that they are derived from a granodiorite source rock – as found in the Sierra Nevada (Figure 4.4-4). By contrast, the sand from the Keeler Fan washes is quite different with dominant calcite derived from Early Permian and Pennsylvanian-age marine sedimentary rocks (e.g. Lone Pine Formation; Keeler Canyon Formation) in the Inyo Mountains.

It should be noted that Kattelmann (1992) discusses the frequency of flood events from the canyons draining the Sierra Nevada but makes no statements concerning floods from the Inyo Mountains and, furthermore, Kattelmann states that the annual average flood timing is 5 years and not 3 as stated by the DWP. Lastly, there is no support or basis for the statement by the DWP that the Keeler alluvial fan is the "second largest in the Owens Valley".

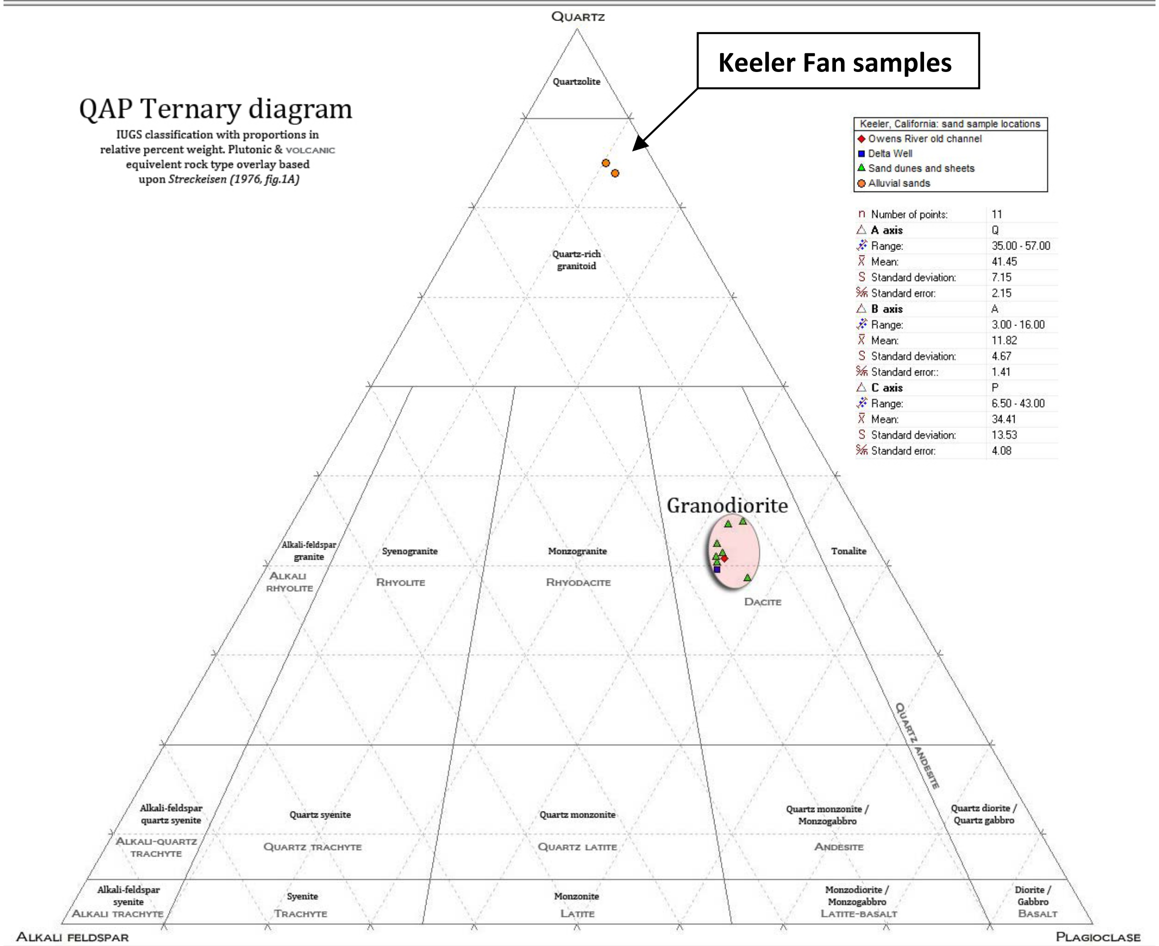

Figure 4.4-4: Ternary diagram to show relationship between collected samples and composition of source rocks. (from Lancaster et.al., 2012)

LADWP COMMENT

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.

DISTRICT RESPONSE

5. The dominant sand transporting winds in the vicinity of the Keeler Dunes are from the northwest such that it follows that the sand source for the aeolian Keeler Dunes deposit must lie in that direction upwind of the dunes. The observed timing of the development of the Keeler Dunes deposit and the historic growth of the deposit requires an import of material into the area. It is not possible to form the dunes in any other manner. The mineral composition of the sand within the Keeler Dunes is such that a source from the Inyo Mountains via floods is impossible. There is no other pathway for water to transport the material into the dune site. A detailed evaluation of potential sand sources for the dunes is provided in the report by Lancaster and Bacon (2012b).

LADWP COMMENT

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.

DISTRICT RESPONSE

6. This assertion is based on a projection of sand transport vectors from the dunes towards the most probable source area. See also comments above on transport pathways. Mineralogical data shows clearly that the sand comprising the Keeler Dunes is identical to that of the Owens River delta and therefore was likely derived from this source directly or indirectly.

LADWP COMMENT

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.

DISTRICT RESPONSE

7. The 104° direction is calculated from *potential* sand transport data – there is no claim that it is the dominant direction – which is from the NW based on both wind data and the orientation of bedforms. The resultant transport direction in the area of the Keeler Dunes based on analysis of sand flux data is discussed in Ono et. al. (2012). From this analysis, net movement of sand within the dunes is toward the southeast.

LADWP COMMENT

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.

DISTRICT RESPONSE

8. Analysis of aerial photographs and satellite images from 12 dates show that the sand covering the roadway was likely deposited there by wind and that the sand was actively being transported through this area. Evidence includes, but is not limited to, presence of sand drifts behind plants and topographic obstacles; coverage of the road by migrating dunes; continuity of sand streaks and sheets with dune areas downwind.

   Reduction of sand covering the highway could not be determined because it was already largely free of sand after 2000, as stated above. It should be noted that the two flash flood events in Keeler (not referred to by Kattelmann (1992)) flowed to the south of the Keeler Dunefield.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

9. Attachment C of the Preliminary Staff Report (Lancaster, 2012) is dated March 9, 2012. Reports on the geomorphology and geology of the area (dated August 31, 2012 and September 10, 2012) were provided as Technical Attachments for the Preliminary Staff Report. The mention to the "companion investigation(s)" in Lancaster (2012) refers to these two reports, completed 5 to 6 months after the March, 2012 Lancaster (2012) report. The geomorphology and geology reports were presented in draft form with the Preliminary Staff Report pending receipt of a few outstanding lab results as well as information from the LADWP on the work that they have conducted in the dunes. Without receipt of data or information from the LADWP and with the lab results complete, final versions of these reports are now available and provided with the Final Staff Report.

LADWP COMMENT

> 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."

DISTRICT RESPONSE

10. The "thinning" is documented by the increasing area of exposed flood silt deposits and alluvial fan sediments observed on progressively more recent images of the Keeler Dunes. In addition, field observations of exposed root systems and erosional pedestals document the erosion of the sand sheet at the northern end of the dune field. The "thinning" is the direct result of an unsaturated and therefore erosional wind flow encountering the sand sheet and dunes, and eroding their western margins.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

11. Aerial photographs from 1947 and 1954 show such a "continuous sand sheet". These photographs were provided in Technical Attachment C to the Preliminary Staff Report and are available in Lancaster (2012).

LADWP COMMENT

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.

DISTRICT RESPONSE

12. See response to comment 10 above. Erosion of the margins of the dunefield is reflected in the increasing area of exposed flood silt deposits and alluvial fan sediments observed on progressively more recent images of the Keeler Dunes. In addition, field observations of exposed root systems and erosional pedestals document the erosion of the sand sheet at the northern end of the dune field.

LADWP COMMENT

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.

DISTRICT RESPONSE

13. Although sand derived by erosion of older aeolian deposits (i.e. termed "locally derived sand" by the LADWP) may have contributed to the growth of Keeler dunes in historic times; it is difficult to assess their contribution, because there is no clear evidence to indicate the past extent of these deposits. In most cases, these older sands are preserved below flood silt deposits and therefore have not contributed to the dune field growth.

LADWP COMMENT

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.

DISTRICT RESPONSE

14. See page 17 and 18 as well as Fig 10 of Attachment C (Lancaster, 2012) to the Preliminary Staff Report for a discussion of trends in dunefield morphology and morphometry. It is well-accepted that an exponential increase in a variable indicates that it is not in an equilibrium state. Ewing et. al. (2006, 2010) show that the number of dune ridges in an area reaches an equilibrium state as smaller ridges merge with larger ones to create an organized pattern

LADWP COMMENT

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.

DISTRICT RESPONSE

15. See the revised Technical Attachment E (Lancaster and Bacon, 2012a) to the Final Staff Report on geologic context and Holocene history of Keeler Dunes.

LADWP COMMENT

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.

DISTRICT RESPONSE

16. The statement made in the report concerning the low vegetation cover within the active dunes is correct. In areas where the active Keeler Dunes have moved across a vegetated area, the resulting destruction and loss of plant cover is clearly evident. This is discussed in more detail in Technical Attachment F by HydroBio to Preliminary Staff Report.

LADWP COMMENT

17. Attachment C, Page 25, Conclusions: Lancaster (2012) states that: "…in prediversion 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).

DISTRICT RESPONSE

17. Based on the detailed geomorphic mapping, there are geomorphic shoreline features at elevations of 1096, 1099, 1101, and 1103 meters (3597, 3606, 3612, and 3619 feet, respectively). These features attest to significant periods of time when the lake was at a level to submerge the area of the existing Owens River delta. The final reports on the geomorphic mapping and Holocene stratigraphy (Bacon and Lancaster, 2012 and Lancaster and Bacon, 2012a) provide further information on the age of these shorelines and their relationship to the Keeler Dunes. These reports are available as Technical Attachments to the Final Staff Report.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

18. There is no geologic evidence for the presence of widespread migrating sand deposits similar to the modern Keeler Dunes associated with low stands of pre-historic Owens Lake. The older dune deposits mapped in the Keeler area and along the northern portion of the lake basin are associated with geomorphic shoreline features.

LADWP COMMENT

> **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.

DISTRICT RESPONSE

The LADWP is incorrect that the information in the Preliminary Staff Report does not support the conclusion made by the District that the Keeler Dunes formed and expanded in recent times following the desiccation of Owens Lake from material that moved from the exposed lake bed. Detailed scientific investigation on the timing and growth of the dunes, geomorphic mapping relationships, the age and composition of the dune sands, as well as the sand transportation direction analysis all support this conclusion (Lancaster (2012), Bacon and Lancaster (2012), Lancaster and Bacon (2012), Lancaster and Holder (2012), and Ono et. al. (2012)).

LADWP COMMENT

> 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).
>
> [footnote omitted]

DISTRICT RESPONSE

1. The Desert Research Institute worked on two companion projects investigating the geology and geomorphology of the Keeler Dunes. Both of these the projects are presented as Technical Attachments to the Preliminary Staff Report. The results of the geomorphic mapping are provided in Attachment D of the Preliminary Staff Report. The geologic interpretation of that mapping along with the results of the stratigraphy and chronology work are provided in Attachment E of the Preliminary Staff Report.

   Both of these reports were identified as "drafts" in the Preliminary Staff Report for two reasons. The first reason was that the results from some of the numerical age dating analyses were pending at the issuing of the reports. The second reason was that the District anticipated receiving data and information on the work that the LADWP has conducted in the dunes in their comments on the Preliminary Staff Report. Now that the age dating analyses have been completed and the District did not receive any data or results from the LADWP's investigations in the dunes, the two reports (Bacon and Lancaster, 2012 and Lancaster and Bacon, 2012a) have been finalized and are presented as Technical Attachments to the Final Staff Report. A discussion of both the stratigraphic context and potential source areas of sand for the Keeler Dunes is provided in the final report by Lancaster and Bacon (2012a) and in Lancaster and Bacon (2012b).

LADWP COMMENT

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. 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.

DISTRICT RESPONSE

2a. The origin of surface sediments in the area mapped by Bacon and Lancaster (2012) as Delta Bar and Plain deposits north of Swansea Bay/Lizard Tail are argued by the City as being misidentified. The LADWP is incorrect in this argument for the following reasons: the geomorphic features in question are associated with deltaic sedimentation associated with an expansive early Holocene lake based documented early Holocene lake levels, fluvial-lacustrine stratigraphy exposed in natural and road cut exposures, as well as cross-cutting relations with younger fluvial and alluvial landforms. Surface characteristics on Delta Plain surfaces also suggest relative stability by having weakly developed varnish coatings on gravel clasts, as well as showing cross-cutting relations (i.e., erosion) with younger deltaic and fluvial features related to lowering lake levels and base levels. The Delta Bar and Plain surfaces in question are also crossed by several small alluvial channels along the eastern margin of the units, as well as truncated to the east by erosion from younger alluvial fans constrained to 3500 to 730 years old, which further supports that both surfaces have had long-term surface stability since their deposition. It is noted that the large-scale, lobate- and irregular shaped Delta Bar features composed of granules to pebbles and sand do not extend across and are not present on alluvial fan units to the east, further supporting primary deposition within a deltaic depositional environment and not associated with alluvial or eolian primary depositional processes. Furthermore, the Delta Bar features also are nearly equally spaced and have formed along topographic contour, as would be expected on a gently sloping delta front. These Delta Bar features also have a morphology that is similar to the smaller late Holocene deltaic bar features that merge with linear shoreline features that were formed by lower and smaller lakes.

Due to the completion of numerical age dating analyses, the final version of the report (Lancaster and Bacon, 2012a) includes a discussion of stratigraphic context of the sand deposits in the Keeler Dunes. The potential source areas of sand for the Keeler Dunes are discussed in Lancaster and Bacon (2012b).

2b. Due to the completion of numerical age dating analyses on aeolian deposits sampled within northern Swansea Bay, the final report (Lancaster and Bacon, 2012a) includes a discussion of the stratigraphic context of the Keeler Dunes. The potential source areas of sand for the Keeler Dunes from the Swansea Bay/Lizard Tail area are discussed in Lancaster and Bacon, (2012b).

LADWP COMMENT

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).

DISTRICT RESPONSE

3a,b. The LADWP comments that the geomorphic map of the Keeler dunefield failed to distinguish “Older” and “Younger” Keeler Dune deposits, and by doing so, suggests insufficient analysis of “Older” deposits. They also suggest that “Older” and “Younger” Keeler Dune deposits should have been partitioned into additional map units.

With respect to the spatial distribution and characteristics of the “Younger Keeler Dune deposits”, Bacon and Lancaster (2012) states:

> *“The Keeler dunefield includes areas of currently active and highly mobile dunes…..” (Bacon and Lancaster, 2012, page 1).*

These areas are represented on the geomorphic map of the Keeler dunefield by eolian active dune [Qe(d)] and eolian active sand sheet [Qe(ss)] map units. In regards to the “Older Keeler Dune deposits”, these deposits are represented by the remaining two eolian surface units shown on the map including eolian sand sheet with coppice dunes [Qe(ssc)] (including plant mounds) and eolian vegetated dune [Qe(vd)] map units. The subsurface “historic and pre-historic” dune deposits that are exposed within vertical exposures and described by Lancaster and Bacon (2012a) were not shown on the geomorphic map of the Keeler dunefield because these deposits are buried by younger alluvial flood deposit (Qfd) map units and/or surficial eolian units; therefore they are not exposed at the surface and not mapped. These subsurface historic and pre-historic deposits or “Older Dune deposits” are referred to in the Alluvial fan, flood deposits (Qfd) unit description section of Bacon and Lancaster (2012) that states:

> *“The Qfd unit is prevalent within the Keeler dunefield where it commonly is exposed as isolated and irregular patches of fine-grained deposits reflecting preexisting microtopography or as isolated pedestals that cap eolian sand deposits to form wind-erosional features (i.e., yardangs) (Figure A-1).” (Bacon and Lancaster, 2012, page A-2).*

A discussion of the stratigraphic context and origin of the active Keeler dunefield is provided in the Final report by Lancaster and Bacon (2012a). This report presents the results of the previously pending numerical age date analysis and a discussion on the “historic and pre-historic” eolian deposits and alluvial fan flood deposits within the Keeler dunefield area.

LADWP COMMENT

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

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.

DISTRICT RESPONSE

3c. Due to the completion of numerical age dating analyses on subsurface eolian and flood deposits within the Keeler dunefield area, the final report (Lancaster and Bacon, 2012a) includes a discussion of the stratigraphic context and origin of the active Keeler dunefield.

LADWP COMMENT

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

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

DISTRICT RESPONSE

3d. The upper elevation of the lacustrine lake plain [Ql9(p)] map unit, dated 1872 A.D., in question by the LADWP, was delineated based on the spatial distribution of shoreline features identified on high resolution aerial photography and LiDAR datasets and not on a constraining elevation.

Within the area of the Keeler dunefield, there are no prominent and well-developed shoreline features at or below an elevation of 3,597 feet (1096 m), however, there are prominent and well-developed shoreline features at an elevation of 3,600 feet (1097 m) consisting mostly of erosional, wave-cut notches developed on relatively small-scale shoreline dunes (i.e., eolian vegetated dune [Qe(vd)] map unit). There are also clear differences in the surface morphology between the adjoining 1872 AD lake plain [Ql9(p)] map unit and older lake plain [Ql7(p)] map unit with an age of 730 cal yr B.P. to 1872 AD. The younger Ql9(p) map unit exhibits smooth surface morphologies from recent wave-modification from 1872 AD lake levels compared to the surface of the older Ql7(p) map unit that has rough surface morphologies from post-lacustrine alluvial erosional and depositional processes, as well as localized eolian deposition of thin sand sheets. The older Ql7(p) map unit also has extensive anthropogenic surface disturbance above an elevation of about 3,600 feet (1097 m), whereas there is minimal anthropogenic surface disturbance from the turn of the century below this elevation indicating that historic anthropogenic activities were principally concentrated above the former margin of the 1872 AD lake level at about 3,600 feet (1097 m) in the vicinity of Keeler.

The 3 foot (1 m) difference in elevation between the 3,597 feet (1096 m) "project" 1872 AD lake level of Gale (1915) and the 3,600 feet (1097 m) geomorphic shoreline elevation documented near Keeler in Bacon and Lancaster (2012) can be explained by faulting and subsidence from the 1872 AD Owens Valley earthquake. Bacon and Lancaster (2012) states:

> *"During the 1872 earthquake, vertical displacements occurred beneath Owens Lake that created a seismic seiche (tsunami) as well as laterally shifted the position of the eastern shoreline of the lake hundreds of yards (meters) to the west, raising the western shoreline (lake level) approximately 3 ft (1 m) in elevation (Smoot et al., 2000) and stranding the former shoreline. Eastside-down normal fault displacements of about 3 ft (1 m) coupled with the natural variability in the height of constructional shoreline features in Owens Lake basin of about 3-4 ft (1-1.5 m) have produced a range in elevation of shoreline features associated with the same lake level." (Bacon and Lancaster, 2012, page 5).*

The map boundary between the Ql9(p) and Ql7(p) units delineates the position of the shoreline near Keeler prior to the Owens Valley earthquake. This former shoreline was stranded approximately 3 feet (1 m) above a new lake level created soon after about 2:30 AM on March 26, 1872 AD during the seismic event. Furthermore, within the geomorphic map area, the 3,597 feet (1096 m) elevation contour is located up to around 200 feet west (basinward) of the 3,600 feet (1097 m) geomorphic shoreline elevation along broad and relatively flat surfaces. The approximate 200 feet lateral shift of the coseismically created shoreline to the west is a similar distance to the amount of dock that was extended out into deeper water at Swansea after the earthquake.

LADWP COMMENT

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

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.

DISTRICT RESPONSE

3e. The geomorphic map of the Keeler dunefield is properly titled because it is centered on the Keeler dunefield and the majority of the area consists of eolian geomorphic map units, in addition to other alluvial and lacustrine geomorphic features that comprise the map area.

LADWP COMMENT

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

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.

DISTRICT RESPONSE

3f. A cross-section with exaggerated vertical scale across geomorphic features within the Keeler dunefield is presented in the Final report of Lancaster and Bacon (2012a).

LADWP COMMENT

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.

DISTRICT RESPONSE

The detailed mapping of the northern shoreline areas and the Keeler Dunes is critical in providing a geomorphic setting for the area. The cross-cutting relationships identified in the mapping provide important controls on the timing and nature of the development of the identified units. This work in combination with the results of the geologic evaluation (Lancaster and Bacon, 2012a) provides a complete picture of the stratigraphy and age of the Keeler Dunes.

LADWP COMMENT

> **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.

DISTRICT RESPONSE

1. The results of the OSL analyses that were pending at the time of the release of the Preliminary Staff Report are now available and provided in the Final Staff Report and the associated Technical Attachment E (Lancaster and Bacon, 2012a). The LADWP has almost a month between the release of the Final Staff Report and the Public Hearing to review the results and provide comments for the record.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

2. The material requested by the LADWP on the radiocarbon dating is provided in Technical Attachment E to the Final Staff Report (Lancaster and Bacon, 2012a).

LADWP COMMENT

> 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.

DISTRICT RESPONSE

3. In the discussion on the Age Date Sampling in Section 4.5 of the Preliminary Staff there is no mention of the source of the dated sands much less an inference that the material came from the bed of Owens Lake. However, this assertion is made in other portions of the Staff Report based on a projection of sand transport vectors from the dunes towards the most probable source area. See also discussion, above, on transport pathways and sand sources in Lancaster and Bacon (2012b). Mineralogical data shows clearly that the sand comprising the Keeler Dunes is identical to that of the Owens River delta.

   A discussion of the stratigraphic context and origin of the active Keeler Dunes is provided in the final report by Lancaster and Bacon (2012a). This report presents the results of the numerical age date analyses and a discussion on the historic and pre-historic aeolian deposits and alluvial fan flood deposits within the Keeler Dunes area.

   The results of the OSL analyses clearly indicate that there was aeolian sand deposits present in the area prior to the modern desiccation of Owens Lake. However, based on the geomorphic mapping and stratigraphic work, the active Keeler Dune deposit lies unconformably over the sub-surface pre-historic aeolian deposit.

LADWP COMMENT

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.

DISTRICT RESPONSE

4. The LADWP provides no basis or reference to support their statement that OSL ages <300 yr are inaccurate. Theoretical and experimental data show that the SAR (Single aliquot regeneration) procedures, used to provide age estimates for the Keeler Dunes samples, provide high precision and reproducibility in a wide variety of environments (Duller, 2004).

LADWP COMMENT

> 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.

DISTRICT RESPONSE

5. The LADWP agreed to work collaboratively with the District on the Keeler Dunes projects in the 2006 Settlement Agreement. As such, the District and LADWP worked together to design the monitoring network in the dunes. The District has also informed and sought input from the LADWP on the work proposed and conducted in the dunes during annual budget proposals from 2008 to 2011. Presentations on the District's work in the dunes were given at collaborative meetings held between the LADWP and the District with the Expert Panel as well as at multiple public meetings at which the LADWP participated. Another meeting was held with the LADWP on October 28, 2012 (via video conference) to specifically discuss the work in the Keeler Dunes. At this meeting there was no mention by the LADWP of their concern regarding District activities in the dunes. The LADWP was made aware of the work being conducted by the District and no request was made by the LADWP for obtaining specific permission for the known or proposed work being done.

   The first time the District became aware that the LADWP had changed from working collaboratively with the District on the project and were now concerned about scientific activities conducted on their property was late 2011 and early 2012. Subsequent to this, the District relocated one monitoring site that was just within LADWP lands (site 7223), removed another (site 9815) that was located on their lands and has refrained from conducting investigations and sample collection on their property.

   Interesting to note that - the District made a request to the LADWP in June 2012 for permission to access locations on their property to collect samples for additional OSL numerical age dating analyses. Over 5 months later and after several follow-up requests, the District is still waiting for permission for the sample collection.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

6. The majority of the fine-grained deposits are dominantly composed of *silt-sized* material such that the particle size is incorrect for the development of *sand* dunes.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

7. The results of mineralogical analyses on sand originating from the Inyo Mountains (Keeler Fan) are compared to the composition of the sands found in the Keeler Dunes, Swansea Dunes, Owens Lake bed and Owens River in Figures 4.4-3 and 4.4-4 (above) and Lancaster et. al. (2012). The distinct mineralogical composition of the sand from the Inyo Mountains is clearly evident. The Inyo derived material has a much higher proportion of quartz and calcite and a corresponding lower proportion of feldspar supporting the District’s position that the majority of sand in the Keeler Dunes is derived from the Owens River, with a very minor addition of material from the Inyo Mountains.

   The relative proportions of quartz, K-feldspar and plagioclase in the sands from the Owens River, as well as the Keeler and Swansea dunes indicates that they are derived from a granodiorite source rock – as found in the Sierra Nevada (see Figure 4.4-4, above). By contrast, the sand from the Keeler Fan washes is quite different with dominant calcite derived from Early Permian and Pennsylvanian-age marine sedimentary rocks (e.g. Lone Pine Formation; Keeler Canyon Formation) in the Inyo Mountains.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

8. A discussion on the development of the historic and pre-historic surface and sub-surface aeolian sand deposits in the Keeler Dunes area is provided in the November 2012 reports by Bacon and Lancaster (2012) and Lancaster and Bacon (2012a).

LADWP COMMENT

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.

DISTRICT RESPONSE

9. Attachment E of the Preliminary Staff Report “suggests a regional climatic control on periods of sand accumulation, related to increase in sediment supply from fluvial and lacustrine sources” (page 12). Note that this is in reference to the aeolian sand deposits and not the flood deposits. The numerical age date from the radiocarbon analyses indicate that the age of the dated flood deposit was from 1782-1835, or during the later portion of the Little Ice Age. There is no suggestion in the Preliminary Staff Report or the associated Technical Attachment on the frequency of flood events from the Inyo Mountains.

LADWP COMMENT

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).

DISTRICT RESPONSE

10. The information presented in Attachments C and D is consistent with each other. Attachment C discusses the results of the development of the modern Keeler Dune field based on air-photos and imagery from 1944 to 2010. An evaluation is made of the changes observed in modern Keeler Dunes based on several parameters, one of which is the number

of crescentic dunes ridges. No mention is made of the “older dune deposits” since the focus of the work was on the development of the modern dunes. On the other hand, Attachment D presents the distribution and description of units from the detailed geomorphic mapping including both historic and pre-historic aeolian units.

LADWP COMMENT

> 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.

DISTRICT RESPONSE

The results of the detailed geomorphic mapping, numerical age dating, mineralogical analyses, and stratigraphic relationships in combination with analysis of historic ground-based and air photos/imagery, and an analysis of dune movement and sand transportation paths clearly indicate that the active and emissive Keeler Dune field developed after the modern desiccation of Owens Lake from material transported into the dunes from the Owens Lake bed. The work is based on sound scientific study and the conclusion is supported by the preponderance of data.

LADWP COMMENT

> **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.

DISTRICT RESPONSE

The surface change analysis provides a two-year glimpse at how sand motion in the northern portion of the exposed Owens Lake bed could have contributed to the accumulation of sand in the area of the Keeler Dunes. The process of wind erosion on the lake bed had been going on for over 85 years, since the lake bed was fully exposed in 1926. The surface change analysis examines the direction of sand movement for only the last two years before the installation of the shallow flood dust control project, which effectively controlled the source of sand upwind from the Keeler Dunes. The amount of sand movement during the study period (2000-2001) was among the lowest in the eleven years of sand flux measurements in the Keeler Dunes as seen in the annual sand flux trend for the two Keeler Dune sites (Site 7223 and Site 7247)

(Figure 4.7-1). Because of the relatively short duration of the pre-dust control period and the low sand flux rates, the results should be viewed qualitatively to help understand the direction of sand movement in the northern part of Owens Lake, and should not be interpreted as a quantitative assessment of long-term dune formation.

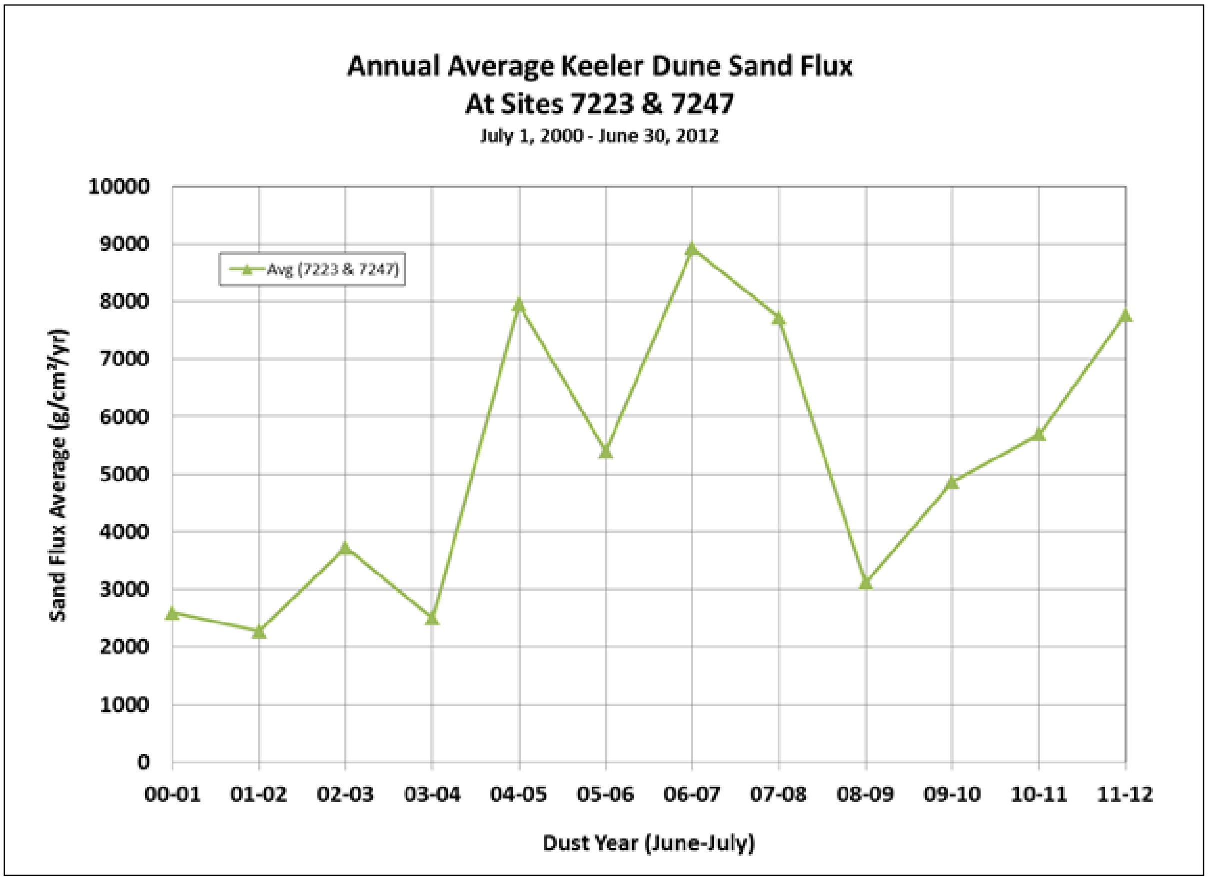

Figure 4.7-1. Sand flux from the Keeler Dunes from July 2000 to June 2012.

It certainly would have been interesting to have sand flux data from this area for the period from the 1950's through the 1990's as discussed in Section 4.3 of the Preliminary Staff report when there was significant expansion of the dunes. However, in lieu of a long term sand flux record, an analysis was conducted of the wind data and drift potential[2] from the 20 year record from the District's A-Tower site (located on the northeast portion of Owens Lake) and 60+ year record from Bishop. The results of this analysis show that the drift potential or sediment mobility changes over time. During the period from 1948 to 1966 the predominant drift potential was from northerly winds. From 1967 to 1980 the drift potential was balanced

[2] Drift potential is a measure of the amount of sand that could be transported by the wind and is considered to be proportional to the sand flux. It is a measure of the wind power.

between the northerly and southerly directions. The predominant drift potential was shifted back to the northerly component from 1981 to 2010 (Lancaster and Holder, 2012).

The observed results from the 2-year record used in the surface change analysis are consistent with the analysis of the long term wind record and drift potential results. The 2-year period used for the sand motion study came at a time when the amount of sand moving into the dune area was declining, (Lancaster, 2012).

LADWP COMMENT

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.

DISTRICT RESPONSE

1. The irregular grid used in the analysis of the 2009-2012 sand flux data was developed by the District using 125 x 125 meter subdivisions of the 1-kilometer grid. The sub-grid cells assigned to each site were based on the overall surface character of the lake bed and the Keeler Dunes in order to represent the net sediment transportation into or out of each area.

LADWP COMMENT

2. Page 68, 2000 to 2001 Surface Change: The sand-motion modeling for the predust 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.

DISTRICT RESPONSE

2. The sand flux monitoring network used for the sand motion analysis was designed for the Dust ID modeling program and was not designed to determine how the Keeler Dunes formed. However, the information did provide excellent qualitative information that provided insight into the movement of sand from the lake bed to the dune area. As previously stated, because of the relatively short duration of the pre-dust control period and the low sand flux rates, the results should be viewed qualitatively to help understand the direction of sand movement in the northern part of Owens Lake, and should not be interpreted as a quantitative assessment of long-term dune formation.

LADWP COMMENT

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.

DISTRICT RESPONSE

3. The sand motion analysis does not refute the assessment of the predominant sand transport direction by Lancaster (2012). As previously stated, the sand motion analysis was done for a two-year period and it occurred at a time when expansion of the dune field was in decline. Lancaster's assessment of the predominant sand transport direction is based on an analysis of long-term wind data and dune morphology.

   The District investigated site visit records for site 7199 and precipitation records during the 2000 to 2001 calendar years. On the site visit records, the surface condition of the area in the vicinity of the monitoring site is recorded. The District collected precipitation data from a series of rain gauges associated with the hydrologic monitoring of the region. In this precipitation record, notes were recorded for each precipitation event specifically noting if there were flooding or runoff events. From a review of these two records it is apparent that flash flooding events were not a factor in the data collected from site 7199. Sand movement analysis from site 7199 indicates the direction of sand motion in this area and the net transportation direction is to the southeast off of the lake bed and onto the alluvial fan.

   As part of the District's On-Lake Aeolian Project (Cox and Holder, 1997), sand catch data was collected at a location near site 7199 from May 1993 to July 1996. This site (NE-9) was located along the historic shoreline between the North Sand Sheet and the northern portion of the Keeler Dunes. The sand catch was measured in eight different directions (Figure 4.7-2). The directional sand catch data displays two primary directions, W-NW and S, similar to the wind data from the A-Tower and Keeler (Figures 4.4-1) and illustrates that the main direction of sand movement at this site was from the adjacent North Sand Sheet.

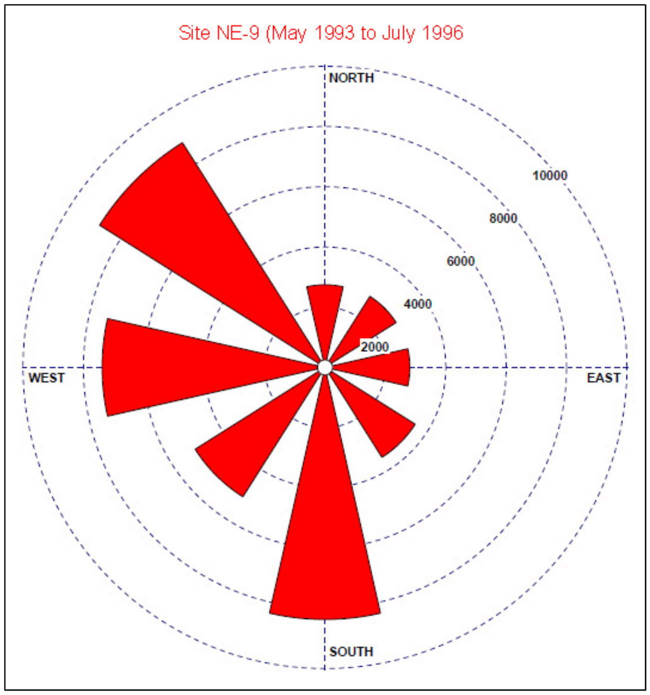

Figure 4.7-2. Plot by direction of the sand catch from site NE-9 from May 1993 to July 1996

It would have been interesting to have sand flux data from this area for the period from the 1950's through the 1990's as discussed in Section 4.3 of the Preliminary Staff Report when there was significant expansion of the dunes. The 2-year sand motion study came at a time when the amount of sand moving into the dune area was declining. Because of its location northwest of the Keeler Dunes, Site 7199 would have been one of the pathways for sand to move from the playa to the dunes during the period when the dunes were expanding.

LADWP COMMENT

4. Page 72, 2009 to 2012 Surface Change: The sand-motion modeling for the postdust 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.

DISTRICT RESPONSE

4. Between 2000 and 2008 there were only 2 sand flux sites in the Keeler Dunes, so doing the exercise of calculating the sand motion between two sites would not have been very useful. The District added more sand flux sites in 2008 for the purpose of characterizing the sand motion across the area and for conducting a more detailed modeling analysis of PM_{10} emissions from the Keeler Dunes using the Dust ID model. As in the case of the 2000 and 2001 study period, the sand flux network was not set up to monitor sand movement throughout the off-lake area between Lizard Tail and Keeler. However, the information from 2000 to 2001 did provide excellent qualitative information that provided insight into the movement of sand on the uncontrolled areas of the lake bed and in the Keeler Dunes.

   The District used wind data from A-Tower and the Keeler met sites with the sand flux data. Hourly sand flux data was paired with hourly wind data from the closest met site to the Sensit location. As part of the review of the DWP's comments, the District included met data from three met sites within the Keeler Dunes (Figure 4.4-2, above). It should be noted that the wind vanes and anemometers at these sites are positioned at 2-m and 4-m above surface as compared to the 10-m heights for the A-Tower and Keeler met sites. Previous comparisons of met data from these sites found significant differences in the wind speeds at sites within the dunes because the vegetation and dune topography affected wind speed measurements at the 2-m anemometer heights. However, since the sand motion analysis only uses the wind direction, this is less influenced by the terrain at the higher wind speeds associated with wind erosion.

   Sites 9811 and 9812 were installed in January 2011 and were therefore not present during much of the analysis period. These sites were installed for a special purpose: to gather information for the development of a dust control strategy and therefore were located in areas that are not representative of sand flux in the surrounding area. Although the two sites are relatively close together, one site shows net sand motion to the northeast and the other shows net sand motion to the southeast (Figure 4.7.3), which indicates that local topography is influencing sand flux at these sites. In any case, the net sand motion from 9811 and 9812 is away from adjacent cells and so it would not influence the surface change calculations in the network.

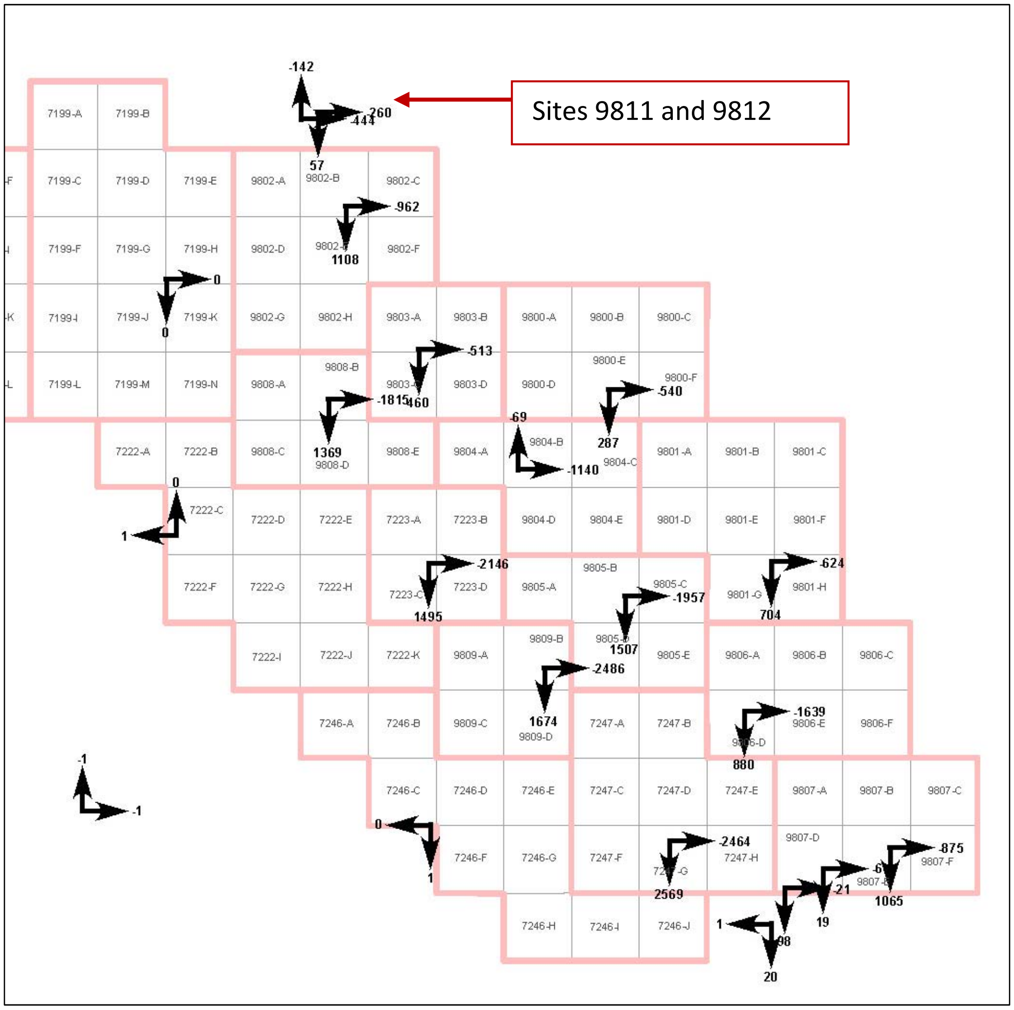

Figure 4.7.3. Map of the model grid used in the Keeler Dunes area showing the sand flux x and y sand flux components for 2011-2012 from the monitoring sites. Notice that the resulting vector for sites 9811 and 9812 is oriented in a direction away from the Keeler Dunes.

LADWP COMMENT

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.

DISTRICT RESPONSE

5. As discussed in the Preliminary Staff Report in Section 4.3, following the implementation of the Shallow Flooding dust control areas in Zone 2 on the North Sand Sheet at the end of 2001, the lake bed adjacent to the Keeler Dunes became largely controlled such that the sediment transport into the Keeler Dunes was drastically reduced. The overall conclusion of the Preliminary Staff Report and the Final Staff Report on the origin and development of the Keeler Dunes is built on the collective results and information for all of the investigations and not from any one of the many individual pieces of information collected.

   In this cell by cell analysis of the erosion and deposition, cells that are immediately downwind (east) of the shallow flood areas will have no incoming sand from the westerly direction, and therefore any sand motion in those cells will result in deflation or erosion, unless there is a larger amount of sand coming into the cell from the north or the south. The District found that by comparing the results of the sand motion analysis and other observations, such as those by Lancaster (2012) and HydroBio (2012), helps to better understand all of the results.

   Contrary to DWP's comment, if sites 9811 and 9812 were included the analysis, the results would not show an influx of sand from the Swansea Dunes (see response to LADWP's comment 4, above and Figure 4.7-3). As explained in Section 4.3 and Attachment C (Lancaster, 2012) of the Preliminary Staff Report and also in Lancaster and Holder (2012) the dune field has been starved of sand and is in a state of negative sediment budget, so that erosion is occurring on the upwind margin. The continued expansion of the southern dunes towards the southeast during this time is a result of reworking of existing sand in these dunes, augmented by redistribution of sand from the northern part of the dune field. It does not represent any significant addition of sand from external sources.

LADWP COMMENT

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.

DISTRICT RESPONSE

6. Section 4.6 and Attachment F of the Preliminary Staff Report discuss results of the sand motion data collected from two time periods: 2000-2001 and 2009-2012. The District recognizes that the data are limited due to short time intervals and the locations of the sites available for the analysis. However, with that said, the results of the surface change analysis provide an excellent qualitative look at the transportation directions and magnitudes both before dust control implementation on the lake bed as well as during the last three years. The results of this analysis provide information to support the results of other investigations conducted by the District as to the origin of sand within the Keeler Dunes.

   The sand flux vectors from 2000-2001 (Figure 4.6.3 and 4.6.4 in the Preliminary Staff Report), prior to dust controls on the lake bed, show a significant transport direction from the northern portion of the North Sand Sheet into the Keeler Dunes during this two year period. At this same time there was also net transport of material to the southeast on the lake bed itself. These patterns are consistent with those observed in the field and those described in the results of the District's shallow core project (Holder, 1997). As discussed above, the transport directions from the Swansea Dunes from 2011 to 2012 (Figure 4.7-3) do not support the suggestion from the LADWP that they were the source of sand for the expansion of the Keeler Dunes.

LADWP COMMENT

> **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.

DISTRICT RESPONSE

The investigations summarized in Section 4.7 of the Preliminary Staff Report and presented in Attachment G are based on imagery from a 10-year period and dune measurements made over a four year period. During the period of time studied, it is clear that the prominent dunes present in the Keeler Dunes migrated consistently to the southeast. A longer record of dune development and movement is provided Section 4.3 of the Preliminary and Final Staff report and in the associated technical Attachments. The results of the on the ground dune transects support the results dune movement based on air photo and satellite imagery as discussed in Lancaster (2012).

As discussed above, the majority of sand that fueled the growth and development of the modern Keeler Dunes was supplied from the bed of Owens Lake and not from the Swansea Dunes or the alluvial fan deposits. This position is supported by the results of multiple detailed scientific investigations. The results of these investigations were made available in the Preliminary Staff Report and are provided in the Final Staff Report.

LADWP COMMENT

> **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.

DISTRICT RESPONSE

As presented in the District's Preliminary Staff report and Technical Attachments, the District conducted multiple broad-ranging scientific investigations and detailed research over a four year period focused on how the Keeler Dunes formed and the changes that have occurred in the nature of the landscape over time. The investigations were originally conducted collaboratively with the LADWP per the 2006 Settlement Agreement (GBUAPCD and LADWP, 2006) and 2008 SIP (GBUAPCD, 2008). All of the work that the District has conducted in the dunes has been presented to the public through a series of Public Meetings and in the September 7, 2012 Preliminary Staff Report and Technical Attachments. Over a year ago, the District learned that the LADWP is conducting their own investigations in the dunes. The LADWP has not provided results or information to the District as to the nature of the work.

In the review and comments on the District's Preliminary Staff Report, the City does not provide any technical information on the work they have conducted and does not provide any data to support their comments regarding the District's work. The comments by the LADWP look myopically at individual aspects of the results to conclude that these points do not support the District's overall position on how the modern Keeler Dunes formed. The District instead took a broad look at all of the results of all of the research to formulate their position. While individual pieces of data may not singly point to the origin of the Keeler Dunes the overall picture created by the sum of all of the results clearly indicates that the modern Keeler Dunes are a recent element of the landscape supplied with sand that moved off of the exposed Owens Lake bed exposed by the historic desiccation of Owens Lake.

The District has a team of prominent expert scientists that have conducted rigorous research and investigations aimed at providing an answer as to the origin and the development of the Keeler Dunes. A broad spectrum of investigations were conducted to research the origin of the dunes ranging from a historical search of documents, references, maps, and photos of the Owens Lake and Keeler area, to an analysis of air photos and satellite imagery, to detailed geomorphic and geologic mapping, age date and mineralogical analyses, to an analysis of sand motion in the area. The broad nature of the investigations tested the working hypothesis on the origin of the dunes from not one, but three different time perspectives: historical, prehistoric, and recent.

The District has carefully reviewed and considered the comments from the LADWP on the Preliminary Staff Report and finds that the conclusion that the active Keeler Dunes formed as a result of exposure of the bed of Owens Lake is strongly supported by the results of the scientific research. This conclusion was not predetermined by the District; instead it was thoroughly researched and tested during the course of the scientific investigations. However, in order to address some of the comments made by the LADWP, the District has revised the Preliminary Staff Report and most of the associated Technical Attachments. The revised report is presented as the Final Staff Report on the Origin and Development of the Keeler Dunes, November 2012.

There is no justification for delaying the Public Hearing by the District Governing Board scheduled for December 13, 2012. The District has conducted research on the origin of the Keeler Dunes for the last four years and has addressed all of the comments made by the LADWP. The District's investigations are thorough and complete and provide sufficient information for the District Board to make an informed determination on how and when the Keeler Dunes formed.

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