Great Basin Unified Air Pollution Control District

2013 Amendment to the Owens Valley PM_{10} SIP

Board Order 130916-01

Exhibit 3: Stipulated Order for Abatement Number 110317-01

Theodore D. Schade
Air Pollution Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short Street, Bishop, California 93514-3537
760-872-8211 Fax: 760-872-6109

B/O #110317-01

March 17, 2011

I HEREBY CERTIFY that at a regular meeting of the Great Basin Unified Air Pollution Control District Governing Board held in the multi-purpose room of the City of Los Angeles, Department of Water and Power, Bishop, California on March 17, 2011 an order was duly made and entered as follows:

AGENDA ITEM #14: **ADOPTION OF AN ORDER FOR ABATEMENT DIRECTING THE CITY OF LOS ANGELES TO IMPLEMENT AN ADDITIONAL 3.1 SQUARE MILES OF BEST AVAILABLE CONTROL MEASURES FOR CONTROL OF PM10 EMISSIONS FROM THE DRIED BED OF OWENS LAKE AND TO PAY SIX MILLION FIVE-HUNDRED THOUSAND DOLLARS ($6,500,000) TO OFFSET EXCESS AIR POLLUTION EMISSIONS.**

A motion was made by Cervantes and seconded by Sweeney Adopting the Stipulated Order with the modifications relative to deleting references to the Hearing Board and replacing thereof the Governing Board. Directing Board Chair Arcularius to sign the Order following signatures from the General Manager of the City of Los Angeles Department of Water and Power and the Air Pollution Control Officer of the Great Basin Unified Air Pollution Control District. The following findings were also made by the Governing Board:

1) Notice of hearing on this matter was duly given and published in accordance with Health and Safety Code §42450 and District Rule 811.

2) All parties have stipulated to this matter being heard by the District Governing Board and have waived all rights to contest ongoing authority of the District Governing Board to hear this matter.

3) Members of the public were offered opportunity to provide comment on the Order of Abatement and comments of <u>zero</u> people were heard.

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Ayes: Board Members – Arcularius, Hansen, Johnston, Cervantes, Veatch, Sweeney, Eastman

Noes: Ø

Abstain: Ø

Absent: Board Members - Ø

Motion carried 7/0 and so ordered.

ATTEST:

Shirley Ono

Shirley Ono, Acting Clerk of the Board

Final: 3/17/2011

BEFORE THE GOVERNING BOARD OF THE

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

In the Matter of **THEODORE D. SCHADE** AIR POLLUTION CONTROL OFFICER GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT, Petitioner, vs. **CITY OF LOS ANGELES DEPARTMENT OF WATER AND POWER** Respondent.	**Order Number 110317-01** **FINDINGS AND DECISION OF GOVERNING BOARD UPON HEARING FOR STIPULATED ORDER FOR ABATEMENT** Hearing Date: March 17, 2011 Location: Bishop, California

FINDINGS AND DECISION OF THE GOVERNING BOARD

A petition from the Great Basin Unified Air Pollution Control District's Air Pollution Control Officer for a Stipulated Order for Abatement ("Order") was heard on March 17, 2011, pursuant to notice and in accordance with the provisions of California Health and Safety Code Section 40823 and District Rule 811. Seven members of the District Governing Board were present: Board Chair, Linda Arcularius, Board members Tom Sweeney, Henry Veatch, Larry Johnston, Tim Hansen, Richard Cervantes and John Eastman. The District Governing Board was represented by George Poppic of the California Air Resources Board. Petitioner, Theodore D. Schade, the Air Pollution Control Officer (APCO), was represented by Randy Keller, District Counsel. Respondent, the City of Los Angeles Department of Water and Power, was represented by Michelle Lyman, Deputy City Attorney for the City of

Los Angeles. The public was given the opportunity to testify. The matter was submitted and evidence received. The District Governing Board finds, concludes and orders as follows:

FINDINGS OF FACT

1. The Great Basin Unified Air Pollution Control District (hereinafter "District") is organized pursuant to Division 16, Part 3, Chapter 3 of the California Health and Safety Code, and is the sole and exclusive agency with the responsibility for comprehensive air pollution control and regulation in the Great Basin Valleys Air Basin (California's Alpine, Mono and Inyo Counties), including that area of southern Inyo County known as the Owens Lake bed (Exhibit 1).

2. Respondent, the City of Los Angeles, acting by and through its Department of Water and Power, is a municipal corporation organized under the Los Angeles City Charter and the constitution and laws of the State of California, doing business within the jurisdiction of the Great Basin Unified Air Pollution Control District. Respondent operates a municipal water collection, distribution and aqueduct system in Inyo and Mono Counties for the purpose of supplying water to the residents of the City of Los Angeles.

3. Respondent is subject to District Governing Board Order 080128-01 adopted on January 28, 2008 (Exhibit 2). District Governing Board Order 080128-01 is the order contained in both the *2008 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan* (2008 SIP) and the *2010 PM_{10} Maintenance Plan and Redesignation Request for the Coso Junction Planning Area.* This order requires the Respondent to take a number of actions by certain specified dates in order to timely control the particulate matter air pollution (PM_{10}) emissions caused by its water production, diversion, storage and conveyance activities.

4. Respondent is also subject to District Hearing Board Order GB09-06 (Exhibit 3). District Hearing Board Order GB09-06 is the order associated with a variance, granted to the Respondent on September 25, 2009, that provided the Respondent additional time to implement PM_{10} controls on some areas of the Owens Lake bed originally ordered by District Governing Board Order 080128-01.

5. District Governing Board Order 080128-01 required Respondent to install a total of 13.2 square miles of additional PM_{10} controls beyond the 29.8 square miles of PM_{10} controls constructed prior to January 1, 2007. These 13.2 square miles are known as the "Phase 7" areas.

6. Of the required 13.2 total square miles in Phase 7, Respondent implemented 9.6 square miles in compliance with District Governing Board Order 080128-01 and District Hearing Board Order GB09-06 and there are 0.5 square miles known as the "Channel Area" on which no representations regarding compliance status are made in this Order. These 10.1 square miles are not the subject of this Order.

7. However, within the 3.1 square-mile balance of the 13.2 square-mile Phase 7 areas, there are six sub-areas known collectively as "Phase 7a" where Respondent did not implement dust control measures in compliance with District Governing Board Order 080128-01 and District Hearing Board Order GB09-06. For the Phase 7a areas, District Governing Board Order 080128-01 required Respondent to implement any combination of approved PM_{10} controls known as Best Available Control Measures ("BACM"), which consists of Shallow Flooding, Managed Vegetation and Gravel Blanket, or an experimental, non-BACM PM_{10} control measure known as "Moat and Row."

8. Respondent had the legal option to select at its sole discretion any of the methods of dust control described in Findings of Fact Paragraph 7 herein and was required to secure all appropriate approvals and construct the controls by the deadline set forth in the order and modified by the variance. The deadline set by District Governing Board Order 080128-01 for constructing controls on the Phase 7a project areas was originally April 1, 2010, if Respondent selected BACM controls, or October 1, 2009, if Respondent selected Moat & Row controls.

9. Using District-, State- and Federally-approved air pollution modeling techniques specifically developed for Owens Lake emissions (District Board Order 080128-01, Attachment B, "Supplemental Control Requirements Determination Procedure"), for the period 2006 through 2010 the District determined that the Phase 7a areas emitted an annual average of approximately 6,265 tons of excess PM_{10}. These excess emissions have caused and contributed to violations of the state and federal 24-hour PM_{10} standards.

10. All of the Phase 7a areas are on State of California public lands managed by the California State Lands Commission ("CSLC"). Respondent is required to secure a lease from the CSLC before it may proceed to conduct any dust control activities occurring on state lands. The CSLC is not subject to District Governing Board Order 080128-01 and District Hearing Board Order GB09-06 or any other current order requiring it to control PM_{10} emissions from the areas of the dried bed of Owens Lake owned by the State of California and managed by the CSLC.

11. Respondent exercised its discretion to implement Moat and Row controls on the Phase 7a project areas. In order to secure the necessary permits, leases and approvals from other public agencies, Respondent was required to and did conduct full-scale dust

control performance testing of Moat and Row at two locations on the Owens Lake bed. Results of the testing were disputed by the Petitioner and Respondent.

12. As a condition of considering Respondent's application for a Moat and Row lease for the Phase 7a areas, CSLC staff required that Respondent prepare a supplemental Environmental Impact Report ("SEIR") pursuant to the California Environmental Quality Act ("CEQA"). Respondent agreed to prepare the SEIR required by CSLC staff. The SEIR prepared and finalized by Respondent was not legally challenged by the CSLC or any other party.

13. Delays caused by preparation of the SEIR and securing the necessary permits, leases and approvals resulted in Respondent's inability to implement Moat and Row dust control measures on Phase 7a by October 1, 2009. Respondent therefore sought and was granted Variance Order GB09-06 from the District Hearing Board. The Variance Order extended the deadline for completion of the Phase 7a Moat and Row controls by one year from October 1, 2009 until October 1, 2010. The variance order also contained additional requirements designed to reduce excess PM_{10} emissions to the maximum extent feasible. These requirements provided for PM_{10} control through the use of temporary tilling on 3.5 square miles of area then under construction (a portion of the Phase 7 areas) and through implementation of a future dust control project to be completed six months earlier than would have normally been required under the provisions of Governing Board Order 080128-01. The expedited future project is 2.03 square miles of BACM known as the "Phase 8" project, which was ordered by the District Governing Board on December 6, 2010 (Order Number 101206-01).

14. For more than two years, Respondent negotiated with the CSLC in an attempt to procure a lease to implement Moat and Row controls in the Phase 7a project areas.

15. On April 6, 2010, the CSLC denied Respondent's application for the Moat and Row lease. As a result of the CSLC's denial of the Moat and Row lease, Respondent was unable to construct Moat and Row dust control measures on any part of the 3.1 square-mile Phase 7a project areas and was required to remove the Moat and Row dust control measures in place at the two Phase 7a demonstration areas. Thereafter, Respondent had insufficient time to comply with CEQA, obtain the necessary permits, leases and approvals and construct BACM on the 3.1 square mile Phase 7a project areas by October 1, 2010.

16. At all times relevant herein, Respondent acted in good faith to comply with District Governing Board Order 080128-01 and District Hearing Board Order GB09-06.

17. As there were no approved PM_{10} controls in place on the Phase 7a areas by the October 1, 2010 deadline, Petitioner determined that Respondent was in violation of District Governing Board Order 080128-01 and District Hearing Board Order GB09-06 on that date. Petitioner determines that Respondent will remain in violation of District Governing Board Order 080128-01 and District Hearing Board Order GB09-06 until approved PM_{10} controls are fully installed and operational on all Phase 7a areas.

18. "Fully installed and operational" means that all required Phase 7a and "Transition Areas" (additional areas that are transitioned from an existing BACM to another BACM in order to conserve water) infrastructure, earthwork and appurtenances necessary for compliant BACM operation is installed and, in the case of managed vegetation BACM, all plant materials are in place, but the plants may not necessarily be fully developed or grown

sufficiently to meet the 2008 SIP requirements for cover conditions. The Phase 7a and Transition Areas locations are shown and described in Exhibit 4.

19. Due to the fact no approved controls were in place on the Phase 7a areas, on October 1, 2010 the APCO issued Notice of Violation ("NOV") number 471 to Respondent for violating District Governing Board Order 080128-01 and District Hearing Board Order GB09-06.

20. Paragraph 11 of District Governing Board Order 080128-01 requires the APCO to use the "2008 Owens Valley Planning Area Supplemental Control Requirements Determination Procedure" ("SCR procedure," contained in Attachment B of Order) to determine the need for additional PM_{10} controls on the Owens Lake bed beyond those required by the original Order.

21. The SCR procedure provides that if Respondent is in compliance with the requirements set forth in "Board Order 080128-01 regarding the amount, timing and operation of existing and future dust controls, the APCO will not issue additional written SCR determinations until after May 1, 2010 and will not use data collected prior to April 1, 2010 for new determinations." The last SCR determination was issued in January 2008 in association with the 2008 SIP and used data up to June 30, 2006. The data collected starting July 1, 2006 has not previously been used to make an SCR determination.

22. Respondent maintains the right to challenge SCR determinations made by the APCO and orders for additional PM10 controls issued by the APCO based on such SCR determinations. Respondent retains all of its rights pursuant to Health and Safety Code § 42316, Attachment B to Board Order 080128-01, and all other available legal remedies to

challenge SCR determinations and orders based on such determinations. Nothing in this Order for Abatement amends or otherwise changes the SCR procedures.

23. Notice of hearing on this matter was duly given and published in accordance with Health and Safety Code §42450 and District Rule 811.

24. All parties have stipulated to this matter being heard by the District Governing Board and have waived all rights to contest the ongoing authority of the District Governing Board to hear this matter.

25. Members of the public were offered the opportunity to provide comment on the Order of Abatement. No public comments were offered.

26. To the extent any of these Findings of Fact are considered or deemed to be Conclusions or part of the Order, they are incorporated into those sections as if fully set forth therein.

CONCLUSIONS

1. The District Governing Board finds that Respondent is in violation of requirements in District Governing Board Order 080128-01 and District Hearing Board Order GB09-06 due to Respondent's failure to implement approved PM_{10} control measures on the 3.1 square-mile Phase 7a areas by October 1, 2010. The District estimates these violations are expected to result in approximately 6,265 tons of excess PM_{10} per year to be emitted from the Phase 7a areas of the dried bed of Owens Lake. These emissions would have been controlled if the Phase 7a PM_{10} controls had been implemented according to requirements. Excess PM_{10} emissions from the Phase 7a areas are expected to continue to cause or contribute to exceedances of both state and federal 24-hour PM_{10} standards.

2. The District Governing Board finds that Petitioner and Respondent have worked together to develop a number of corrective actions and Petitioner has committed to take such actions so as to provide effective PM_{10} control on the Phase 7a as expeditiously as feasible. Until dust control measures are implemented pursuant to this Order, there is the potential for excess emissions and state and federal air quality standards violations to continue to occur.

3. The District Governing Board finds that Respondent can achieve compliance with District requirements as expeditiously as feasible by implementing BACM, including an APCO-approved BACM test on Area T12-1 only, on the 3.1 square-mile Phase 7a areas.

4. The District Governing Board finds that, in addition to the expeditious implementation of BACM, Respondent must offset the potential excess PM_{10} air pollution emissions that may be emitted during the non-compliance period by taking additional actions to control and/or offset any excess air pollution emissions to the extent feasible.

5. The District Governing Board finds that due to the need to construct extensive infrastructure to deliver water to the emissive Phase 7a areas, if Respondent were to terminate, or reduce its water production, diversion, storage or conveyance activities in Inyo County, the available water could not immediately or readily be put to use in reducing excess PM_{10} air pollution emissions.

6. The District Governing Board finds it is not reasonable under California Health and Safety Code section 42316 to require Respondent to cease or curtail its water production, diversion, storage and conveyance activities in Inyo County during the non-compliance period, since the water is needed to comply with dust control requirements for the existing 39.9 square miles of PM_{10} control measures currently operating at Owens Lake

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as required by District Governing Board Order 080128-01 and District Hearing Board Order GB09-06.

7. Therefore, the District Governing Board finds that the cessation or curtailment of Respondent's water production, diversion, storage and conveyance activities in Inyo County during the non-compliance period is contrary to Health and Safety Code § 42316 and would not provide a corresponding benefit in reducing the excess PM_{10} emissions.

8. The District Governing Board finds that, in addition to the essential and mandatory requirements that Owens Lake dust controls be effective and ensure that air quality standards are met in a timely manner, it is important that Owens Lake dust controls be as cost-efficient and water-use-efficient as possible.

9. The District Governing Board finds that issuance of this Order will not constitute a taking of property without due process of law.

10. The District Governing Board finds that corrective actions to be taken by the Respondent and compliance with the conditions set forth in this Order will bring the Respondent's water production, diversion, storage and conveyance activities into compliance with District orders, rules and requirements as expeditiously as feasible.

11. To the extent any of these Conclusions are considered or deemed to be Findings of Fact or part of the Order, they are incorporated into those sections as if fully set forth therein.

ORDER

THEREFORE, subject to the aforesaid statements, findings and good cause appearing, the Governing Board of the Great Basin Unified Air Pollution Control District orders as follows:

1. Except as provided in Paragraph 2 of this Stipulated Order for Abatement (Order), below, Respondent shall install, operate and maintain Best Available Control Measures (BACM) on approximately 3.1 square miles of the Owens Lake bed known as the "Phase 7a" areas and on approximately 3.0 square miles known as the "Transition Areas" as shown and described in Exhibit 4. BACM shall consist of the existing approved Shallow Flooding, Managed Vegetation, Gravel Blanket or any new/modified District-approved BACM. BACM are described in Paragraphs 12, 15, 16 and 17 of District Governing Board Order 080128-01, as well as in Chapter 5 of the 2008 SIP.

2. Respondent shall construct existing BACM, or conduct testing of new or modified BACM, as set forth in Attachment D of District Governing Board Order 080128-01 on up to one-third (0.33) square mile of the Phase 7a project area. The test area is limited to the Phase 7a subarea known as "T12-1" and is shown in Exhibit 4. BACM testing shall begin before October 1, 2011 and shall be conducted as provided in the 2008 SIP. As provided in District Governing Board Order 080128-01, Attachment D, additional research on potential new, modified and adjusted BACM shall be allowed within the 43.0 square mile 2008 Total Dust Control Area (which is described in District Board Order 080128-01, Exhibit 1).

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3. The BACM and BACM-testing described in Order Paragraphs 1 and 2 shall generally be constructed as set forth in the Project Description attached as Exhibit 5. The Parties agree that in order for the project to comply with Health and Safety Code Section 42316, the Phase 7a project will rely upon and incorporate the use of all three approved BACMs.

4. Respondent shall install fully operational BACM for the Phase 7a areas and Transition Areas according to the following schedule:

a. Except the T12-1 BACM test area, BACM controls shall be fully installed and operational (as defined in Findings of Fact Paragraph 18, above) by December 31, 2013. All Phase 7a and Transition areas controlled by the Managed Vegetation BACM are to achieve fully-compliant BACM vegetation cover as specified in the March 2010 Managed Vegetation BACM Proposal (Exhibit 6) by December 31, 2015. The APCO shall submit said Proposal to the District Governing Board for approval and incorporation into the 2008 SIP prior to July 31, 2011.

b. For the T12-1 BACM test area (as provided in Order Paragraph 2, above) either any existing BACM or a District-approved new BACM shall be fully installed and operational by December 31, 2015 or an earlier date, if specified in the District's approval of the new BACM.

5. Respondent shall not be deemed in violation of this Order if Respondent is acting in good faith to comply with the terms of Order Paragraphs 1 through 4, but is impeded in its ability to comply with one or more of those terms of this Order as applicable to the Phase 7a and Transition Areas due to:

a. Unreasonable delays caused by the California State Lands Commission (CSLC), the District, or any other agency, except the City of Los Angeles and its agencies, in processing Respondent's application for a required permit, approval or lease necessary to allow Respondent to implement any of the three BACM, or the proposed 7a project.

b. Denial by the CSLC, the District, or any other agency, except the City of Los Angeles and its agencies, of a required permit, approval or lease necessary to allow Respondent to implement any of the three BACM, or the proposed 7a project.

c. A condition for a required permit, approval or lease made by the CSLC, the District or any other agency, except the City of Los Angeles and its agencies, that is unreasonable, unduly onerous, or that is not comparable to conditions contained in similar permits, approvals or leases necessary to allow Respondent to implement any of the three BACM, or the proposed 7a project.

d. Delays caused by any third party challenge to Respondent's compliance with CEQA related to the Phase 7a areas or the Transition Areas.

e. A condition of Force Majeure, which is defined to mean an extraordinary event or circumstance beyond the control of the parties, such as a war, labor actions, riot, crime, disruption of utilities or acts of God (such as adverse weather, earthquake, volcanic eruption or other natural disaster). Adverse weather is any weather condition, including but not limited to flooding and dust storms, that forces the Respondent to suspend all construction operations or prevents the Respondent from proceeding with 50 percent or more of the normal labor force and of the equipment

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engaged on critical path work. Delays shall only be granted for adverse weather days greater than 30 days for each 12 month period from April 1 through March 31.

f. Force Majeure is not intended to excuse delays or conditions where non-performance is caused by the usual and natural consequences of external forces, or where the intervening circumstances are specifically contemplated.

The Parties shall follow the procedure set forth in Order Paragraph 6 to determine if Respondent acted in good faith, but has been impeded in its ability to comply with the Order for any of the causes or conditions set forth above.

6. If Respondent's Board of Commissioners determines that Respondent has been impeded in its ability to comply with the requirements of this Order due to one or more conditions set forth in Order Paragraph 5, the following procedure shall be followed:

a. The Board of Commissioners shall pass a resolution making such a finding. If such a resolution is passed by the Board of Commissioners, Respondent shall notify the APCO in writing within 15 days of such resolution, and propose a detailed schedule of increments of progress setting deadlines for future actions to come into full compliance with this Order and to request an extension of the deadlines contained in this Order ("Schedule of Increments").

b. If the APCO concurs with the Board of Commissioners resolution, the Respondent and APCO shall jointly petition the District Governing Board to modify this Order as provided in Order Paragraph 22.

c. If the APCO does not concur with the Board of Commissioners resolution, the following shall occur:

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i. The APCO shall notify the Respondent and the District Governing Board in writing of his finding within 15 days of receipt of the Board of Commissioner's resolution.

ii. Within 30 days of such written notice by the APCO to Respondent, two District Governing Board members and two of Respondent's Board members may meet to make a non-binding recommendation as to whether Respondent has met the requirements of Order Paragraph 5 and whether the requested Schedule of Increments should be granted, granted with modifications, or denied. The final recommendation, if any, shall be made in writing within 15 days of the meeting. If a recommendation is not made, or the meeting does not take place within 30 days of written notice by the APCO, Respondent may request a final determination from the District Governing Board at a public hearing, as provided in Order Paragraph 22.

iii. If there is written recommendation pursuant to Order Paragraph (6)(c)(ii), the APCO shall submit such written recommendation to the District Governing Board. The Respondent shall have the burden of proof by a preponderance of the evidence that the conditions set forth in Order Paragraph 5 have been met.

iv. If, at a public hearing, as provided in Order Paragraph 22, the District Governing Board finds that Respondent has proved by a preponderance of the evidence that the conditions set forth in Order Paragraph 5 have been met, the District Governing Board shall grant or grant with modifications the Schedule of Increments to allow Respondent additional time to comply without additional financial penalties being imposed for the delay. In addition, Respondent shall not be found in violation of this Order.

d. The Respondent retains all of its appellate and other legal rights to contest the findings of the District Governing Board to a court of competent jurisdiction.

7. In order to decrease water use on Owens Lake consistent with the stated goals of the Respondent and the District, up to 3.0 square miles of existing Shallow Flood controls as described in the attached Project Description (Exhibit 5) may be transitioned to any combination of the three approved BACM measures (Managed Vegetation, Shallow Flooding and/or Gravel Blanket) in order to provide a water supply for the 3.1 square miles of Phase 7a areas. The Transition Areas and the Phase 7a areas (with the exception of Area T12-1, which will be a BACM test) when completed shall only include BACM and will not include Moat and Row or any other non-BACM.

8. The parties stipulate that during construction of the Transition Areas, the Transition Areas may not be compliant at all times with the BACM requirements set forth in Governing Board Order 080128-01. Respondent therefore shall take "Reasonable Precautions" to control particulate matter emissions to the extent practicable during construction of the Transition Areas as set forth in District Rule 401A (adopted 09/05/74; amended 12/04/06). Respondent has developed a Conceptual Dust Control Plan for the Transition Areas consistent with, and considered to be the Reasonable Precautions required by, District Rule 401A and (attached hereto as Exhibit 7). Upon completion of the design of the Transition Areas and prior to any construction or any time when dust control measures in Transition Areas may be modified in a manner that would cause the areas not to comply with BACM requirements, Respondent shall submit to the APCO for his approval a final Dust

Control Plan. The APCO shall expeditiously review Respondent's plan and shall not unreasonably withhold his approval of such plan. Despite the terms of Sections 7.9 of the 2008 SIP and Attachment D to the Board Order, if the Transition Areas are not BACM compliant and if there is a monitored exceedance or if the Dust ID Protocol predicts an exceedance of the National Ambient Air Quality Standard for PM_{10} caused solely by emissions from the Transition Areas (as determined by the "Dust ID" procedure set forth in the 2008 SIP), the District shall not take enforcement action pursuant to the Health and Safety Code, a variance will not be required and the Respondent shall not be deemed in violation of this Order, District Governing Board Order 080128-01, the 2008 SIP, or other District rules or orders related to such exceedances, provided that Respondent implements the approved Dust Control Plan or under circumstances of force majeure prohibiting compliance with the Dust Control Plan during this transition period

9. Respondent shall submit quarterly written reports on Phase 7a and Transition Area progress to the APCO and Board Clerk. Quarterly reports shall describe the status of the work completed during that quarter, the planned work for the next four quarters, compliance with the schedule, and specifically identify issues that could delay progress on the Phase 7a project. Respondent shall promptly notify the District in writing of any circumstances that could cause project delays. Quarterly reports shall be due within 30 days of the end of each calendar quarter. The first quarterly report subject to this Order shall be due on or before July 30, 2011 and the last quarterly report subject to this Order shall be due for the quarter during which Respondent has achieved full compliance for all Phase 7a areas and all Transition Areas.

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10. Based on the 2008 SIP modeling protocol estimate of 6,265 tons of excess annual PM_{10} air pollution emissions expected to be caused by Respondent's failure to implement effective PM_{10} controls on the Phase 7a areas by the mandatory deadlines, Respondent shall pay six-million-five-hundred-thousand dollars ($6,500,000.00) to the District to offset and mitigate such excess emissions that may occur between October 1, 2010 and December 31, 2013.

11. Except as provided in Order Paragraphs 5, 6, 8 and 9, above, and failure to comply with BACM implementation and operation deadlines for all Phase 7a areas and Transition areas as set forth in Order Paragraph 4, above, or by deadlines as subsequently modified by the District as provided in Paragraph 22, Respondent shall be subject to additional daily offset payments prorated by the amount of noncompliant area according to the following formula:

$$\text{Offset Amount (\$/day)} = \$5{,}500 + \$4500\,(A_{7a} + A_{TA})/6.1$$

where,

A_{7a} = Non-compliant Phase 7a Area (square miles), and

A_{TA} = Non-compliant Transition Area (square miles).

12. Respondent shall make the payment as set forth in of this Order Paragraph 10, above, within 90 days of the date of this Stipulated Order for Abatement, or within 90 days of the issuance of an order to pay, if additional payments are demanded, as provided in Paragraph 11 above, for failure to meet the completion dates set forth in Order Paragraph 4, above.

13. Eighty-five percent (85%) of the excess air pollution offset/mitigation payment made by Respondent to the District under Paragraphs 10 and 11 of this Order shall

be deposited into an Owens Lake Excess Air Pollution Offset Fund established by the District. These monies shall be used for Clean Air Projects within the District (Inyo, Mono and Alpine Counties) with preference given to projects in the Owens Valley PM_{10} Planning Area. "Clean Air Projects" are defined as improvements, replacements, or programs that directly or indirectly result in a reduction in air pollution emissions. Monies shall not be used to fund projects that Respondent is required to undertake or implement. The District Governing Board shall have the sole authority and discretion regarding project selection and approval, but will consider any project recommendations made by Respondent. Projects shall be publicized as joint projects of the Great Basin Unified Air Pollution Control District and the Los Angeles Department of Water and Power. Fifteen percent (15%) of the Clean Air Projects funds will be deposited into the District's regular budget account. All costs incurred by the District to administer the Clean Air Projects program will be paid by the District from the District regular budget account. The District shall have the sole discretion and responsibility for the Clean Air Projects program administration, planning and implementation, and Respondent shall not be responsible for program costs other than for the offset mitigation payments in compliance with Paragraphs 10 and 11 of this Order.

14. The APCO shall resume the Supplemental Control Requirement determinations required in Paragraph 10 of District Governing Board Order 080128-01 and shall use data collected since July 1, 2006 to make such determinations.

15. The parties commit to work cooperatively to support Respondent's efforts to develop and implement new PM_{10} control measures or modify existing measures that are as water-use efficient as possible.

16. Respondent shall comply with all other District rules, codes, orders and regulations not covered by this Order for Abatement, including all provisions of District Governing Board Order 080128-01 and District Hearing Board order GB09-06 that have not been modified by this Order for Abatement. Respondent's violation of any District rules, codes, orders or regulations not covered by this Order for Abatement, including all other provisions of District Governing Board Order 080128-01 and District Hearing Board Order GB09-06, shall be subject to District enforcement and will be considered separate violations not subject to the limitations and reductions set forth in the Order for Abatement.

17. This Order for Abatement does not act as a variance and Respondent is subject to all rules and regulations of the District except as provided in this Order for Abatement.

18. Final compliance shall be achieved, and this Order for Abatement shall terminate when Phase 7a and the Transition Areas are fully operational, but no later than December 31, 2015. Respondent shall notify the Clerk of the Board and the APCO in writing when final compliance is achieved.

19. Respondent enters into this Stipulated Order for Abatement without admitting liability and for the limited purpose of settling NOV No. 471 issued to Respondent by the APCO on October 1, 2010, and for violation of Governing Board Order 080128-01, and for violation of District Hearing Board Order GB09-06. Respondent specifically waives and agrees not to appeal or otherwise contest this Stipulated Order for Abatement under Health and Safety Code Section 42316 or any other cause of action. Respondent however, reserves its legal and appellate rights to contest any allegation that it has violated this Stipulated Order for Abatement. Respondent does not waive or give up its right to contest any other future

order, NOV, civil or criminal prosecution, or any other action the District may bring against Respondent subsequent to entry of this Stipulated Order for Abatement.

20. This Stipulated Order for Abatement is a full and final settlement of NOV No. 471 issued by the APCO to Respondent on October 1, 2010, and for the violation of Governing Board Order 080128-01. The stipulated order is the final integrated agreement between the parties regarding the matters addressed herein. By entering this Stipulated Order of Abatement, Respondent is hereby released from any additional liability for these violations except as set forth in this Order.

21. The District Governing Board shall retain jurisdiction over this matter until December 31, 2015, unless the Order is amended or modified.

22. The parties may petition the District Governing Board for a modification of this Order for Abatement with or without a stipulation. The Governing Board may modify the Order for Abatement without the stipulation of the parties upon a showing of good cause therefore and upon making the findings required by Health and Safety Code Section 42451(a) and District rule 805(a). Any modification of the Order shall be made only at a public hearing held upon ten (10) days published notice and appropriate notice to the parties.

23. The United States Environmental Protection (USEPA) Region 9 has been informed of this agreement made and entered into between the District and Respondent.

24. Petitioner and Respondent stipulate that the District Governing Board has full and complete jurisdiction in the matter of this Stipulated Order for Abatement.

25. Petitioner and Respondent affirm that their respective signatories below have the authority to represent and bind their respective parties to the terms of this Stipulated Order for Abatement.

Final: 3/17/2011

Reviewed and Stipulated by:

Air Pollution Control Officer, Petitioner:

Theodore D. Schade, Air Pollution Control Officer — Date: 1 April 2011

Los Angeles Department of Water and Power, Respondent:

Ronald O. Nichols, General Manager — Date: 3/30/11

ORDERED FOR THE BOARD BY:

Linda Arcularius

Linda Arcularius, Chair, District Governing Board — Date: April 1, 2011

ATTEST:

Shirley Ono

Shirley Ono, Acting Board Clerk

Date: April 1, 2011

APPROVED AS TO FORM AND LEGALITY
CARMEN A. TRUTANICH, CITY ATTORNEY

MAR 29 2011

Michelle Lyman

MICHELLE LYMAN
DEPUTY CITY ATTORNEY

Final: 3/17/2011

List of Exhibits

Exhibit 1	Owens Lake – Map
Exhibit 2	District Governing Board Order 080128-01, contained in the *2008 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan*, January 28, 2008
Exhibit 3	District Hearing Board Order GB09-06, *Findings and Order Granting Regular Variance from Requirements Set Forth in Governing Board Order 080128-01*, September 25, 2009
Exhibit 4	Phase 7a and Transition Areas– Map and Coordinate Description
Exhibit 5	Phase 7a and Transition Areas Project Description
Exhibit 6	March 2010 Managed Vegetation BACM Proposal
Exhibit 7	Conceptual Transition Area Dust Control Plan

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

Board Order Number 110317-01 ~ Exhibits 1 through 7

City of Los Angeles, Department of Water & Power

Abatement Hearing

March 17, 2011

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 1

OWENS LAKE – MAP

Great Basin Unified Air Pollution Control District - Order for Abatement 10-01

Exhibit 1: Owens Lake General Vicinity Map

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 2

DISTRICT GOVERNING BOARD ORDER

080128-01

Exhibit 2

Theodore D. Schade
Air Pollution Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short Street, Bishop, California 93514-3537
760-872-8211 Fax: 760-872-6109

Board Order No. #080128-01

2008 Revision to the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (SIP) and associated Environmental Impact Report (EIR)

January 28, 2008 / February 1, 2008

I HEREBY CERTIFY that Board Order No. 080128-01 was duly adopted and issued by the Governing Board of the Great Basin Unified Air Pollution Control District at a regular meeting on February 1, 2008, continued from January 28, 2008, held in the Inyo County Board of Supervisors Chamber, Inyo County Administrative Center, 224 North Edwards Street (US Highway 395), Independence, California. A true and correct copy is attached hereto.

ATTEST:

Wendy Sugimura

Wendy Sugimura, Clerk of the Board

BOARD ORDER # 080128-01
REQUIRING THE CITY OF LOS ANGELES TO UNDERTAKE MEASURES TO CONTROL PM_{10} EMISSIONS FROM THE DRIED BED OF OWENS LAKE

With regard to the control of PM_{10} emissions from the bed of Owens Lake, the Governing Board of the Great Basin Unified Air Pollution Control District (District) orders the City of Los Angeles (City) as follows:

PREAMBLE

A. WHEREAS, the 1998 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (1998 SIP), dated November 16, 1998 and the 2003 Revision to the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (2003 SIP), dated November 13, 2003, require the City to implement a series of measures and actions to reduce particulate emissions from the Owens Lake bed such that the Owens Valley Planning Area (OVPA) will attain and maintain the federal 24-hour National Ambient Air Quality Standards (NAAQS) for particulate matter (PM_{10}) by the statutory deadlines;

B. WHEREAS, the District is required by law to maintain its discretion to protect the environment, public health and safety, and this Order is intended to fulfill those duties without improperly constraining that lawful exercise of discretion;

C. WHEREAS, based on additional information collected subsequent to the information used to adopt the 1998 SIP and 2003 SIP, the District has determined that additional measures and actions will be required to continue to reduce particulate emissions in the OVPA such that the OVPA will attain and maintain the federal 24-hour NAAQS for PM_{10} by the statutory deadlines;

D. WHEREAS, in 2006 a dispute arose between the District and the City regarding the District's requirements for the City to control dust from additional areas at Owens Lake beyond those areas identified in the 2003 SIP;

E. WHEREAS, on December 4, 2006 a Settlement Agreement was approved by both the District and the City. Under the provisions of this agreement, the City agreed to implement additional dust control measures by April 1, 2010 and the District agreed to revise the 2003 SIP before March 1, 2008 to incorporate the provisions of the Settlement Agreement;

F. WHEREAS, on March 23, 2007, the U.S. Environmental Protection Agency (USEPA) published a finding that the Owens Valley Planning Area did not attain the 24-hour NAAQS for particulate matter of 10 microns or less (PM_{10}) by December 31, 2006 as mandated by the U.S Clean Air Act Amendments of 1990;

G. WHEREAS, as a result of the USEPA finding, the 2003 SIP must be revised to include a control strategy that will provide for attainment in the Owens Valley Planning Area as soon as practicable and that said revised SIP must be submitted to the USEPA by December 31, 2007;

H. WHEREAS, in consideration of the District's continuing duties under federal and state law, including but not limited to the Clean Air Act, to control particulate emissions from the Owens Lake bed without interruption, the District intends, if this Order is stayed or disapproved, that Board Order #031113-01 (adopted on November 13, 2003) shall continue to be in effect, so that at all times there will be continuous control of these emissions;

I. WHEREAS, the District thereby intends that if this Order is stayed due to a legal challenge, including but not limited to a challenge to this Order under California Health and Safety Code Section 42316, to the State Implementation Plan, or to the Environmental Impact Report for this SIP, or if this Order is disapproved by the California Air Resources Board (CARB), the District will revert to enforce the terms of Board Order #031113-01 which shall continue to be in effect and shall remain in full force for the duration of any stay or, in the case of disapproval, unless and until another Order is issued by this Board; and

J. WHEREAS, to prevent the deterioration of air quality due to dismantling or "backsliding" on control measures that have already been implemented before any such stay or disapproval, the District intends that the City shall continue to operate and maintain all control measures already implemented at the time of any such stay or disapproval without interruption, unless and until a further Order of the District allows for such interruption, if the City has not appealed the control measures under Section 42316 within 30 days of the effective date of this Order, and if those control measures were not invalidated as a result of that appeal;

K. WHEREAS, it is the District's intention that this 2008 revised SIP is consistent with the 2006 Settlement Agreement between the District and the City and that it is the District's intention to independently meet all its commitments and obligations under said Settlement Agreement.

THEREFORE, IT IS HEREBY ORDERED AS FOLLOWS:

ORDER

IMPLEMENTATION OF OWENS LAKE BED PM_{10} CONTROL MEASURES

1. Existing PM_{10} controls – From the date of adoption of this order, the City shall continue to operate and maintain the existing Best Available Control Measures (BACM) for PM_{10}, as described in Paragraph 8 hereof, on 29.8 square miles of the Owens Lake bed within the 2003 Dust Control Area (DCA) delineated in Exhibit 1.

2. Additional Shallow Flood supplemental PM_{10} controls – By April 1, 2010 the City shall implement a minimum of 9.2 square miles of additional Shallow Flooding BACM PM_{10}

controls within the 12.7 square-mile area known as the 2006 Supplemental Dust Control Area (SDCA) delineated in Exhibit 1. The areas within the SDCA designated for Shallow Flooding only are delineated in Exhibit 1. Shallow Flooding BACM is described in Paragraphs 8, 9 and 15 hereof.

3. Other additional supplemental PM_{10} controls – On a maximum of 3.5 square miles within the 2006 SDCA delineated in Exhibit 1, the City shall implement BACM for PM_{10}, as described in Paragraphs 8, 9 and 15 through 17 hereof, or the City may implement the alternative non-BACM PM_{10} control measure known as “Moat & Row,” as described in Paragraph 18. If BACM are installed, the controls shall be operational by April 1, 2010. If Moat & Row is installed, it shall be operational by October 1, 2009.

4. Channel Area PM_{10} controls – A 0.5 square-mile area of natural drainage channels on the south area of the Owens Lake bed is known as the “Channel Area” and is delineated in Exhibit 1. The City shall control PM_{10} emissions from the Channel Area by implementing and operating BACM, modified-BACM or alternative non-BACM controls approved by the District’s Air Pollution Control Officer (APCO), that take into account the resource issues in the Channel Area, by April 1, 2010. Portions of the Channel Area that are determined by the APCO to be naturally non-emissive (for example, adequately vegetated areas) will not require controls. If BACM are implemented in the Channel Area, they shall be as described in paragraphs 8, 9 and 15 through 17 hereof. If the City seeks to implement modified-BACM or alternative non-BACM, the City will apply such modifications as are permissible to resource agencies in this channel, with the primary objective of controlling dust, and provide the District with a monitoring plan aimed at identifying source areas that could cause or contribute to shoreline violations. Should such areas be identified after facilities are fully operational (including vegetative development), the District and the City will work with resource agencies to develop site-specific and implementable dust control approaches. Regardless of the approach selected for Channel Area dust control, the City shall prepare and submit to the District a detailed plan demonstrating the need and effectiveness of the control measures and their projected impacts to the environment, and obtain the prior approval of the District and any other applicable regulatory agencies with jurisdiction over the Channel Area for use of the modified-BACM. The City shall be responsible for any additional environmental analyses that may be required and for all required permits.

5. Total PM_{10} control area – The 29.8 square-mile 2003 Dust Control Area (DCA), the 12.7 square-mile 2006 Supplemental Dust Control Area (SDCA) and the 0.5 square-mile Channel Area together comprise the 43.0 square-mile area known as the 2008 Total Dust Control Area (TDCA). These PM_{10} control areas are delineated in Exhibit 1.

6. Minor adjustments to PM_{10} control area boundaries – Upon written request by the City to the District and written approval by the District’s APCO, minor adjustments may be made to the interior and exterior boundaries of the 2006 SDCA, for example to avoid impacts to existing resources or features, or for constructability reasons, which approval shall not be unreasonably withheld. In the event of such modification, the boundaries of the 2008 TDCA shall also be modified to reflect the modified 2006 SDCA boundaries.

7. Study Areas – The District has identified four additional "Study Areas" on the Owens Lake bed totaling up to 1.85 square miles that may require some level of control in order to attain the PM_{10} NAAQS. The four Study Areas are delineated in Exhibit 1. The District will study emissions from the Study Areas occurring between July 1, 2006 and April 1, 2010 to determine whether they will cause or contribute to PM_{10} NAAQS exceedances such that controls will be required. The District will use the data collected during this period to make a determination after May 1, 2010 as to the need for additional controls, as set forth in Paragraph 10, below. However, if the City is not in compliance with Paragraphs 1 and 3 of this Order, the determination as to the need for additional controls in the Study Areas may be made prior to May 1, 2010.

PM_{10} CONTROL MEASURES

8. The City shall implement BACM PM_{10} control measures as set forth in this Order, described below in Paragraphs 15 through 17. The City may implement the alternative non-BACM PM_{10} control measure as set forth in this Order, described below in Paragraph 18. To complete implementation of a specified control measure by a date as required by this Order means that the control measure shall be constructed, installed, operated and maintained without interruption, so as to comply with the performance standards for the specified control measure not later than 5:00 p.m. on the required date.

9. All PM_{10} control measures within the 2006 SDCA shall be designed, constructed, installed, operated and maintained by the City to achieve the initial target minimum dust control efficiencies (MDCEs) shown on the MDCE Map, attached as Exhibit 2. MDCEs are the actual dust control measure control efficiencies required to meet the PM_{10} NAAQS, based on data collected during the four-year period between July 2002 and June 2006. Prior to April 1, 2010, upon request of the City and written approval of the APCO, which approval shall not be unreasonably withheld, the initial target MDCEs may be modified if the modified target MDCEs meet the criteria set forth in the MDCE Selection Process Spreadsheet, as set forth in the 2006 Settlement Agreement between the District and the City. This Settlement Agreement is attached as Attachment A.

CONTINGENCY MEASURES – SUPPLEMENTAL CONTROL DETERMINATIONS

10. At least once per calendar year after May 1, 2010, the District's APCO will make a written determination as to whether any areas, in addition to those described in Exhibit 1, require air pollution control measures in order to attain or maintain compliance with the NAAQS for PM_{10}. The APCO's determination will also contain an analysis of the minimum dust control efficiency provided by the PM_{10} controls in the 2008 TDCA to determine if a higher level of control efficiency is required in order to attain or maintain compliance with the NAAQS for PM_{10}. In making these determinations, the APCO shall employ the methods described in Paragraph 11 of this Order. If the City is not in compliance with Paragraphs 1 and 3 of this Order, the determination as to the need for additional controls may be made prior to May 1, 2010.

    A. If the APCO determines under this Paragraph that additional areas require air pollution control measures or that existing PM_{10} control measures require a higher level of control efficiency, the APCO shall issue a written determination to the City informing them that the provisions of Paragraph 11 of this Order require the City to implement, install, operate and maintain PM_{10} BACM on additional areas of the Owens Lake bed or that the control efficiency on existing PM_{10} controls must be increased. The determination will identify those areas of the lake bed that will require PM_{10} BACM and the control efficiency necessary to attain the PM_{10} NAAQS. The City shall secure all permits and leases necessary to implement BACM and conduct any additional analysis, if any, required to comply with the California Environmental Quality Act and any other applicable laws.

B. The APCO's annual determinations will use data collected after April 1, 2010, except as provided in Paragraph 7, above, for the four Study Areas. The annual determinations for the Study Areas will use data collected after July 1, 2006.

C. In the event the City appeals the supplemental control determination under Health & Safety Code Section 42316, and pending a decision of the CARB, the City is not required to comply with any measure imposed by the supplemental control determination. The District relies upon action by the CARB to issue its decision on the City's appeal within 90 days. If CARB does not affirm the District supplemental control determination, or otherwise require the City to immediately undertake alternative supplemental control measures within 90 days in such circumstances where automatic control measures are required under Sections 172(c)(1) or 182(c)(9) of the federal Clean Air Act, 42 U.S.C. Sections 7502(c)(9) and 7511a(c)(9), the District relies upon the CARB to take these federal requirements into account in its determination of the City's appeal and to issue such interim orders as necessary to implement automatic supplemental control measures so that this Order complies with the Clean Air Act and can be approved by the U.S. Environmental Protection Agency as a proper State Implementation Plan. The foregoing is not intended to provide the CARB with any authority other than its authority under state law.

D. Paragraph 11 fixes the period of time within which the implementation of the additional control measures must be completed. Upon implementation, the City shall continuously operate and maintain, without interruption, the control measures to comply with performance standards set forth for such measures in the control measure descriptions contained in this Order.

CRITERIA FOR DETERMINING THE NEED FOR ADDITIONAL PM_{10} CONTROLS

11. The criteria, methods and procedures for the APCO's determination of the need for additional PM_{10} controls described in Paragraph 10 shall be those described in detail in the "2008 Owens Valley Planning Area Supplemental Control Requirements Determination Procedure" document incorporated as Attachment B along with its referenced "2008 Owens Lake Dust Source Identification Program Protocol" incorporated as Attachment C.

NEW BACM, ADJUSTMENTS TO EXISTING BACM, AND BACM TRANSITIONS

12. Upon written request by the City, the APCO may approve new BACM, a modification or adjustment to the existing BACMs described in Paragraphs 15, 16 and 17 of this Order, and/or the transition from one BACM to another provided that, at all times, the performance

standards of one or the other BACM are continuously met during the transition to assure that the transition shall not prevent the OVPA from attaining or maintaining the NAAQS for PM_{10}. The City's request shall contain a detailed description of the proposed alternative and a demonstration that the request satisfied all requirements of law and this Order. The APCO shall have full discretion to consider any such application for a change in BACM, and to accept, reject or condition its approval of such application. Non-compliance with any such condition shall be enforceable as noncompliance with a District Order. Without limiting the District's discretion as provided herein, the procedures for transitions of implemented control measures or adjustments to BACM shall be those described in Attachment D, "2008 Procedure for Modifying Best Available Control Measures (BACM) for the Owens Valley Planning Area."

ALTERNATIVE METHODS FOR IMPLEMENTING CONTINGENCY MEASURES AND SUPPLEMENTAL CONTROLS

13. Notwithstanding any other provision of this Order, the District shall maintain its authority under Health and Safety Code Section 42316 to order the City to implement additional controls, to control additional emissive areas and/or to undertake additional reasonable measures necessary to mitigate the air pollution caused in the District by the City's water-gathering activities in order to prevent the OVPA from failing to attain or maintain the NAAQS for $PM_{10,}$ if circumstances arise that are not specifically addressed in Paragraphs 10 or 12 of this Order.

RELATIONSHIP TO BOARD ORDER 031113-01

14. The District hereby stays the force and effect of Board Order 031113-01 for all times that this Order is in full force and effect. In the event this Order, or any provision of this Order, is stayed due to a legal challenge, including but not limited to a challenge to this Order under Health & Safety Code Section 42316, or any other law, to the State Implementation Plan, or to the Environmental Impact Report for this Revised SIP, or in the event the Order is disapproved by the CARB, the following shall apply:

    A. If the stay or disapproval causes Paragraph 1 through 5 of this Order to cease its operative force and effect, Board Order #031113-01 shall immediately be in effect and shall remain in full force for the duration of any stay or, in the case of disapproval, until another Order is issued by this Board. In addition, the City shall continue to operate and maintain without interruption all control measures already implemented in any area if those control measures were not appealed under Health & Safety Code Section 42316 within 30 days of the date of this Order, and if those measures were not invalidated as a result of that appeal.

    B. If the stay or disapproval causes Paragraph 10 and/or 11 of this Order to cease its operative force and effect, but does not affect Paragraphs 1 through 5 of this Order, the City shall continue to operate and maintain all control measures already implemented without interruption.

    C. If the stay or disapproval does not affect Paragraphs 1 through 7, 10 or 11 of this Order, those Paragraphs and any other terms of this Order that are not stayed or disapproved shall be in effect, and shall remain in full force for the duration of any stay. In all cases, the City shall continue to operate and maintain, without interruption, all control measures already implemented.

D. If a stay of this Order is imposed, then lifted so that this Order is in effect, the City shall, immediately, meet all requirements and deadlines set by this Order as if no stay had been imposed. The City shall not remove or decrease any control measures without the express written permission of the APCO, and the provisions of Board Order 031113-01 shall again be stayed. If the stay of this Order is only partially lifted such that any portion of this Order remains stayed, Board Order 031113-01 shall remain in effect as provided under Paragraphs 14.A., 14.B. and 14.C, above.

PM_{10} CONTROL MEASURES

15. BACM Shallow Flooding

The “Shallow Flooding” PM_{10} control measure will apply water to the surface of those areas of the lake bed where Shallow Flooding is used as a PM_{10} control measure. Water shall be applied in amounts and by means sufficient to achieve the following performance standards:

A. For Shallow Flooding areas within the 29.8 square-mile 2003 DCA:

i. Until April 1, 2010: At least 75 percent of each square mile of the designated areas shall continuously consist of standing water or surface-saturated soil, substantially evenly distributed for the period commencing on October 1 of each year, and ending on June 30 of the next year. If a contiguous Shallow Flood dust control area is less than one square mile, 75 percent of the entire contiguous area shall consist of substantially evenly distributed standing water or surface-saturated soil.

ii. After April 1, 2010:

a. At least 75 percent of each square mile of the designated areas shall continuously consist of standing water or surface-saturated soil, substantially evenly distributed for the period commencing on October 16 of each year, and ending on May 15 of the next year. If a contiguous Shallow Flood dust control area is less than one square mile, 75 percent of the entire contiguous area shall consist of substantially evenly distributed standing water or surface-saturated soil.
b. Beginning May 16 and through May 31 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 70 percent.
c. Beginning June 1 and through June 15 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 65 percent.
d. Beginning June 16 and through June 30 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 60 percent.
e. If for any Shallow Flooding area, the percent of areal wetness cover in the periods specified in Paragraphs 15.A.ii,b, c, and d, above, is below the minimum percentages specified for each shallow flood area based on the air quality model for the analysis period from July 2002 through June 2006, and there were no monitored or modeled exceedances of the federal standard at the historic

shoreline, that area will be deemed to be in compliance, if the City demonstrates in writing and the APCO reasonably determines in writing that maximum water delivery mainline flows were maintained throughout the applicable period.

B. For Shallow Flooding areas within the 12.7 square-mile 2006 SDCA:

i. The percentage of each area that must have substantially evenly distributed standing water or surface-saturated soil shall be based on the Shallow Flood Control Efficiency Curve (SFCE Curve) attached as Exhibit 3 to achieve the control efficiency levels in the MDCE Map (Exhibit 2).

ii. For Shallow Flooding areas with control efficiencies of 99 percent or more:

a. Beginning May 16 and through May 31 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 70 percent.
b. Beginning June 1 and through June 15 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 65 percent.
c. Beginning June 16 and through June 30 of every year, Shallow Flooding areal wetness cover may be reduced to a minimum of 60 percent.
d. If for any Shallow Flooding area, the percent of areal wetness cover in the periods specified in Paragraph 15.B.ii.a,b, and c, above, is below the minimum percentages specified for each shallow flood area based on the air quality model for the analysis period from July 2002 through June 2006, and there were no monitored or modeled exceedances of the federal standard at the historic shoreline, that area will be deemed to be in compliance if the City demonstrates in writing and the APCO reasonably determines in writing that maximum water delivery mainline flows were maintained throughout the applicable period.

C. Beginning on April 1, 2010, if modeled or monitoring data shows an exceedance or exceedances of the PM_{10} NAAQS at the historic shoreline as a result of excessive dry areas within Shallow Flooding control areas during the dust control periods for each year between October 1 and June 30 of the next year, the provisions of Paragraph 10 shall apply.

D. From July 1 through September 30 of each year, the City is not required by the 2008 SIP to apply water to Shallow Flooding areas for dust control purposes, but is required to maintain minimum areal wetness cover as required by applicable environmental documents, permits, leases and approvals.

E. Aerial photography, satellite imagery or other methods approved at the sole discretion of the APCO shall be used to confirm wetness coverage.

F. The following portions of the areas designated for control with Shallow Flooding are exempted from the requirement of dust control by means of a saturated surface:

i. Raised berms, roadways and their shoulders necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive and

ii. Raised pads containing vaults, pumping equipment or control equipment necessary for the operation of Shallow Flooding infrastructure which are otherwise controlled and maintained to render them substantially non-emissive.

G. "Substantially non-emissive" shall be defined to mean that the surface is protected with gravel, durable pavement or other APCO-approved surface protections sufficient to meet the requirements of District Rules 400 and 401 (visible emissions and fugitive dust).

H. Excess surface waters and shallow groundwaters above the annual average water table that existed before site construction that reach the lower boundary of the dust control areas will be contained, collected and recirculated for reapplication to dust control areas or otherwise lawfully discharged. The dust control measure areas shall have lateral boundary edge berms and/or drains as necessary to contain excess waters in the control areas and to isolate the dust control measure areas from each other and from areas not controlled. If drains are used, they shall be designed and constructed so that they may be regulated such that groundwater levels, surface water extent and wetlands in adjacent uncontrolled areas are not impacted. These requirements do not apply to Shallow Flood area T36-4, due to its adjacency to the Lower Owens River Project (LORP) and the City's intention to integrate the design and operation of T36-4 into the LORP.

I. The City shall remove all exotic pest plants, including salt cedar (*Tamarix ramosissima*), that invade any of the areas designated for control by Shallow Flooding.

J. As necessary to protect human health, the City shall prevent, avoid and/or abate mosquito, other pest vector and biting nuisance insect breeding and swarming within and in the vicinity of the control areas, including within communities less than three miles from a PM_{10} control area, by effective means that minimize adverse effects upon adjacent wildlife.

16. <u>BACM Managed Vegetation</u>

A. <u>Existing Managed Vegetation areas</u>
For areas controlled with the Managed Vegetation PM_{10} control measure prior to January 1, 2007, the areas shall be operated and maintained in accordance with a Managed Vegetation Operation and Management Plan to be approved in writing by the APCO, which approval shall not be unreasonably withheld. The requirements of the Plan may be revised upon written request by the City and written approval of the APCO, which approval shall not be unreasonable withheld,. The City's request shall contain a specific description of the modification requested and provide a demonstration regarding the effect of the modification on the environment and PM_{10} control effectiveness.

B. <u>New Managed Vegetation areas</u>
In PM_{10} control areas constructed after January 1, 2007 where Managed Vegetation is used as a PM_{10} control measure, the following performance standard shall be achieved commencing on October 1 of each year, and ending on June 30 of the next year: substantially evenly distributed live or dead vegetation coverage of at least 50 percent on each acre designated for Managed Vegetation.

C. <u>All Managed Vegetation areas</u>

i. The vegetation planted for dust control shall consist only of locally-adapted native species approved by the APCO or other species approved by both the APCO and the California State Lands Commission (CSLC). To date, the only approved locally-adapted native species is saltgrass (*Distichlis spicata*). However, other appropriate species may be approved upon written request of the City and written approval of both the APCO and CSLC.

ii. Vegetation coverage shall be measured by the point-frame method, by ground-truthed remote sensing or by other methods approved at the sole discretion of the APCO.

iii. The following portions of the areas designated for control with Managed Vegetation are exempted from the requirements set forth in Paragraphs 16.A. and 16.B., above:

   a. Portions consistently inundated with water, such as reservoirs, ponds and canals,

   b. Roadways and equipment pads necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive, and

   c. Portions used as floodwater diversion channels or desiltation/retention basins.

iv. "Substantially non-emissive" shall be defined to mean that the surface is protected with gravel, durable pavement or other APCO-approved surface protections sufficient to meet the requirements of District Rules 400 and 401 (visible emissions and fugitive dust).

v. Excess surface waters and shallow groundwaters above the root zone depths that reach the lower boundary of the dust control areas shall be collected and recirculated for reapplication to dust control areas or otherwise lawfully discharged. The dust control measure areas shall have lateral boundary edge berms and/or drains as necessary to contain excess waters in the control areas and to isolate the dust control measure areas from each other and from areas not controlled. Drains shall be designed and constructed so that they may be regulated such that groundwater levels, surface water extent and wetlands in adjacent uncontrolled areas are not impacted.

vi. To protect the Managed Vegetation control measure from flood damage and alluvial deposition, the City shall incorporate stormwater and siltation control facilities into and around Managed Vegetation areas adequate to maintain the dust mitigation function of Managed Vegetation. The Managed Vegetation protection facilities shall be designed to dissipate flood waters and capture the alluvial material carried by flood waters, so as to avoid greater than normal water flows and deposition of alluvial material into the Owens Lake brine pool.

vii. The City shall remove all exotic pest plants, including salt cedar (*Tamarix* spp.), that invade any of the areas designated for control by Managed Vegetation.

viii. As necessary to protect human health, the City shall prevent, avoid and/or abate mosquito, other pest vector and biting nuisance insect breeding and swarming within and in the vicinity of the dust control areas, including within communities less than three miles from a PM_{10} control area, by effective means that minimize adverse effects upon adjacent wildlife.

17. BACM Gravel Blanket

A. In areas where Gravel Blanket is used as a PM_{10} control measure, the City shall meet the following performance standard: one hundred percent of the control area shall be covered with a layer of gravel at least four inches thick. All gravel material placed must be screened to a size greater than one-half inch (½ inch) in diameter. Where it is necessary to support the gravel blanket, it shall be placed over a permanent permeable geotextile fabric. The gravel shall have resistance to leaching and erosion. It shall be no more toxic than the gravel from the Keeler fan site analyzed by the District in the Final Environmental Report prepared for the 1997 SIP. To minimize visual impacts, all gravel used shall be comparable in coloration to the existing lake bed soils.

B. To protect the Gravel Blanket control measure from flooding, the City shall incorporate drains and channels into and around the control measure areas adequate to maintain the dust mitigation function of the Gravel Blanket, and outlet flood waters into the Owens Lake brine pool, Shallow Flooding areas, or reservoirs. The drains and channels shall be designed to incorporate features such as desiltation or retention basins that are adequate to capture the alluvial material carried by the flood waters and to avoid greater than normal deposition of this material into the Owens Lake brine pool.

C. The gravel placement design and implementation shall adequately protect the graveled areas from the deposition of wind- and water-borne soil or infiltration of sediments from below. All graveled areas will be visually monitored to ensure that the Gravel Blanket is not filled with sand, dust or salt and that it has not been inundated or washed out from flooding. If any of these conditions are observed over areas larger than one acre, additional gravel will be transported to the playa and applied to the playa surface such that the original performance standard is maintained. The City shall apply best available control measures (BACM) and New Source Performance Standard (NSPS) emission limits to its gravel mining and transportation activities occurring within the District's geographic boundaries as required by the District in the City's District-issued Authority to Construct and Permit to Operate.

18. Alternative Non-BACM Moat & Row Control Measure

A. The Moat & Row PM_{10} control measure is not a currently-approved BACM. The preliminary form of Moat & Row is described in Exhibit 4 of the 2006 Settlement

Agreement between the District and the City (Attachment A). The final form of the Moat & Row PM_{10} control measure will be determined from the results of a demonstration project and testing to be conducted by the City on the lake bed. All Moat & Row controls will be designed, constructed and operated to achieve the MDCEs described in Paragraph 9.

B. The PM_{10} control effectiveness of Moat & Row may be enhanced by combining it with other dust control methods such as vegetation, water, gravel, or the addition of other features that enhance sand capture and sheltering or directly protect the lake bed surface from wind erosion. The effectiveness of the array can also be increased by adding additional moats and rows to the array.

C. Final design for the Moat & Row control measure will be determined solely by the City after consultation with and written notification to the District. The City shall consider the following elements in its final design:

i. Test results demonstrating that the required MDCE for each Moat & Row area can be met,

ii. Completion of all required environmental documentation, approvals, permits and leases, and

iii. Inclusion of monitoring in the infrastructure design to continuously monitor compliance with the target MDCE for each area.

D. Upon written request of the City, the APCO shall determine in writing if any given Moat & Row design constitutes BACM or MDCE-BACM in accordance with Attachment D, “2008 Procedure for Modifying Best Available Control Measures (BACM) for the Owens Valley Planning Area.”

E. Areas of Moat & Row that do not function as designed or that cause or contribute to an exceedance of the federal 24-hour PM_{10} NAAQS will be remediated as specifically provided in Attachment B, the “2008 Owens Valley Planning Area Supplemental Control Requirements Determination Procedure.”

PM_{10} CONTROL MEASURE COMPLIANCE AND ENFORCEMENT

19. The District and City will work collaboratively to develop improved wetness and vegetative cover measurement techniques, control efficiency relationships, and compliance specifications for all PM_{10} control measures. Final acceptance and implementation of all compliance measurement techniques and PM_{10} control measure compliance specifications with regulatory impact will be at the sole discretion of the APCO.

STORMWATER MANAGEMENT

20. The City shall design, install, continually operate and maintain flood and siltation control facilities to protect the all PM_{10} control measures installed on the lake bed at all times, and in a manner that groundwater levels, surface water extent, and wetlands in adjacent

uncontrolled areas are not impacted by induced drainage. Flood and siltation control facilities shall be integrated into the design and operation of the PM_{10} control measures. All flood and siltation control facilities and PM_{10} control measures damaged by stormwater runoff or flooding shall be promptly repaired and restored to their designed level of protection and effectiveness. All flood and siltation control facilities shall be designed and operated in a manner to prevent any greater threat of alluvial material contamination to the existing trona mineral deposit lease area (State Lands Commission leases PRC 5464.1, PRC 3511 and PRC 2969.1) than would have occurred under natural conditions prior to the installation of PM_{10} control measures.

SCHEDULE

21. The Control Measures shall be implemented on the areas set forth in Paragraphs 1 through 4 by the dates set forth in those Paragraphs. Supplemental Control Requirements shall be met on the schedule provided for in Attachment B.

PERFORMANCE MONITORING PLAN

22. The City, in consultation with the District, shall annually develop and provide to the District in writing a Performance Monitoring Plan (PMP) to aid in its operation of the Owens Lake dust mitigation program on the Owens Lake bed.

    A. The PMP shall describe the measurements and methods used to verify the performance of the constructed DCMs. The PMP shall also describe the measurements and methods used to maximize information on dust emissions from any areas of special interest.

    B. The City shall implement the PMP, and will use the results as a guide for making operational decisions about the type, location, timing, and level of dust control measures needed to prevent exceedances of the federal standard at the shoreline.

    C. The District may use information from the PMP to assist in determining the likely sources of dust emissions causing or contributing to exceedances (if any) of the federal standard at the shoreline.

    D. The PMP for each calendar year shall be submitted to the APCO by March 31 of the following calendar year.

ADDITIONAL REQUIREMENTS

23. The District Board orders the City of Los Angeles to satisfy the following requirements related to the implementation of the Shallow Flooding, Managed Vegetation, Gravel Blanket and Moat & Row control measures:

    A. The City's construction, operation and maintenance activities shall comply with all Mitigation Measures set forth in Final Environmental Impact Reports, EIR Addendums and Mitigated Negative Declarations associated with the areas on which dust controls are placed, and all subsequent environmental documents adopted by the District for implementation of the requirements of this SIP.

B. The City shall comply with any and all applicable requirements of the Mitigation Monitoring and Reporting Programs adopted by the District and associated with the Final Environmental Impact Reports and Final Environmental Impact Report Addendums for this project, and with all subsequent environmental documents adopted by the District for implementation of the requirements of this SIP. All mitigation measures required in certified environmental documents associated with the implementation, operation and maintenance of PM_{10} control measures required by this order are hereby incorporated as requirements of this order and may be enforced as such.

C. The City shall apply best available control measures (BACM) to control air emissions from its construction/implementation activities occurring in the District's geographic boundaries.

Exhibits

Exhibit 1 Map and Coordinates of PM_{10} Control Areas

Exhibit 2 Minimum Dust Control Efficiency Map

Exhibit 3 Shallow Flood Control Efficiency Curve

Attachments

Attachment A 2006 Settlement Agreement between the Great Basin Unified Air Pollution Control District and the City of Los Angeles

Attachment B 2008 Owens Valley Planning Area Supplemental Control Requirements Determination Procedure

Attachment C 2008 Owens Lake Dust Source Identification Program Protocol

Attachment D 2008 Procedure for Modifying Best Available Control Measures (BACM) for the Owens Valley Planning Area

Exhibit 1 - Map and coordinates of PM_{10} control areas

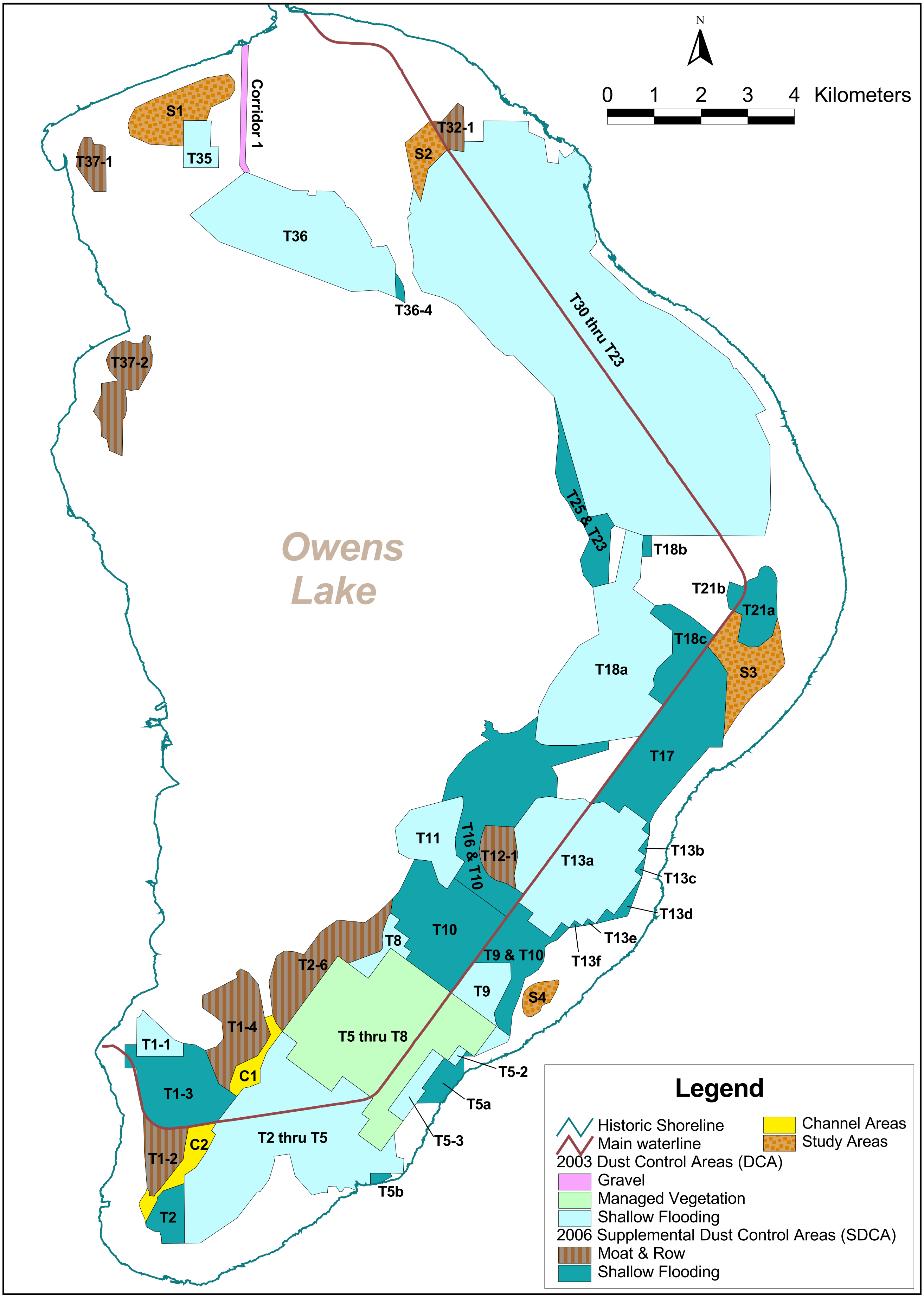

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T32-1	0.17	SDCA	415,639.7810	4,042,385.2695
			415,283.2810	4,043,000.1953
			415,539.4060	4,042,999.0234
			415,866.3750	4,043,383.8359
			415,994.4060	4,043,304.2109
			416,002.6250	4,042,981.9922
			416,005.6250	4,042,568.5234
			416,000.9380	4,042,344.1055
			415,872.2190	4,042,360.3477
			415,645.7500	4,042,391.2070
			415,639.7810	4,042,385.2695
T37-1	0.21	SDCA	408,348.9690	4,041,492.4844
			408,085.5000	4,041,493.3164
			407,718.8130	4,042,027.7422
			407,731.5000	4,042,299.3945
			407,804.9060	4,042,524.2148
			407,873.2810	4,042,654.1211
			408,032.2500	4,042,647.6875
			408,089.5630	4,042,502.0625
			408,267.6560	4,042,491.4219
			408,347.0630	4,042,440.3203
			408,348.9690	4,041,492.4844
T36-4	0.03	SDCA	414,532.5630	4,039,759.7188
			414,583.3750	4,039,699.2617
			414,643.3130	4,039,605.6250
			414,700.5000	4,039,498.9766
			414,718.6880	4,039,441.7188
			414,729.1250	4,039,314.2500
			414,747.2500	4,039,108.7500
			414,550.5940	4,039,224.6563
			414,528.0310	4,039,697.5039
			414,532.5630	4,039,759.7188
T37-2	0.59	SDCA	408,694.5000	4,035,836.9883
			408,417.2190	4,035,957.7344
			408,370.5940	4,036,191.9453
			408,249.5940	4,036,258.3164
			408,231.6880	4,036,571.0625
			408,075.5000	4,036,791.1719
			408,254.4060	4,037,157.2813
			408,249.9060	4,037,387.3789
			408,606.5630	4,037,448.5391
			408,414.0000	4,037,664.3359
			408,348.8750	4,037,888.7227
			408,415.9060	4,038,042.2422
			408,494.0000	4,038,156.0977
			408,687.9380	4,038,284.6484
			408,762.7190	4,038,303.7813
			408,853.0940	4,038,290.2422
			408,911.3130	4,038,246.2109
			409,028.9380	4,038,251.5742
			409,126.1560	4,038,258.7344
			409,134.0630	4,038,309.6602
			409,144.5940	4,038,382.5547
			409,201.0630	4,038,424.0508
			409,255.5940	4,038,422.9180
			409,299.1250	4,038,391.3789
			409,304.7190	4,038,329.9609
			409,254.9380	4,038,259.1797
			409,308.0940	4,038,163.0195
			409,312.7190	4,038,061.7695
			409,335.7190	4,038,017.0195
			409,334.3750	4,037,792.3008
			409,260.5630	4,037,628.4492
			409,184.9060	4,037,508.1055
			409,044.0630	4,037,256.8359
			408,869.9060	4,037,236.6055
			408,755.8130	4,037,260.8867
			408,768.2810	4,037,143.0156
			408,784.9690	4,037,079.6914
			408,789.7190	4,036,817.3555
			408,751.4060	4,036,667.7344
			408,706.5940	4,036,616.2422
			408,694.5000	4,035,836.9883

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T25 & T23	0.57	SDCA	418754.0310	4033026.4648
			418552.9690	4033287.6914
			418484.0000	4033621.1133
			418689.0940	4034066.4102
			418529.0310	4034424.5078
			418434.8130	4034452.0664
			418325.1880	4034653.5234
			418224.7810	4034845.3438
			418067.7500	4035047.7852
			417953.1880	4035467.4961
			417980.5000	4035865.3203
			418027.9060	4036319.6094
			417924.7190	4037107.5195
			418665.4380	4034527.8516
			419064.9060	4034610.8672
			419222.8750	4034343.4492
			419141.3750	4034271.8047
			419084.1880	4033110.8242
			418754.0310	4033026.4648
T18b	0.03	SDCA	419802.4690	4033687.7656
			420012.7190	4033690.4844
			420006.8750	4034140.9297
			419832.0310	4034141.9609
			419802.4690	4033687.7656
T21a	0.43	SDCA	421766.0310	4032526.5938
			421758.4690	4032529.3477
			421806.2810	4032593.7305
			421884.3440	4032697.7148
			421918.7190	4032746.2988
			421948.4060	4032795.7422
			421977.7500	4032858.2227
			421994.8130	4032902.9766
			422010.1880	4032960.1484
			422019.3130	4033018.7031
			422022.5630	4033079.4023
			422021.5000	4033108.1875
			422103.3750	4033191.3320
			422274.9380	4033248.8359
			422331.4380	4033437.2383
			422451.9060	4033492.2617
			422530.2190	4033470.0195
			422579.0940	4033430.6797
			422659.7190	4033313.9453
			422698.6880	4033173.2383
			422688.0630	4032830.0469
			422701.7500	4032367.5195
			422592.2190	4031994.7988
			422299.6560	4031762.5020
			422105.2500	4031749.0176
			421854.9690	4031871.4102
			421952.1880	4032442.4199
			421827.1560	4032498.3555
			421778.4380	4032522.0762
			421766.0310	4032526.5938
T21b	0.06	SDCA	422021.5000	4033108.1875
			421959.5000	4033044.5586
			421680.6250	4033146.5156
			421615.5310	4032859.4297
			421668.6250	4032569.9238
			421758.4690	4032529.3477
			421806.2810	4032593.7305
			421884.3440	4032697.7148
			421918.7190	4032746.2988
			421948.4060	4032795.7422
			421977.7500	4032858.2227
			421994.8130	4032902.9766
			422010.1880	4032960.1484
			422019.3130	4033018.7031
			422022.5630	4033079.4023
			422021.5000	4033108.1875

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T18c	0.53	SDCA	420,276.9060	4,030,498.4297
			419,947.7810	4,030,741.5820
			420,067.1880	4,030,907.8086
			420,051.5940	4,031,073.7539
			420,132.5000	4,031,300.5000
			420,460.9690	4,031,604.8574
			420,448.8130	4,032,104.4238
			420,133.6880	4,032,354.6504
			419,976.0000	4,032,480.4629
			420,091.3440	4,032,635.9063
			420,399.6560	4,032,679.1270
			420,847.1880	4,032,406.2988
			421,369.5310	4,031,989.5391
			421,208.0630	4,031,771.3574
			421,204.5310	4,031,775.5723
			420,996.0630	4,031,494.8789
			420,276.9060	4,030,498.4297
T17	1.77	SDCA	419,965.0000	4,027,728.2129
			419,803.2190	4,027,847.7363
			419,922.8440	4,028,009.4902
			419,437.4690	4,028,368.0195
			419,317.9690	4,028,206.2617
			418,994.5310	4,028,445.2656
			418,723.3130	4,028,395.6211
			418,709.8750	4,028,405.5527
			418,741.5630	4,028,448.9863
			419,397.6250	4,029,329.5273
			419,791.5940	4,029,850.3008
			419,798.7500	4,029,851.3320
			420,276.9060	4,030,498.4297
			420,996.0630	4,031,494.8789
			421,204.5310	4,031,775.5723
			421,439.0940	4,031,498.2363
			421,631.0310	4,031,208.7773
			421,571.8750	4,030,077.3184
			421,548.9690	4,029,833.7383
			421,523.2500	4,029,607.1328
			421,241.1880	4,029,607.8887
			421,116.0000	4,029,457.7559
			420,776.0000	4,029,075.9551
			420,233.7500	4,028,421.8027
			420,070.9690	4,028,193.2832
			419,973.2500	4,027,978.3457
			419,965.0000	4,027,728.2129
T16 & T10	2.00	SDCA	416,930.1250	4,025,968.3438
			415,789.8440	4,026,810.3555
			416,016.5310	4,027,163.7949
			415,829.9690	4,027,301.7383
			415,812.0000	4,027,654.7695
			415,987.3440	4,028,348.7813
			415,969.6880	4,028,562.7461
			415,530.3750	4,028,446.4922
			415,660.2500	4,028,955.4551
			416,062.8130	4,029,458.0664
			416,386.1560	4,029,683.9746
			416,436.9060	4,029,720.7148
			416,449.5000	4,029,732.7207
			416,468.5940	4,029,742.7246
			416,489.8750	4,029,746.4355
			416,529.4060	4,029,741.9941
			416,547.9690	4,029,741.4180
			416,541.4060	4,029,755.8789
			416,528.0940	4,029,767.9277
			416,515.2190	4,029,777.7969
			416,501.9690	4,029,786.2637
			416,489.6560	4,029,794.9004
			416,430.1250	4,029,834.6543
			416,415.3750	4,029,843.4570
			416,400.7190	4,029,849.4766
			416,387.3130	4,029,856.1563
			416,372.5940	4,029,860.3105
			416,368.5310	4,029,870.0703
			416,375.7810	4,029,880.6270
			416,384.4690	4,029,895.7617
			416,385.5310	4,029,910.9023
			416,395.3130	4,029,918.6621
			416,406.0630	4,029,922.9727
			416,419.9060	4,029,929.8086
			416,435.1560	4,029,936.6543
T16 & T10 continued	2.00	SDCA	416449.2500	4029947.3340
			416459.1250	4029961.2246
			416462.9690	4029976.8418
			416471.5630	4029988.3965
			416481.0000	4029994.3359
			416483.2500	4030000.4590
			416476.4690	4030004.0684
			416464.6250	4030013.5332
			416452.1250	4030020.7266
			416447.3130	4030031.0762
			416454.8750	4030042.8809
			416467.7500	4030052.9766
			416466.0630	4030067.6035
			416454.5310	4030077.5586
			416440.6250	4030076.0938
			416437.6250	4030084.6914
			416445.8130	4030098.3496
			416459.0310	4030110.6875
			416465.9060	4030126.0488
			416467.1560	4030142.7871
			416461.5310	4030157.1523
			416450.1560	4030168.0938
			416439.0940	4030177.2402
			416443.8750	4030188.7227
			416458.4380	4030192.3809
			416470.3130	4030190.8789
			416479.0310	4030177.9727
			416493.8130	4030171.2637
			416510.6250	4030166.2656
			416527.2190	4030165.8828
			416541.7810	4030161.9238
			416568.0630	4030143.3945
			416585.0000	4030137.3281
			416601.6250	4030130.7734
			416608.7190	4030112.7188
			416614.8750	4030093.7324
			416614.1560	4030081.1367
			416606.9690	4030057.0176
			416610.2810	4030041.6328
			416621.0310	4030029.7910
			416626.8440	4030016.4492
			416634.6560	4030003.4863
			416639.6560	4029988.0273
			416642.2500	4029973.2676
			416656.7190	4029972.4727
			416688.3750	4029977.5293
			416704.9380	4029976.5762
			416715.9690	4029964.5742
			416723.1250	4029949.7949
			416734.4690	4029937.7109
			416747.7190	4029929.2070
			416759.0310	4029916.4004
			416768.4690	4029902.2207
			416781.8130	4029898.3633
			416790.3750	4029900.3945
			416827.0940	4029907.2129
			416838.2500	4029915.7813
			416845.7500	4029917.9492
			416852.5940	4029916.0938
			416867.9690	4029916.1543
			416880.3440	4029917.7637
			416895.6880	4029914.7402
			416925.9380	4029904.3965
			416940.7190	4029903.4805
			416954.8130	4029907.8730
			416966.3750	4029914.2246
			417119.3130	4029946.7070
			417187.6250	4029971.9180
			417581.8750	4030267.7148
			417521.0310	4029772.5156
			417653.4060	4029674.6738
			417852.7810	4029647.5566
			418383.2810	4029647.0859
			419085.9690	4029748.5098
			419093.6560	4029564.0527
			417877.2810	4029195.6055
			418000.2190	4028968.8594
			417985.4380	4028529.5684
			417827.8440	4028557.0566
			417546.5630	4028514.7832
			417094.6880	4027903.0527

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T16 & T10 continued	2.00	SDCA	416,457.7500	4,027,936.9766
			416,404.6880	4,027,788.4297
			416,365.0310	4,027,655.1465
			416,321.9690	4,027,364.6660
			416,373.0940	4,027,155.4727
			416,439.1560	4,026,996.8691
			416,529.0000	4,026,870.1172
			416,679.5310	4,026,765.2285
			416,794.3130	4,026,730.5000
			416,918.4690	4,026,690.9277
			417,059.9690	4,026,600.0957
			417,118.0940	4,026,580.9805
			417,289.0630	4,026,454.5645
			416,930.1250	4,025,968.3438
T12-1	0.33	SDCA	417,094.6880	4,027,903.0527
			416,457.7500	4,027,936.9766
			416,404.6880	4,027,788.4297
			416,365.0310	4,027,655.1465
			416,321.9690	4,027,364.6660
			416,373.0940	4,027,155.4727
			416,439.1560	4,026,996.8691
			416,529.0000	4,026,870.1172
			416,679.5310	4,026,765.2285
			416,794.3130	4,026,730.5000
			416,918.4690	4,026,690.9277
			417,059.9690	4,026,600.0957
			417,118.0940	4,026,580.9805
			417,075.7810	4,026,862.2246
			417,153.0940	4,027,305.2637
			417,068.6250	4,027,867.7852
			417,094.6880	4,027,903.0527
T13B	0.02	SDCA	419,887.6880	4,027,285.1777
			419,726.0630	4,027,404.7207
			419,965.0000	4,027,728.2129
			419,949.5310	4,027,659.1582
			419,887.6880	4,027,285.1777
T13c	0.02	SDCA	419,810.5000	4,026,842.1797
			419,648.7500	4,026,961.7246
			419,887.6880	4,027,285.1777
			419,878.5000	4,027,228.6270
			419,810.5000	4,026,842.1797
T10	1.51	SDCA	414,755.7190	4,025,075.7422
			414,875.1560	4,025,237.4785
			414,713.3750	4,025,356.9609
			414,832.8130	4,025,518.7363
			414,509.4060	4,025,757.7637
			414,628.8750	4,025,919.4863
			414,432.8750	4,026,064.3691
			414,474.4380	4,026,371.4551
			414,574.5630	4,026,473.5742
			414,628.3130	4,026,552.7695
			414,946.8130	4,027,212.2402
			415,303.7810	4,027,171.2852
			415,463.6880	4,026,710.9355
			415,641.0630	4,026,578.4043
			415,789.8440	4,026,810.3555
			416,930.1250	4,025,968.3438
			416,221.4060	4,025,003.5195
			415,803.2190	4,024,437.5703
			415,788.3750	4,024,419.2480
			415,755.0630	4,024,385.7285
			415,740.0630	4,024,367.4102
			415,730.9380	4,024,355.1348
			414,755.7190	4,025,075.7422
T13d	0.08	SDCA	418,812.1880	4,025,829.3945
			419,051.1560	4,026,152.9102
			419,212.9380	4,026,033.3887
			419,810.5000	4,026,842.1797
			419,654.8130	4,026,404.0859
			419,499.9380	4,025,999.3496
			419,182.9690	4,025,925.2813
			418,812.1880	4,025,829.3945

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T2-6	0.97	SDCA	411915.1560	4023883.7793
			411828.0940	4024594.2207
			411988.0310	4025141.2695
			412161.8440	4025254.5859
			412387.4060	4025234.3184
			412577.3130	4025175.8184
			412752.9380	4025413.6777
			412942.5940	4025667.2090
			413298.0630	4025913.1816
			413700.7190	4025878.1113
			413843.4060	4025859.0313
			413892.3750	4025869.0625
			414103.4380	4026021.7207
			414294.0310	4026188.3672
			414474.4380	4026371.4551
			414432.8750	4026064.3691
			414383.9380	4025998.1035
			414275.7810	4025684.7422
			414249.7810	4025496.0488
			414265.6560	4025321.0762
			414210.4380	4025245.9102
			413520.9060	4024987.7734
			413307.2500	4025145.6113
			412118.5000	4023536.9766
			411983.4060	4023714.6152
			411915.1560	4023883.7793
T9 & T10	0.70	SDCA	416221.4060	4025003.5195
			416930.1250	4025968.3438
			417169.6250	4026292.8027
			417483.0630	4026061.2207
			417363.6560	4025899.4727
			417848.8440	4025540.9238
			418087.8130	4025864.4414
			418249.6250	4025744.9199
			417981.1560	4025483.1621
			417862.3130	4025432.8262
			417742.6560	4025357.7832
			417731.0940	4025299.8848
			417711.4060	4025042.9023
			417596.9060	4024857.0391
			417427.9690	4024735.2051
			417308.1560	4024673.9160
			417192.2500	4024288.4082
			417038.6560	4023907.3789
			416987.0630	4023427.0801
			416718.5940	4023625.4961
			416734.5000	4023647.0195
			416700.3130	4023672.3301
			416688.8130	4023734.0977
			416678.0000	4023742.0566
			416644.1880	4023924.8242
			417009.4380	4024643.3945
			416999.7190	4024998.1367
			416221.4060	4025003.5195
T13e	0.01	SDCA	418530.9060	4025787.1563
			418650.3750	4025948.9160
			418812.1880	4025829.3945
			418722.7810	4025817.3457
			418530.9060	4025787.1563
T13f	0.01	SDCA	418249.6250	4025744.9199
			418369.0940	4025906.6797
			418530.9060	4025787.1563
			418416.1250	4025770.9355
			418249.6250	4025744.9199
T1-4	0.81	SDCA	410989.3130	4022252.0020
			410984.9060	4022253.3125
			410759.9060	4022411.6719
			410472.0310	4023123.1973
			410718.0630	4023206.8965
			410862.1250	4023378.8164
			410821.5940	4023731.0039
			410665.3750	4023862.7910
			410401.5000	4024041.8867
			410411.4380	4024308.5215
			410520.6560	4024349.3066
			411162.2810	4024681.8047
			411124.9690	4024778.6250
			411222.3440	4024873.7930

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83)	
			X-coordinates	Y-coordinates
T1-4	0.81	SDCA	411,392.4060	4,024,792.1602
continued			411,607.8130	4,024,539.2461
			411,737.1560	4,023,825.0313
			411,867.2500	4,023,463.2520
			411,784.7500	4,023,306.3613
			411,582.4060	4,023,006.9551
			411,126.7810	4,022,795.5957
			410,994.2500	4,022,416.6367
			410,989.3130	4,022,252.0020
T1-3	1.09	SDCA	410,109.0000	4,021,484.2637
			410,014.9380	4,021,469.1094
			409,986.8440	4,021,465.6152
			409,959.4380	4,021,467.4043
			409,836.5940	4,021,452.1992
			409,710.2810	4,021,438.8574
			409,583.4380	4,021,449.5684
			409,464.4690	4,021,488.9551
			409,351.8750	4,021,549.4316
			409,255.5940	4,021,639.3984
			409,218.6880	4,021,681.9980
			409,176.1250	4,021,738.1621
			409,146.5630	4,021,804.0762
			409,136.6880	4,021,861.1289
			409,118.7810	4,021,931.0723
			409,108.8130	4,021,989.7910
			409,094.0000	4,022,070.1055
			409,085.6880	4,022,117.5977
			409,078.5310	4,022,146.7773
			409,061.1250	4,022,247.9473
			409,045.9690	4,022,310.3633
			409,033.1250	4,022,381.5703
			409,029.3750	4,022,398.8301
			409,009.4380	4,022,518.7207
			409,000.8440	4,022,749.8164
			408,748.8130	4,022,752.2285
			408,748.6880	4,022,994.9199
			408,752.0000	4,023,250.6855
			409,002.0630	4,023,249.9121
			408,999.6250	4,023,000.2637
			410,005.2500	4,022,997.9414
			410,001.3440	4,023,280.3730
			410,254.3750	4,023,245.9746
			410,472.0310	4,023,123.1973
			410,759.9060	4,022,411.6719
			410,984.9060	4,022,253.3125
			410,989.3130	4,022,252.0020
			411,145.5940	4,022,140.7344
			410,718.8440	4,021,593.2148
			410,712.3750	4,021,582.9375
			410,529.8750	4,021,556.1816
			410,438.7190	4,021,533.8438
			410,335.4060	4,021,518.5000
			410,242.0940	4,021,502.6836
			410,174.2810	4,021,494.7188
			410,109.0000	4,021,484.2637
T5a	0.21	SDCA	414,982.1560	4,021,997.8184
			415,526.5000	4,022,002.0215
			416,002.5310	4,022,602.1270
			415,998.3750	4,023,002.3203
			416,206.3130	4,023,003.7539
			416,056.9690	4,023,114.1348
			415,817.9380	4,022,790.5840
			415,581.1880	4,022,965.4980
			415,103.1880	4,022,318.4160
			415,178.0630	4,022,263.0664
			414,982.1560	4,021,997.8184
T1-2	0.39	SDCA	409,223.5310	4,020,182.5996
			409,280.3750	4,020,086.8984
			409,276.4690	4,020,023.0879
			409,360.9380	4,020,010.4766
			409,373.6560	4,020,006.3652
			409,409.3130	4,020,065.3262
			409,487.5940	4,020,143.3262
			409,998.0310	4,020,801.4766
			410,027.5940	4,021,036.2754
			410,109.0000	4,021,484.2637
			410,014.9380	4,021,469.1094
			409,986.8440	4,021,465.6152
			409,959.4380	4,021,467.4043
			409,836.5940	4,021,452.1992

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83)	
			X-coordinates	Y-coordinates
T1-2	0.39	SDCA	409710.2810	4021438.8574
continued			409583.4380	4021449.5684
			409495.3440	4021478.5996
			409464.4690	4021488.9551
			409351.8750	4021549.4316
			409255.5940	4021639.3984
			409218.6880	4021681.9980
			409176.1250	4021738.1621
			409146.5630	4021804.0762
			409166.6250	4020986.3672
			409223.5310	4020182.5996
T5b	0.03	SDCA	414001.2500	4020257.5078
			414001.4690	4020502.4766
			414426.0000	4020500.8613
			414464.0310	4020432.0313
			414293.7190	4020338.7207
			414135.9690	4020279.6660
			414001.2500	4020257.5078
T2	0.29	SDCA	410025.1560	4019002.0527
			410016.8750	4020278.1387
			409576.6880	4020126.1250
			409445.4060	4019983.3887
			409435.7810	4019902.2852
			409208.0310	4019472.8008
			409200.4380	4019355.6914
			409374.7500	4019259.9512
			409428.5630	4019253.1973
			409493.8750	4019250.0898
			409534.9380	4019112.7676
			409535.8130	4018994.6445
			410025.1560	4019002.0527
S1	0.71	Study	410001.6560	4042464.2656
			409290.7190	4042500.2383
			408861.2190	4042688.4688
			408813.8750	4042910.9609
			408859.4380	4043071.8984
			408972.0940	4043285.6914
			409337.5310	4043461.0000
			410500.6560	4043924.3945
			410962.4690	4044000.3555
			411096.8440	4043852.2109
			411108.0630	4043672.6836
			410984.4380	4043481.0273
			410592.0940	4043294.9219
			410496.6250	4043013.0352
			410088.4380	4043009.1836
			410003.7500	4043010.8320
			410001.6560	4042464.2656
S2	0.28	Study	414928.6560	4041572.7617
			415075.1250	4041273.9336
			415237.3130	4041985.5195
			415639.7810	4042385.2695
			415283.2810	4043000.1953
			414740.2500	4042529.6992
			414928.6560	4041572.7617
S3	0.72	Study	421208.0630	4031771.3574
			421766.0310	4032526.5938
			421778.4380	4032522.0762
			421827.1560	4032498.3555
			421952.1880	4032442.4199
			421854.9690	4031871.4102
			422105.2500	4031749.0176
			422299.6560	4031762.5020
			422592.2190	4031994.7988
			422701.7500	4032367.5195
			422732.5630	4032243.8984
			422746.8130	4032159.0254
			422779.7500	4032064.7734
			422779.7190	4031946.8984
			422793.9060	4031814.8984
			422817.5310	4031682.9316
			422840.9690	4031565.0645
			422869.3130	4031447.2109
			422836.2810	4031338.7852
			422713.7500	4031206.8086
			422529.9380	4030985.2422
			422250.5940	4030779.7578
			422000.0310	4030499.9922

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
S3 continued	0.72	Study	422,006.2810	4,030,500.0156
			421,836.9380	4,030,271.0234
			421,548.9690	4,029,833.7383
			421,571.8750	4,030,077.3184
			421,631.0310	4,031,208.7773
			421,439.0940	4,031,498.2363
			421,208.0630	4,031,771.3574
S4	0.15	Study	417,410.5630	4,023,845.5176
			417,398.8440	4,023,845.8750
			417,387.4380	4,023,846.9883
			417,377.4060	4,023,848.7207
			417,367.8440	4,023,851.0527
			417,358.9380	4,023,853.9434
			417,350.9380	4,023,857.4238
			417,343.0940	4,023,861.6250
			417,335.2810	4,023,866.7793
			417,327.4690	4,023,872.8066
			417,319.6880	4,023,879.7500
			417,310.5940	4,023,888.9688
			417,301.9690	4,023,899.1680
			417,293.6560	4,023,910.1230
			417,286.2810	4,023,921.5137
			417,281.1250	4,023,930.3848
			417,276.9060	4,023,939.6543
			417,273.1560	4,023,949.9414
			417,269.7190	4,023,961.3281
			417,266.5000	4,023,975.5664
			417,263.6560	4,023,992.3125
			417,257.5630	4,024,036.4043
			417,255.7810	4,024,053.0898
			417,254.3440	4,024,071.4844
			417,253.3440	4,024,112.0410
			417,253.6880	4,024,135.3887
			417,256.4690	4,024,211.2207
			417,258.9380	4,024,248.6602
			417,260.8130	4,024,266.7930
			417,266.0630	4,024,299.1426
			417,269.5630	4,024,313.8516
			417,274.6560	4,024,330.5859
			417,281.5940	4,024,349.5684
			417,289.7810	4,024,368.9414
			417,298.0630	4,024,386.4863
			417,306.2810	4,024,401.4785
			417,314.9690	4,024,415.0508
			417,324.0630	4,024,427.2441
			417,333.2500	4,024,437.8730
			417,341.8130	4,024,446.3809
			417,362.2810	4,024,463.6328
			417,374.6880	4,024,472.7871
			417,391.6880	4,024,484.4727
			417,422.5940	4,024,504.8984
			417,438.9380	4,024,515.1504
			417,454.8440	4,024,524.5742
			417,469.5000	4,024,532.6895
			417,483.8130	4,024,540.1250
			417,497.9690	4,024,546.9180
			417,525.0310	4,024,558.3184
			417,537.3130	4,024,562.7500
			417,550.9690	4,024,567.0371
			417,565.6880	4,024,571.1504
			417,595.7190	4,024,578.3379
			417,644.3750	4,024,588.4512
			417,671.1560	4,024,593.2676
			417,699.5630	4,024,597.4395
			417,729.9690	4,024,601.0371
			417,763.4060	4,024,604.2285
			417,801.4380	4,024,607.2109
			417,876.5000	4,024,612.3184
			417,885.9690	4,024,613.4160
			417,906.1880	4,024,617.6074
			417,954.9060	4,024,630.4629
			417,966.3750	4,024,632.8535
			417,976.4690	4,024,634.2813
			417,984.4060	4,024,634.8398
			417,991.7190	4,024,634.7266
			417,998.0940	4,024,633.9082
			418,004.0310	4,024,632.4531
			418,009.1560	4,024,630.2891
			418,013.8130	4,024,627.4102
			418,017.8750	4,024,623.8594
			418,021.4380	4,024,619.5566
			418,027.1560	4,024,609.7598

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
S4 continued	0.15	Study	418032.4060	4024597.6895
			418034.6560	4024589.4512
			418035.8750	4024580.7773
			418035.6560	4024570.7617
			418034.0630	4024559.9766
			418031.0630	4024548.3418
			418026.3750	4024535.4473
			418020.4690	4024521.3984
			418000.5310	4024478.6465
			417984.5630	4024435.9668
			417970.9060	4024402.7227
			417957.8130	4024373.8125
			417943.3130	4024343.8242
			417931.2500	4024320.3027
			417918.0940	4024295.7734
			417880.1250	4024228.6719
			417859.5000	4024190.0117
			417854.1250	4024181.0176
			417848.9380	4024173.2773
			417843.6250	4024166.4160
			417838.3130	4024160.3535
			417832.0940	4024154.4258
			417825.1250	4024149.1992
			417816.9690	4024144.4160
			417807.5630	4024140.0762
			417799.1250	4024136.8242
			417789.4690	4024133.5957
			417744.3750	4024120.6641
			417733.3130	4024116.6641
			417723.6250	4024112.4082
			417716.8440	4024108.7773
			417710.6880	4024104.8281
			417693.1880	4024092.0859
			417683.1250	4024084.1797
			417674.4380	4024076.5137
			417667.2810	4024069.1191
			417661.4690	4024061.8086
			417657.0630	4024054.5488
			417654.5000	4024048.2773
			417652.5000	4024040.8516
			417647.9060	4024009.5918
			417646.3750	4024002.8047
			417644.5940	4023996.9746
			417640.7500	4023988.9395
			417636.0310	4023980.8086
			417630.3750	4023972.9629
			417623.6560	4023965.2930
			417617.2810	4023958.7949
			417609.9690	4023952.3184
			417601.7810	4023945.7832
			417592.6250	4023939.0781
			417575.3440	4023927.6641
			417540.5940	4023906.3262
			417526.8440	4023897.4316
			417515.0940	4023889.3320
			417487.6880	4023868.7949
			417472.0940	4023858.9844
			417463.6560	4023854.8926
			417455.1880	4023851.9063
			417444.7810	4023849.1504
			417433.6250	4023847.1348
			417422.1560	4023845.9258
			417410.5630	4023845.5176
C1	0.21	Channel	410989.3130	4022252.0020
			410994.2500	4022416.6367
			411126.7810	4022795.5957
			411582.4060	4023006.9551
			411784.7500	4023306.3613
			411867.2500	4023463.2520
			411737.1560	4023825.0313
			411915.1560	4023883.7793
			411983.4060	4023714.6152
			412118.5000	4023536.9766
			411783.0000	4023082.8359
			411698.3750	4022867.5078
			411641.7810	4022726.1934
			411641.2190	4022434.6367
			411422.2810	4022348.0508
			411285.7500	4022320.5957
			411145.5940	4022140.7344
			410989.3130	4022252.0020

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83)	
			X-coordinates	Y-coordinates
C2	0.29	Channel	409,223.5310	4,020,182.5996
			409,280.3750	4,020,086.8984
			409,276.4690	4,020,023.0879
			409,360.9380	4,020,010.4766
			409,373.6560	4,020,006.3652
			409,409.3130	4,020,065.3262
			409,487.5940	4,020,143.3262
			409,998.0310	4,020,801.4766
			410,027.5940	4,021,036.2754
			410,109.0000	4,021,484.2637
			410,174.2810	4,021,494.7188
			410,242.0940	4,021,502.6836
			410,335.4060	4,021,518.5000
			410,438.7190	4,021,533.8438
			410,529.8750	4,021,556.1816
			410,712.3750	4,021,582.9375
			410,604.9060	4,021,412.4785
			410,687.5940	4,021,327.9746
			410,488.7190	4,020,946.6582
			410,264.9380	4,020,620.1895
			410,015.6880	4,020,454.4141
			410,016.8750	4,020,278.1387
			409,576.6880	4,020,126.1250
			409,445.4060	4,019,983.3887
			409,435.7810	4,019,902.2852
			409,208.0310	4,019,472.8008
			409,201.5000	4,019,370.5664
			409,173.3130	4,019,532.8418
			409,115.7190	4,019,657.4395
			409,058.5940	4,019,813.5703
			409,055.4380	4,019,859.0117
			409,098.6560	4,019,944.7520
			409,192.5940	4,020,079.2344
			409,223.5310	4,020,182.5996
Corridor 1	0.14	DCM	411,404.0940	4,041,881.5078
			411,328.8130	4,041,911.0039
			411,307.5940	4,041,894.7266
			411,206.9380	4,042,044.9063
			411,252.4060	4,044,581.8867
			411,297.8130	4,044,632.7539
			411,393.9060	4,044,623.3633
			411,326.8130	4,042,108.9727
			411,411.9380	4,041,944.4414
			411,404.0940	4,041,881.5078
T35	0.26	DCM	410,001.6560	4,042,464.2656
			410,000.0000	4,042,003.4180
			410,754.6560	4,042,002.5391
			410,757.3750	4,042,448.5820
			410,577.9380	4,042,452.2773
			410,599.0630	4,042,999.1289
			410,003.7500	4,043,010.8320
			410,001.6560	4,042,464.2656
T23 thru 30	13.19	DCM	419,832.0310	4,034,141.9609
			419,222.8750	4,034,343.4492
			419,064.9060	4,034,610.8672
			418,665.4380	4,034,527.8516
			417,924.7190	4,037,107.5195
			417,056.8130	4,037,995.5234
			416,908.7190	4,037,982.5234
			416,631.9690	4,038,195.4219
			416,422.7190	4,038,451.3359
			415,865.4690	4,039,054.8633
			415,536.0310	4,039,224.5117
			415,102.2190	4,039,351.9453
			414,905.7190	4,039,737.5508
			414,931.1560	4,040,036.5156
			414,894.9380	4,040,266.0117
			414,848.0630	4,040,378.9961
			414,797.1880	4,040,944.3359
			414,873.6560	4,041,023.6289
			414,828.3130	4,041,092.9570
			414,928.6560	4,041,572.7617
			415,075.1250	4,041,273.9336
			415,237.3130	4,041,985.5195
			415,645.7500	4,042,391.2070
			415,872.2190	4,042,360.3477
			416,000.9380	4,042,344.1055
			416,005.6250	4,042,568.5234
			416,413.8750	4,042,560.2578
			416,415.9060	4,043,001.9297

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83)	
			X-coordinates	Y-coordinates
T23 thru 30 continued	13.19	DCM	417385.2500	4042993.4570
			417370.0940	4042770.4766
			417719.9060	4042619.4531
			417792.5000	4042117.6719
			418026.3130	4042090.2539
			418032.4690	4042385.2734
			418154.9060	4042206.3711
			418410.5000	4042382.5898
			418608.9380	4042170.9414
			418642.5940	4042098.0430
			418743.9060	4042022.1406
			418637.1560	4041594.2695
			418839.1560	4040396.7852
			418687.1250	4040203.3438
			418733.7190	4040126.7656
			419760.8750	4039175.2695
			420448.8750	4038850.6133
			421672.5630	4037910.9570
			421774.5940	4037694.9570
			421823.2190	4037710.5156
			422114.0310	4037354.1172
			422453.6250	4036821.3398
			422236.8440	4036716.3086
			422544.5630	4036065.0313
			422559.9380	4034701.7969
			422429.2810	4034127.0234
			419832.0310	4034141.9609
T36	2.41	DCM	414532.5630	4039759.7188
			414544.1880	4039918.4961
			414347.2810	4040341.8281
			414341.6250	4040340.8398
			414296.4060	4040328.5234
			414287.8440	4040319.8633
			414268.3750	4040314.5508
			414211.2190	4040321.9883
			414047.5000	4040298.1172
			414003.0000	4040378.3242
			414010.8750	4040412.9063
			414039.0940	4040436.0195
			413723.0940	4040965.9141
			413561.2500	4041141.6016
			413478.6880	4041158.2148
			413443.2190	4041269.5156
			413241.1250	4041488.5234
			413191.5310	4041500.2969
			412841.4380	4041505.7500
			412833.7190	4041412.9141
			412690.1560	4041406.0313
			412652.2190	4041436.0781
			412682.0630	4041508.1523
			412344.1560	4041513.1602
			411328.8130	4041911.0039
			410132.5940	4040993.3945
			410766.2190	4040418.8281
			413592.7810	4039353.6953
			414146.5000	4039386.4141
			414550.5940	4039224.6563
			414528.0310	4039697.5039
			414532.5630	4039759.7188
T18a	2.67	DCM	417581.8750	4030267.7148
			417605.5940	4030460.9473
			417838.7500	4030929.0918
			418459.9380	4031788.9746
			418889.0940	4032024.0352
			418754.0310	4033026.4648
			419239.5310	4033150.5156
			419467.0940	4034262.6992
			419832.0310	4034141.9609
			419771.8750	4033218.0078
			419606.1560	4032994.4258
			420091.3440	4032635.9063
			419976.0000	4032480.4629
			420133.6880	4032354.6504
			420448.8130	4032104.4238
			420460.9690	4031604.8574
			420132.5000	4031300.5000
			420051.5940	4031073.7539
			420067.1880	4030907.8086
			419947.7810	4030741.5820
			420276.9060	4030498.4297
			419798.7500	4029851.3320

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T18a continued	2.67	DCM	418,383.2810	4,029,647.0859
			417,852.7810	4,029,647.5566
			417,653.4060	4,029,674.6738
			417,521.0310	4,029,772.5156
			417,581.8750	4,030,267.7148
T11	0.67	DCM	415,789.8440	4,026,810.3555
			415,641.0630	4,026,578.4043
			415,463.6880	4,026,710.9355
			415,303.7810	4,027,171.2852
			414,829.7500	4,027,225.6699
			414,603.4060	4,027,348.4004
			414,525.4380	4,027,872.6914
			414,845.5630	4,028,265.1602
			415,969.6880	4,028,562.7461
			415,987.3440	4,028,348.7813
			415,812.0000	4,027,654.7695
			415,829.9690	4,027,301.7383
			416,016.5310	4,027,163.7949
			415,789.8440	4,026,810.3555
T13a	2.47	DCM	417,169.6250	4,026,292.8027
			417,289.0630	4,026,454.5645
			417,118.0940	4,026,580.9805
			417,075.7810	4,026,862.2246
			417,153.0940	4,027,305.2637
			417,068.6250	4,027,867.7852
			417,546.5630	4,028,514.7832
			417,827.8440	4,028,557.0566
			418,270.9380	4,028,479.7695
			418,552.2190	4,028,522.0059
			418,723.3130	4,028,395.6211
			418,994.5310	4,028,445.2656
			419,317.9690	4,028,206.2617
			419,437.4690	4,028,368.0195
			419,922.8440	4,028,009.4902
			419,803.2190	4,027,847.7363
			419,965.0000	4,027,728.2129
			419,726.0630	4,027,404.7207
			419,887.6880	4,027,285.1777
			419,648.7500	4,026,961.7246
			419,810.5000	4,026,842.1797
			419,212.9380	4,026,033.3887
			419,051.1560	4,026,152.9102
			418,812.1880	4,025,829.3945
			418,650.3750	4,025,948.9160
			418,530.9060	4,025,787.1563
			418,369.0940	4,025,906.6797
			418,249.6250	4,025,744.9199
			418,087.8130	4,025,864.4414
			417,848.8440	4,025,540.9238
			417,363.6560	4,025,899.4727
			417,483.0630	4,026,061.2207
			417,169.6250	4,026,292.8027
T8	0.21	DCM	413,520.9060	4,024,987.7734
			413,954.0000	4,024,667.7598
			414,432.0940	4,025,314.7227
			414,755.7190	4,025,075.7422
			414,875.1560	4,025,237.4785
			414,713.3750	4,025,356.9609
			414,832.8130	4,025,518.7363
			414,509.4060	4,025,757.7637
			414,628.8750	4,025,919.4863
			414,432.8750	4,026,064.3691
			414,383.9380	4,025,998.1035
			414,275.7810	4,025,684.7422
			414,249.7810	4,025,496.0488
			414,265.6560	4,025,321.0762
			414,210.4380	4,025,245.9102
			413,520.9060	4,024,987.7734
T5 thru T8	3.53	DCM	414,505.9690	4,021,353.3281
			414,222.0630	4,020,969.0215
			413,736.8130	4,021,327.4629
			413,975.7810	4,021,651.0234
			413,814.0000	4,021,770.5449
			414,053.0940	4,022,094.1016
			413,406.0630	4,022,572.1836
			413,166.9380	4,022,248.5879
			412,196.4380	4,022,965.6328
			412,435.5630	4,023,289.1914
			412,112.0000	4,023,528.1816

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T5 thru T8 continued	3.53	DCM	413307.2500	4025145.6113
			413954.0000	4024667.7598
			414432.0940	4025314.7227
			416696.5940	4023641.5605
			416218.7190	4022994.5840
			415895.2810	4023233.6211
			415656.1880	4022910.1016
			415332.7190	4023149.1055
			414376.5630	4021855.0645
			414700.1560	4021616.0996
			414505.9690	4021353.3281
T9	0.46	DCM	416218.7190	4022994.5840
			416696.5940	4023641.5605
			415730.9380	4024355.1348
			415740.0630	4024367.4102
			415755.0630	4024385.7285
			415788.3750	4024419.2480
			415803.2190	4024437.5703
			416221.4060	4025003.5195
			416999.7190	4024998.1367
			417009.4380	4024643.3945
			416644.1880	4023924.8242
			416678.0000	4023742.0566
			416688.8130	4023734.0977
			416700.3130	4023672.3301
			416734.5000	4023647.0195
			416718.5940	4023625.4961
			416987.0630	4023427.0801
			416933.0310	4023305.0703
			416218.7190	4022994.5840
T1-1	0.24	DCM	410001.3440	4023280.3730
			410005.2500	4022997.9414
			408999.6250	4023000.2637
			409007.7810	4023833.0859
			409051.0310	4023839.1992
			409110.8440	4023908.2500
			409125.3750	4023977.1719
			409135.9380	4023986.4395
			409555.1250	4023595.2637
			409806.6880	4023351.0098
			410001.3440	4023280.3730
T2 thru 5	3.62	DCM	410025.1560	4019002.0527
			410015.6880	4020454.4141
			410264.9380	4020620.1895
			410488.7190	4020946.6582
			410687.5940	4021327.9746
			410604.9060	4021412.4785
			410718.8440	4021593.2148
			411285.7500	4022320.5957
			411422.2810	4022348.0508
			411641.2190	4022434.6367
			411641.7810	4022726.1934
			411698.3750	4022867.5078
			411783.0000	4023082.8359
			412112.0000	4023528.1816
			412435.5630	4023289.1914
			412196.4380	4022965.6328
			413088.5940	4022306.4473
			413166.9380	4022248.5879
			413406.0630	4022572.1836
			414053.0940	4022094.1016
			413814.0000	4021770.5449
			413975.7810	4021651.0234
			413736.8130	4021327.4629
			414222.0630	4020969.0215
			414505.9690	4021353.3281
			414557.3750	4020853.0215
			414717.5310	4020809.5039
			414704.8750	4020499.7988
			414001.4690	4020502.4766
			414001.2500	4020257.5078
			413767.6560	4020273.3301
			413695.4380	4020332.7383
			413677.0630	4020225.3008
			413700.3440	4020128.3535
			413549.0940	4020190.3926
			413444.4060	4020190.3945
			413394.0000	4020105.0723
			413343.6560	4020101.2031
			413266.1250	4020221.4121

Exhibit 1 - Map and coordinates of PM_{10} control areas

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
T2 thru 5 continued	3.62	DCM	413090.0310	4020217.8281
			413082.4060	4020077.9375
			412973.9060	4020085.6738
			412756.6880	4020031.3984
			412389.2810	4020442.0293
			412270.9690	4020910.1992
			411937.4060	4020860.1270
			411952.8130	4020757.8945
			411835.6880	4020364.6348
			411,644.0940	4,020,105.5039
			411,579.3750	4,020,095.7637
			411,149.7500	4,019,542.1543
			410,360.7190	4,019,008.5000
			410,025.1560	4,019,002.0527
T5-2	0.03	DCM	415,656.1880	4,022,910.1016
			415,817.9380	4,022,790.5840
			416,056.9690	4,023,114.1348
			415,895.2810	4,023,233.6211
			415,656.1880	4,022,910.1016
T5-3	0.22	DCM	414,700.1560	4,021,616.0996
			414,376.5630	4,021,855.0645
			415,332.7190	4,023,149.1055
			415,581.1880	4,022,965.4980
			415,103.1880	4,022,318.4160
			415,178.0630	4,022,263.0664
			414,700.1560	4,021,616.0996

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates

Total SDCA	12.86
Total Study	1.86
Total Channel	0.50
Total DCM	30.12

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Exhibit 2 - TDCA Minimum Dust Control Efficiency map

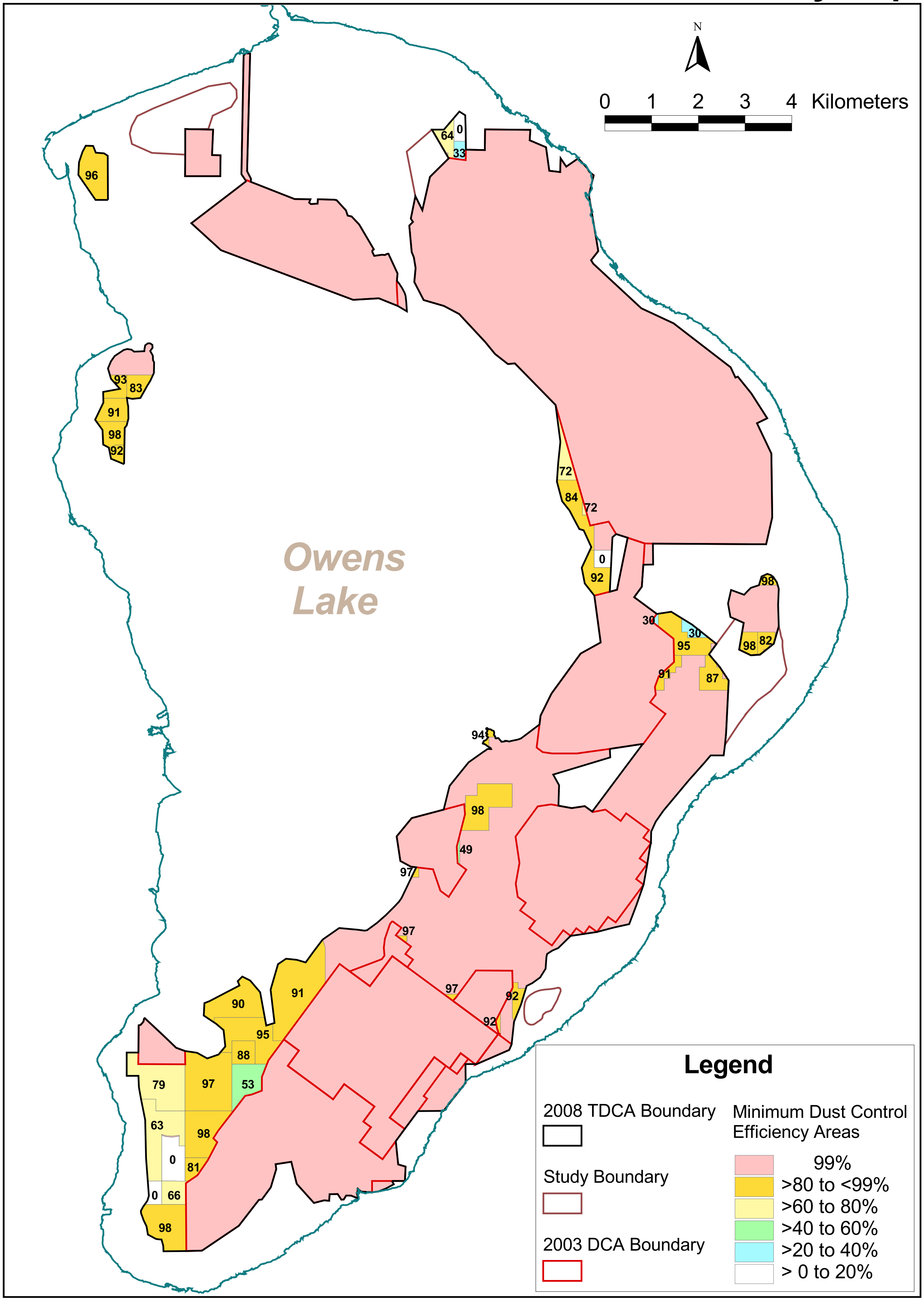

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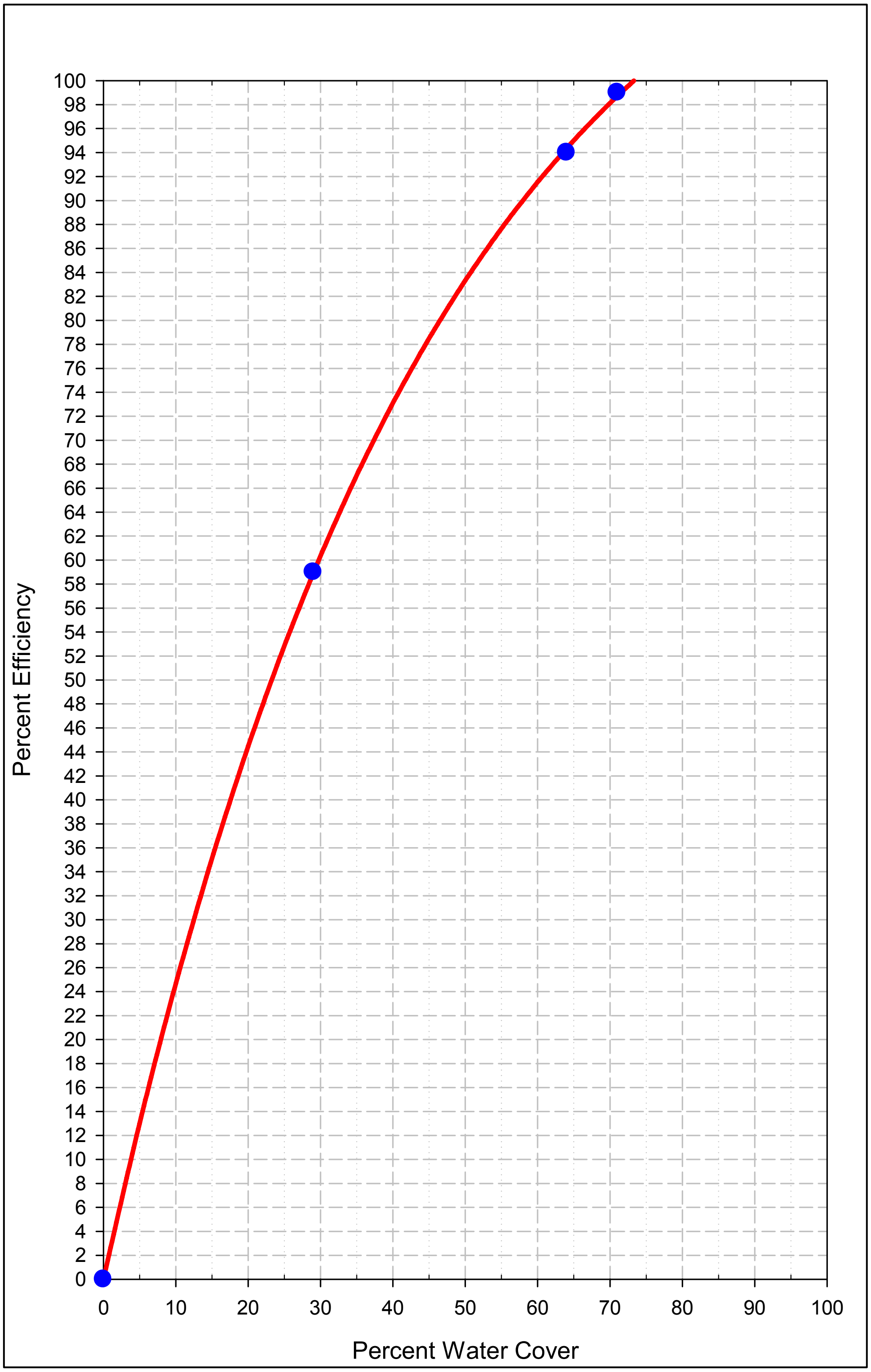
Exhibit 3 - Shallow Flood control efficiency curve



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SETTLEMENT AGREEMENT

This Settlement Agreement (Agreement) is entered into between the Great Basin Unified Air Pollution Control District (District) and the City of Los Angeles by and through its Department of Water and Power (collectively "City") (the City and District to be referred to as the "Parties") to resolve the City's challenge to the District's Supplemental Control Requirement (SCR) determination for the Owens Lake bed issued on December 21, 2005, and modified on April 4, 2006.

RECITALS

WHEREAS:

A. Owens Lake is located in Inyo County in eastern California, south of the town of Lone Pine and north of the town of Olancha.

B. Large portions of the Owens Lake bed are comprised primarily of dry saline soils and crusts.

C. The lake bed soils and crusts are a source of wind-borne dust during significant wind events, and contribute to elevated concentrations of particulate matter less than 10 microns in diameter (PM_{10}).

D. PM_{10} is a criteria pollutant regulated by the federal Clean Air Act, 42 U.S.C. Section 7401 *et seq*., as amended (CAA).

E. Under the National Ambient Air Quality Standard (NAAQS) adopted pursuant to the CAA, PM_{10} levels may not exceed an average concentration of 150 micrograms per cubic meter ($\mu g/m^3$) during a 24-hour period more than one time per calendar year averaged over three years.

F. The District has regulatory authority over air quality issues in the region where Owens Lake is situated.

G. Under Health and Safety Code Section 42316, enacted by the California Legislature in 1983, the District has authority to require the City to undertake reasonable measures at Owens Lake in order to address the impacts of its activities that cause or contribute to violations of federal and state air quality standards, including but not limited to the NAAQS for PM_{10}.

H. In 1987, the United States Environmental Protection Agency (EPA) identified the Owens Valley Planning Area (OVPA), which encompasses

Owens Lake, as an area not meeting the NAAQS for PM_{10}. In 1993, the OVPA was reclassified as a serious non-attainment area under the CAA.

I. In 1997, the District adopted the Owens Valley PM_{10} Demonstration of Attainment State Implementation Plan as required by the CAA (1997 SIP). In 1998, the District and the City agreed that the City would construct control measures on 16.5 square miles of the Owens Lake bed by the end of 2003 as part of a SIP revision in 1998.

J. In 2003, through District Board Order 03111-01 (Order), the District required the City to construct dust control measures (DCMs) on an additional 13.3 square miles of the Owens Lake bed by the end of 2006, for a total of 29.8 square miles of dust control measures, as part of a Revised SIP (2003 SIP). The Order and 2003 SIP also established a process whereby the Air Pollution Control Officer of the District (APCO) must evaluate on at least an annual basis the potential need for additional DCMs and “watch areas” at Owens Lake bed in order to attain the NAAQS. The process involves a determination by the APCO and an opportunity for the City to present an alternative analysis.

K. On December 21, 2005, the APCO issued the 2004/2005 SCR determination finding that the City would be required to implement DCMs on an additional 9.31 square miles of Owens Lake bed and identifying 0.66 square miles as “watch area.”

L. On January 20, 2006, the City appealed the 2004/2005 SCR determination to the California Air Resources Board (CARB). The District disagreed that the determination was subject to such an appeal.

M. On February 22, 2006, the City submitted an Alternative Analysis contesting aspects of the 2004/2005 SCR determination.

N. On April 4, 2006, the APCO modified the SCR determination issued on December 21, 2005 to reduce the supplemental DCM area to 8.66 square miles and increased the “watch area” to 0.79 square miles (Modified SCR determination).

O. On May 3, 2006, the City filed an appeal of the April 4, 2006 Modified SCR determination with the CARB. The District disagreed that the determination was subject to such an appeal.

P. On May 4, 2006, the City filed a petition for writ of mandate challenging the APCO’s April 4, 2006 Modified SCR determination (*City of Los Angeles Department of Water and Power v. Great Basin Unified Air Pollution Control District*, Kern County Superior Court Case No. S-1500-

CV-258678, RJO). The Parties entered into mediation and a temporary stay of the litigation.

AGREEMENT

NOW, THEREFORE, in consideration of the provisions herein contained and to resolve the disputes over methods to address air quality at Owens Lake, including the disputes over the SCR determination issued on December 21, 2005, and modified on April 4, 2006, the City and the District hereby agree as follows:

DUST CONTROL MEASURES (DCMs)

1. The City shall apply DCMs as provided in this Agreement on additional areas of the lake bed beyond the 29.8 square miles required in the 2003 SIP.

   A. The areas on the lake bed on which DCMs will be applied are designated in this Agreement as follows:

      (i) The 12.7 square-mile area of additional DCMs shall be known as the 2006 Supplemental Dust Control Area (SDCA).

      (ii) The 29.8 square miles of DCMs required by the 2003 SIP shall be known as the 2003 Dust Control Area (DCA).

      (iii) The 0.5 square miles of natural drainage channels on the south area of the lake bed shall be known as the Channel Area.

      (iv) The combined 43.0 square miles of DCMs and Channel Area shall be known as the Total Dust Control Area (TDCA).

      (v) The SDCA, DCA, Channel Area and TDCA are delineated on the TDCA Map, attached as Exhibit 1. The SDCA and Channel Area coordinate descriptions are attached as Exhibit 2. The DCA coordinate description is contained in the 2003 SIP.

   B. Minor adjustments may be made to the boundaries of the SDCA upon written request by the City to the District and written approval by the APCO, which approval shall not be unreasonably withheld. In the event of such modification, the boundaries of the TDCA shall also be modified to reflect the modified SDCA boundaries.

   C. The City may, at its sole option, apply DCMs to additional areas outside the TDCA.

   D. The City shall begin full operation of the DCMs within the SDCA as follows:

(i) Moat and row controls shall be operational by October 1, 2009.

(ii) All other controls shall be operational by April 1, 2010.

E. Following the dates set out above in this Section, the City shall continuously operate and maintain the DCMs within the TDCA. The City shall continuously operate and maintain DCMs within the DCA as required under the 2003 SIP, except as otherwise provided in this Agreement.

2. A. The City shall construct within the SDCA a minimum of 9.2 square miles of Shallow Flood dust controls. The Shallow Flood areas are delineated on the Dust Control Measure Map, attached as Exhibit 3.

B. On the remaining 3.5 square miles of the SDCA not specifically designated for Shallow Flood on the DCM Map (Exhibit 3), the City shall

(i) construct Shallow Flood, Managed Vegetation, or gravel cover, as described in the Dust Control Measures Description, attached as Exhibit 4, and which are currently approved as Best Available Control Measures (BACM) under the 2003 SIP; or

(ii) subject to Sections 3, 7 and 8, treat up to 3.5 square miles of the SDCA with the alternative dust control measure known as "Moat and Row," as described in the DCM Description (Exhibit 4).

C. TDCA areas designated as Channel Area represent areas containing natural drainage channels having potentially significant resource issues and regulatory constraints. While these areas are not a part of the SDCA, they shall be addressed as part of the control strategy for the SDCA. However, it is acknowledged that the control strategy in this area may be subject to additional regulatory constraints, design considerations, and impacts caused by adjacent DCMs.

D. The internal control measure boundaries delineated on the DCM Map (Exhibit 3) are approximate and are subject to final written approval by the APCO. The areas designated on the DCM Map (Exhibit 3) for Shallow Flood and Moat and Row may be modified upon written request by the City to the District and written approval by the APCO, which approval shall not be unreasonably withheld.

3. All DCMs within the SDCA shall be designed, constructed, operated and maintained by the City to achieve the initial target minimum dust control efficiencies (MDCEs) shown on the MDCE Map, attached as Exhibit 5. The initial target MDCEs (Target MDCEs):

A. Are based on the results of air quality modeling, as described in the 2003 SIP, conducted by the City and approved by the APCO for the period July 2002 through June 2006;

B. Assume 100 percent control efficiency in the 29.8 square miles of the DCA required under the 2003 SIP, except during the fall and spring ramping periods as described in Section 26, and achievement of the target MDCEs for the areas in the SDCA. Control efficiencies during the fall and spring ramping periods shall be based on modeling that accounts for reduced wetness cover pursuant to Sections 5 and 26;

C. Have been selected to achieve PM_{10} concentrations that will not exceed the federal 24-hour PM_{10} ambient air quality standard of 150 $\mu g/m^3$ (federal standard) at all historic shoreline (elevation 3600 feet above sea level) receptors.

4. Prior to April 1, 2010, the Target MDCEs may be modified, upon request of the City and written approval of the APCO, which approval shall not be unreasonably withheld, if the modified MDCEs meet the criteria set forth in the MDCE Selection Process Spreadsheet, attached as Exhibit 6, pursuant to Section 3.

5. For the Shallow Flood areas identified in DCM Map (Exhibit 3), the percentage of each area that must be wetted shall be based on the Shallow Flood Control Efficiency Curve (SFCE Curve) attached as Exhibit 7, or an update of the SFCE Curve mutually agreeable to the Parties, to achieve the control efficiency levels in the MDCE Map (Exhibit 5).

6. The Parties believe that the City's existing Managed Vegetation site may currently achieve a control efficiency of 99 percent. Therefore, the City shall continue to maintain and the District shall continue to monitor the site to ensure that it achieves 99 percent control efficiency. No later than July 1, 2007, the City shall submit to the District an operation and management plan for the City to maintain cover conditions that achieve 99 percent control efficiency in the Managed Vegetation areas. The plan shall be subject to written approval by the APCO, which approval shall not be unreasonably withheld. Prior to the time that the Managed Vegetation area is in compliance with an approved SIP, the District will not issue a Notice of Violation (NOV) for the existing Managed Vegetation area as long as:

A. From January 1, 2007, to the earlier of July 1, 2007 or the date when the City's operation and management plan is approved by the APCO, the City maintains its current operation and management practices for its Managed Vegetation areas; and

B. After the APCO's written approval of the operation and management plan, the City implements all provisions of its operation and management plan; and

C. The City's Managed Vegetation area site does not cause an exceedance of the federal standard at the historic shoreline.

7. As Moat and Row is not a currently approved BACM dust control measure under the 2003 SIP, the City will develop, in consultation with the District, and conduct Moat and Row Demonstration Projects on the lake bed. These Demonstration Projects will be conducted on two or more locations on the lake bed outside of the DCA. The proposed location of these Demonstration Project areas are shown on attached Moat and Row Demonstration Project Map (Exhibit 8). The actual locations of the projects may be changed by the City, and in such event, the City shall notify the APCO in writing of the changed locations. The City will be the California Environmental Quality Act (CEQA) lead agency for implementation of the Moat and Row Demonstration Projects.

8. Based on results of the Moat and Row Demonstration Projects described in Section 7 and subject to Sections 2 and 3, the City in its sole discretion may decide which DCMs to implement in the areas designated for Moat and Row in Section 2 and Exhibit 3 of this Agreement. The City shall consult with the District before making its decision and inform the District of its decision in writing.

A. Depending on the results of the Moat and Row Demonstration Projects, the measures implemented in these areas by the City may include Moat and Row, enhanced Moat and Row (*e.g.*, closer Moat and Row spacing, Moat and Row with some Shallow Flooding, Moat and Row with some vegetation), combined Moat and Row/Shallow Flood, MDCE-BACM, or BACM.

B. If the City implements Moat and Row, it shall design and construct Moat and Row to achieve the Target MDCEs described in Section 3. The Moat and Row configuration required to achieve these Target MDCEs will be decided solely by the City, after consultation with and written notification to the District.

C. In the event of a dispute regarding the City's proposed decision or action pursuant to Section 8.A or 8.B, either Party may initiate the Dispute Resolution Process pursuant to Section 32.

D. Upon written request of the City, the APCO shall determine in writing if Moat and Row and/or Enhanced Moat and Row constitutes BACM or MDCE-BACM, in accordance with the revisions to the 2003 SIP provided in Section 28.

DUST IDENTIFICATION (DUST ID) PROGRAM

9. The Parties mutually recognize that a method for identifying sources of potential exceedances of the federal standard at the historic shoreline could be developed that is superior to and could replace or modify the current Dust ID Program.

A. The Parties will work cooperatively, with the participation of a mutually agreeable independent third party technical expert or experts under contract to the District and jointly managed by the Parties, in a good faith effort to develop, before April 1, 2010, an improved Dust ID Program. The APCO will implement all mutually-agreeable changes to the Dust ID Program and notify the City in writing of those changes.

B. The District will continue to work with the City after April 1, 2010 to further improve the Dust ID Program and will implement all additional mutually agreeable changes in a written decision.

C. In furtherance of efforts to improve the Dust ID Program:

(i) The Parties will promptly begin a mediated process for refining the Dust ID Program and resolving disputes.

(ii) The Parties will select a mutually agreeable expert or panel of independent third-party technical experts.

(iii) The District, after consultation with the City, will increase the number of PM_{10} monitors at or near the historic shoreline. In all cases, the District will notify the City of the location of the monitors within 30 days of placement of the monitors. If a PM_{10} monitor is located above the historic shoreline, the District will make reasonable attempts to account for non-lake bed sources that may affect the monitor.

(iv) The District, after consultation with the City, will modify the existing sand flux monitor network to concentrate on areas of special interest, and will, in all cases, notify the City of the modifications within 30 days of any modification.

(v) The Parties will establish mutually agreeable model performance measures. Such measures may, but are not required to, include a minimum model performance standard.

(vi) The District will make reasonable efforts to account for impacts of DCM construction activities.

10. The City will lead a joint effort with the District to develop methods for directly measuring PM_{10} emission rates from the lake bed. The District will incorporate mutually agreeable methods into the Dust ID Program.

11. A. If the City is in compliance with Sections 1 and 2 of this Agreement, the following shall apply to the time period before April 1, 2010.

(i) The APCO will not issue any further determinations regarding the need for SCRs that provide for additional requirements beyond those in this Agreement. However, the District will continue to use the Dust ID Program, as that program may be modified pursuant to Sections 9 and 10. The District will periodically advise the City of results in writing and may recommend actions to the City based on the model results.

(ii) Data collected before April 1, 2010 will not be used in future determinations requiring SCRs, except in those areas delineated as Study Areas on the Study Area Map attached as Exhibit 9 and described in Exhibit 2. Data collected from the Study Areas between July 1, 2006 and April 1, 2010 may only be used in SCR determinations after April 1, 2010, and may be used only in accordance with the current form of the Dust ID Program that is in effect after April 1, 2010.

(iii) The District will not issue an order requiring the City to implement any additional controls on any lake bed dust source areas in order to achieve the state PM_{10} standard of 50 micrograms per cubic meter unless compelled to issue such an order by state law.

B. The District shall determine compliance with the state PM_{10} standard based on concentrations only in the surrounding communities, unless otherwise compelled by state law.

12. The City, in consultation with the District, shall annually develop and provide to the District a Performance Monitoring Plan (PMP) to aid in its operation of the Owens Lake dust mitigation program on the Owens Lake bed.

A. The PMP will describe the measurements and methods used to verify the performance of the constructed DCMs and Moat and Row test areas. The PMP will also describe the measurements and methods used to maximize information on dust emissions from areas of special interest.

B. The City shall implement the PMP, and will use the results as a guide for making operational decisions about the type, location, timing, and level of dust control measures needed to prevent exceedances of the federal standard at the shoreline.

C. The District may use information from the PMP to assist in determining the likely sources of dust emissions causing or contributing to exceedances (if any) of the federal standard at the shoreline.

SHALLOW FLOOD BACM REFINEMENT

13. The City shall have the option to conduct field testing to refine the wetness cover requirement to achieve 99 percent control efficiency in Shallow Flood areas within the DCA (Shallow Flood Cover Test).

A. The Shallow Flood Cover Test shall occur on one or more areas totaling not more than 1.5-square-miles, to be selected by the City and approved by the APCO, which approval shall not be unreasonably withheld, from within the TDCA areas requiring 99 percent control.

B. The Shallow Flood Cover Test design shall be prepared by the City and approved by the APCO, which approval shall not be unreasonably withheld, prior to implementation. Based on that design, the APCO will reasonably determine wetness cover requirements for the Shallow Flood Cover Test.

C. The City will be CEQA lead agency for the Shallow Flood Cover Test.

14. If the APCO reasonably determines in writing that DCMs in the TDCA have been operational for one full year (defined as 365 consecutive days) with no exceedance of the federal standard at monitors located at or above the historic shoreline caused solely by sources within the TDCA, the City shall be permitted to reduce the wetness cover by an average of 10 percent over Shallow Flood areas requiring 99 percent control efficiency, excluding areas identified in Section 14.C, provided that:

A. Application of the 10 percent reduction in wetness cover during the Fall and Spring Shallow Flood DCM Compliance periods set out in Sections 25 and 26 shall result in the lower of:

(i) The areal cover resulting from a 10 percent reduction; or

(ii) The areal cover required in Section 26.A.

B. To implement the reductions set out in this Section, the City shall be required to first submit a written Wetness Cover Plan to the District for reducing the wetness cover on the eligible areas. The Wetness Cover Plan shall take into account:

(i) the results of testing carried out pursuant to Section 13, if conducted; and

(ii) the results of fall and spring Shallow Flood wetness cover reduction operations carried out pursuant to Section 26.

C. If, in any year, the Wetness Cover Plan proposes reductions in wetness cover greater than 10 percent in any portion of the Shallow Flood areas covered by the Plan (consistent with the 10 percent limit on the overall average reduction), the City shall obtain the additional written approval of the APCO, which approval shall not be unreasonably withheld.

D. In the event shoreline monitors show an exceedance of the federal standard, whether that exceedance is caused by sources within, outside, or both within and outside of the TDCA, no further reductions in wetness cover shall be permitted for any Shallow Flood area that has contributed to the exceedance, as determined by the methodology in Section 18 and subject to the provisions of Section 16.

E. Except as provided in Section 16, the City may continue to operate using reductions of wetness cover pursuant to a previously approved Wetness Cover Plan.

15. For each Dust Control Season (October 1 of each year through June 30 of the next year) that wetness cover reductions have taken place under the provisions of Section 14, the City shall prepare and submit to the District a written report summarizing the results of the wetness cover reductions within 90 days after conclusion of the corresponding Dust Control Season. The report shall document the percentage of wetness cover for Shallow Flood areas and the effect(s) of wetness cover reductions on PM_{10} concentrations at the historic shoreline.

16. Any areas for which wetness cover has been reduced pursuant to Section 14 and that cause or contribute to an exceedance of the federal standard at the historic shoreline shall be remediated by the City under the Remedial Action Plan requirements pursuant to Sections 18 and 22 below.

A. Subject to APCO written approval, which approval shall not be unreasonably withheld, the City may further reduce the wetness cover beyond that allowed in Section 14 provided that:

(i) The maximum 24-hour PM_{10} shoreline monitor values for at least 365 consecutive days of operation following initiation of the last approved Wetness Cover Plan does not exceed 130 $\mu g/m^3$; and

(ii) The City demonstrates to the reasonable satisfaction of the APCO that the modeled contributions from the lake bed for the same time period set forth in Section 16.A.(i) plus the background of 20 $\mu g/m^3$ do not exceed 120 $\mu g/m^3$ at the historic shoreline.

B. If the monitored values at the historic shoreline exceed 130 $\mu g/m^3$, and it is determined that non-lake bed sources are contributing greater than 20 $\mu g/m^3$, then the District will expeditiously seek to identify and require control of those non-lake bed sources so that the City may continue to implement efficient DCMs on the lake bed.

C. If the City is entitled to further reduce wetness cover pursuant to this Section, the City shall prepare and submit an updated Wetness Cover Plan to the District to describe the wetness cover proposed for the subsequent, applicable Dust Control Season. The updated Wetness Cover Plan shall include:

(i) A map that depicts the eligible Shallow Flood areas;

(ii) The proposed amount of wetness cover for each eligible Shallow Flood area; and

(iii) The method for determining effectiveness of the proposed wetness cover.

D. The Wetness Cover Plan shall be subject to approval of the APCO, which approval shall not be unreasonably withheld.

<u>ACTIONS TO ADDRESS STANDARD VIOLATIONS</u>

17. After May 1, 2010, the APCO will recommence written SCR determinations under the revisions to the 2003 SIP as provided in Section 28. Recommenced determinations will use Dust ID data collected only after April 1, 2010, except as provided in Section 11.A.(ii) for Study Areas, and shall be made at least once in every calendar year.

18. If, pursuant to Section 17, the APCO determines that a monitored or modeled exceedance of the federal standard caused by emissions from the lake bed has occurred at or above the historic shoreline:

A. The APCO, based on all available information, including visual observation, monitoring and modeling, and in consultation with the City, will identify the need for additional controls, monitoring, or both.

B. (i) If the APCO identifies the need for additional controls, the APCO shall issue a SCR determination.

(ii) If the City does not agree with the APCO's determination, the City may, within 60 days of the APCO's determination, submit to the District an Alternative Analysis. If the City submits an Alternative Analysis, the APCO shall consider the Analysis and may withdraw, modify or confirm the SCR determination.

(iii) If the APCO issues a modified SCR determination or confirms the initial SCR determination and the City does not agree with the APCO's action, the City may initiate the Dispute Resolution Process pursuant to Section 32. The APCO may modify the SCR determination based on the Dispute Resolution process.

(iv) In the event the Parties are unable to resolve disagreements over future SCR determinations through the Dispute Resolution Process, the City may appeal future determinations to CARB under the provisions of Health and Safety Code Section 42316 (Section 42316), provided that the Parties expressly intend that this Agreement be the final resolution regarding the existing disputes between the Parties that are the subject of this Agreement. Based on the foregoing, the City stipulates and agrees that all of the provisions and determinations, including the measures and procedures, contained in the 2003 SIP, the provisions of this Agreement to be included in modifications to the 2003 SIP pursuant to this Agreement, and the SCR determination dated April 4, 2006, which the City in good faith disputed, shall be deemed to be valid and reasonable, and that the City will not challenge those provisions or determinations by appeal under Section 42316 or in any other proceeding, including any other administrative or judicial forum. Subject to this Paragraph, the City may challenge any future SCR determination under Section 42316; however any arguments or challenges must be based on data and information that do not currently exist, but that exist after the execution of this Agreement.

C. The City shall prepare and submit for the APCO's consideration and written approval, which approval shall not be unreasonably withheld, a Remedial Action Plan as described in Section 21 to address the exceedance(s). The City shall submit the Remedial Action Plan within 60 days of the date the SCR determination becomes final.

D. The District may, as appropriate, also issue a notice of violation.

19. In the event:

A. The APCO has made a written determination pursuant to Section 18 that an exceedance of the federal standard, occurring after April 1, 2010, resulted from a Control Area or portion of a Control Area treated with Moat and Row; and

B. That Control Area or portion of a Control Area causing the exceedance was remediated by the City as provided in Section 21 below; and

C. That Control Area or a portion of that Control Area is subsequently the sole cause of an exceedance of the federal standard at or above the historic shoreline, (*i.e.*, an exceedance occurred after the City attempted to remediate that area under Section 21);

then the City shall convert that Control Area, or that portion of that Control Area, from Moat and Row to MDCE-BACM or BACM, to address the exceedance described in Section 19.C., for all or the portion of that Control Area that caused the subsequent exceedance, under the time deadlines provided for in Section 24.

20. If the APCO determines that Moat and Row constitutes BACM or MDCE-BACM, then upon issuance of such written determination, the provisions of Section 19 that require the City to convert to BACM or MDCE-BACM may be satisfied by applying the BACM or MDCE-BACM approved under this Section 20.

21. A Remedial Action Plan prepared by the City pursuant to Section 18 will contain a description of:

A. Any and all needed changes, repairs or enhancements to DCMs, including one or some combination of the following:

(i) Maintenance of facilities (*e.g.*, berms, moats and rows);

(ii) Changes to Shallow Flood or Managed Vegetation facilities or operations (*e.g.*, increase in wetness cover extent, improved wetness cover distribution, enhancement of vegetation);

(iii) Augmentation (*e.g.*, more moats and rows) or enhancement (*e.g.*, addition of sand fences, surface wetting, armoring, vegetation, surface roughening) of Moat and Row areas;

(iv) Transition of Moat and Row areas to BACM, or MDCE-BACM.

B. Any and all needed expansion of DCMs, and specific plans for expanding the measures.

C. A schedule for the work to be performed to implement the changes, clearly indicating the point at which facilities will be operational and effective at design levels.

22. The Schedule of Contingency Measures attached to this Agreement as Exhibit 10 sets forth a non-exclusive list of items that shall be included by the City in its Remedial Action Plans, described in Section 21, and the timing required for their implementation.

23. Before any full-scale Moat and Row areas are operational, the City shall submit to the District a conceptual design and schedule for possible implementation of BACM or MDCE-BACM to each Moat and Row area consistent with Section 19. These designs and schedules are the potential contingency measures to be implemented by the City where a transition from Moat and Row to another DCM is needed, or where such transition is required pursuant to Section 19.

24. Areas to be transitioned from Moat and Row to BACM or MDCE-BACM will be operational within the times set forth in the Moat and Row Transition Schedule attached as Exhibit 11. DCMs for new areas will be operational within the times set forth in the DCM Operation Schedule attached as Exhibit 12.

<u>FALL AND SPRING SHALLOW FLOOD DCM COMPLIANCE</u>

25. For the time period from October 16 of each year through May 15 of the next year, the Shallow Flood Control Areas shall be considered to be in compliance with this Agreement and applicable laws and regulations, if the areal wetness cover within each Shallow Flood Control Area in the TDCA meets the MDCE required in Exhibit 6 using the SFCE Curve in Exhibit 7.

26. The provisions set forth in this section shall apply to all Shallow Flood areas with target control efficiencies of 99 percent or more, except those which the City and the District may mutually agree to exclude.

A. Beginning on April 1, 2010, compliance of TDCA Control Areas with 99 percent control efficiency Shallow Flood requirements shall be as follows:

(i) Beginning May 16 and through May 31 of every year, Shallow Flood may be reduced to a minimum of 70 percent areal wetness cover.

(ii) Beginning June 1 and through June 15 of every year, Shallow Flood may be reduced to a minimum of 65 percent areal wetness cover.

(iii) Beginning June 16 and through June 30 of every year, Shallow Flood may be reduced to a minimum of 60 percent areal wetness cover.

(iv) If for any Shallow Flood area, the percent of areal wetness cover in the periods specified in Sections 26A.(i), (ii) and (iii) is below the minimum percentages specified in those sections, and there were no monitored or modeled exceedances of the federal standard at the historic shoreline, that area will be deemed to be in compliance with this Agreement and applicable laws and regulations if the City demonstrates in writing and the APCO reasonably determines in writing that maximum mainline flow was maintained in the applicable period.

B. From July 1 through September 30 of each year, the City is not required by the 2003 SIP to apply water for dust control, but is required to maintain minimum areal wetness cover as required by applicable environmental documents and approvals.

C. Beginning on April 1, 2010, if modeled or monitoring data shows an exceedance or exceedances of the federal standard at the historic shoreline as a result of excessive dry areas on Shallow Flood Control Areas during the dust control periods for each year between May 16 through June 30, and October 1 through October 15, the provisions of Sections 17 and 18 shall apply.

27. The provisions of Sections 25 and 26 are subject to the results of air quality modeling, to be conducted by the City and approved by the APCO, that demonstrates attainment of the federal standard at the historic shoreline using the reduced areal wetness covers set forth in Section 26. The modeling shall be conducted as described in the 2003 SIP using data for the period July 2002 through June 2006. The control efficiency of the areal wetness covers shall be modeled using the SFCE Curve as provided in Section 5.

REVISION OF THE STATE IMPLEMENTATION PLAN (SIP)

28. A. The APCO will propose a District Board Order that will revise the 2003 SIP to incorporate all of the terms and conditions of this Agreement, except such terms and conditions, if any, that may not lawfully be included in the SIP. The APCO will propose the Board Order and SIP revision at a time sufficient to allow the proposed revisions to be considered and adopted by the District Board by July 1, 2008. The time for consideration and adoption shall take into account, without limitation, the time for legally required environmental review and public notice and hearing. The District Board will act on the proposed SIP revisions by July 1, 2008.

B. If the District Board has the legal ability to act and fails to act by November 1, 2008 on a proposed District Board Order as described in Subsection 28.A, the City may terminate this Agreement by providing written notice to the District, provided, however, that the City will not provide such notice prior to the conclusion of the Dispute Resolution Process pursuant to Section 32, which process may be initiated by either Party.

C. The Parties have developed this Agreement with the intention that its provisions will be incorporated into a revision of the 2003 SIP and are consistent with applicable provisions of the Health and Safety Code, including Section 42316, and applicable provisions of federal law regarding attainment of the NAAQS.

D. The APCO shall confer in good faith with the City to develop procedures to modify and authorize MDCE-BACM for incorporation into the revisions to the 2003 SIP.

E. The District will be CEQA lead agency and will prepare, in consultation with the City, and will consider for certification on or before March 1, 2008 an environmental impact report (EIR) on the proposed SIP revisions.

F. (i) In the event:

(a) the District Board adopts a District Board Order revising the 2003 SIP that does not incorporate all the terms and conditions of this Agreement, except such terms and conditions, if any that may not lawfully be included in the SIP; or

(b) the District Board adopts a District Board Order revising the 2003 SIP that incorporates all the terms and conditions of this Agreement except such terms and conditions, if any, that may not lawfully be included in the SIP, and subsequent judicial action causes the revised SIP to be materially inconsistent or materially in conflict with the terms and conditions of this Agreement,

the City may terminate this Agreement in the case of Section 28.F(i)(a), and either Party may terminate this Agreement in the case of Section 28.F(i)(b), within 30 days of such action by providing written notice to the other Party.

(ii) If the City does not elect to terminate this Agreement pursuant to Section 28.F(i) and any inconsistencies or conflicts exist between this Agreement that preclude compliance with both, the provisions of the District Board Order shall prevail.

G. The City will support and will not appeal or in any other way challenge or oppose revisions to the 2003 SIP and resulting District Board Order that incorporate all of the terms and conditions of this Agreement, except such terms and conditions, if any, that may not lawfully be included in the SIP. After issuance of the District Board Order provided for in this Section, the City shall not challenge the order under CEQA to the extent that Order is consistent with this Agreement.

H. In the event the District Board fails to certify the EIR by March 1, 2008 or to act on the proposed SIP revisions by July 1, 2008, the Parties shall meet and confer as provided in Section 33.A.

I. Any provisions of this Agreement that are incorporated into the District Board Order as provided in Section 28.A. shall, upon adoption of that Order by the District Board, cease to have any further force and effect as part of this Agreement, and shall instead be effective as part of the District Board Order.

J. Any provisions of this Agreement that are not incorporated into the District Board Order as provided in Section 28.A shall remain in full force and effect as part of this Agreement until May 1, 2012, at which time those provisions shall cease to be of any further force or effect as part of this Agreement, provided that the Parties may mutually agree in writing to extend this date.

COVER MEASUREMENT TECHNIQUES AND PERFORMANCE SPECIFICATIONS

29. The District and City will collaboratively develop wetness and vegetative cover measurement techniques, control efficiency relationships, and compliance specifications. Final acceptance of those cover measurement techniques and compliance specifications with regulatory impact will be at the sole discretion of the APCO.

KEELER DUNES

30. The Parties acknowledge that dust emissions from the area known as the Keeler Dunes may cause or contribute to exceedances of federal and state standards for PM_{10}. The City hereby agrees to cooperate with the District and other federal, state and local agencies and experts as necessary to develop a plan to reduce dust emissions from the Keeler Dunes.

COOPERATION BETWEEN PARTIES AND DISPUTE RESOLUTION

31. In carrying out the terms of this Agreement, the Parties intend to cooperate fully and to consult with each other effectively and on a regular basis. The Parties will make good faith efforts to provide each other with relevant documents and

technical information in a timely manner, and they will keep each other informed of their respective progress in actions to implement the actions set forth in this Agreement, including, without limitation, progress in entering into consultant and construction contracts and in securing permits from agencies with permitting authority.

32. Notwithstanding the Parties' commitment to cooperate in implementing the terms of this Agreement, they recognize that differences may arise between them. To address this situation, the Parties agree that, in the event either Party believes that a dispute exists regarding implementation or interpretation of any provision of this Agreement, that Party may, by informing the other Party in writing within 21 days of the decision or determination, action or proposed action triggering the dispute, initiate non-binding mediation between the Parties. A party may not seek non-binding mediation for issues that were already the subject of mediation under this Section unless both Parties agree in writing.

A. The mediator shall be a mediator mutually acceptable to the Parties. The Parties may also by mutual agreement include in the mediation, one or more of the technical experts selected pursuant to Section 9.C.(ii), or any other technical experts, such experts to be under contract to the District and jointly managed by the Parties. The City shall be responsible for the cost of the mediator and the technical experts pursuant to Health and Safety Code Section 42316. The mediation will be conducted and completed within 60 days of the notice initiating the Dispute Resolution Process unless that time period is extended by mutual agreement of the Parties. The mediation will be conducted under all applicable California laws regarding mediation, including but not limited to Cal. Evidence Code Sections 1115-1128.

B. Neither Party will commence any litigation concerning the implementation of terms of this Agreement unless that Party has first initiated the mediation described in this Section, and the sooner of the following two events takes place:

(i) Sixty (60) days has expired from the date that Party first sent written notice to commence the mediation; or

(ii) Both Parties agree, or the mediator(s) states, in writing that the mediation has been completed.

(iii) Notwithstanding the provisions of this Section 32.B, a Party may commence litigation at an earlier time if necessary to pursue a claim or cause of action that would otherwise be time barred under an applicable statute of limitations.

C. If the Dispute Resolution Process pursuant to this Section 32 is initiated to address a dispute regarding a SCR determination issued by the APCO pursuant to Section 18.B, then that SCR determination shall not be deemed final until the conclusion of this process under Section 32.B.

D. Nothing in this section is intended to or shall be construed to restrict or eliminate a Party's right to utilize available legal remedies following completion of the mediation process.

EXTENSIONS OF TIME

33. A. In the event that the District

(i) Anticipates that it will fail to certify or fails to certify an environmental impact report on the proposed SIP revisions and related actions by March 1, 2008; or

(ii) Anticipates that it will fail to act on or fails to act on a proposed District Board Order pursuant to Section 28.A by July 1, 2008,

the District shall promptly notify the City, and Parties shall meet and confer to determine what if any revisions to other dates contained in this Agreement may be appropriate. The Parties may mutually agree to the participation of a mediator in the meet and confer process.

B. In the event the City

(i) Anticipates that it will be unable to complete implementation or fails to complete implementation of moat and row controls pursuant to this Agreement by October 1, 2009; or

(ii) Anticipates that it will be unable to complete implementation or fails to complete implementation of all other controls by April 1, 2010,

the City may seek relief for such failure or delay by obtaining a variance from the Hearing Board of the Great Basin Unified Air Pollution Control District pursuant to District Regulation VI and all applicable law for variance relief from a District Order, including but not limited to Health and Safety Code Section 42350 *et seq*. In such event, the District shall, at the request of the City, meet with the City, prior to or after the filing of a request for a variance, in order to ascertain whether the District will support the City's variance request. In the event the District will not support the City's variance request, the City may invoke the Dispute Resolution Process pursuant to Section 32.

C. Nothing in this Section is intended to or shall limit the ability of the City to seek a variance from requirements not included in this Section.

D. Each Party will undertake to inform the other Party as early as practicable of the fact that it anticipates that it will not meet or has failed to meet any of the dates set out in this Section.

34. In the event either Party claims that the other Party is in material breach of the terms of this Agreement, including without limitation, a claim by the District that the City is in material breach under Section 11, the Party claiming the breach shall provide written notice of the claimed breach to the other Party. In the event the Party claimed to be in breach contests such claim, the issue shall be subject to the Dispute Resolution Process in Section 32.

LAWSUIT/APPEAL SETTLEMENT CONDITIONS

35. Within 15 days of execution of this Agreement, the APCO shall issue a revised SCR determination that incorporates the terms of this Agreement and that supersedes all previous determinations.

36. Upon issuance by the APCO of the revised SCR determination as described in Section 35, the City shall immediately commence the process for implementing additional DCMs on the Owens Lake bed consistent with the terms of this Agreement.

37. Upon issuance by the APCO of the revised SCR determination as described in Section 35, the City shall within seven days dismiss with prejudice its CARB appeals and the litigation against the District as described in the Recitals at Paragraphs L, O. and P.

DEFINITIONS

38. Definitions of terms used in this Agreement are contained herein and in Exhibit 13. Where specifically identified in Exhibit 13, these terms as used in this Agreement and Exhibits shall have the meanings provided in this Exhibit 13. Where no definition is provided herein or in Exhibit 13, the words and terms shall have their meaning as provided in the federal Clean Air Act or state air pollution law in the Health and Safety Code, and where no definition is found there, shall have their ordinary meaning as read in the context of this Agreement and consistent with the expressed intent of the Parties.

NOTICES

39. Whenever, under the terms of this Agreement, written notice is required to be given or a report or other document is required to be sent by one Party to another, it shall be sent by overnight mail and directed to the individual at the address

specified below, unless that individual or his or her successor gives notice of a change to the other Party in writing.

As to the City:

Ronald F. Deaton
General Manager
Los Angeles Department of Water and Power
111 North Hope Street, Room 1550
Los Angeles, CA 90012

As to the District:

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

ADDITIONAL PROVISIONS

40. By this Agreement, the City and the District intend to settle their disputes regarding methods to address air quality issues at Owens Lake, including disagreements over the SCR determination issued on December 21, 2005, and the Modified SCR determination issued on April 4, 2006.

41. This Agreement is the final integrated agreement between the Parties regarding the matters addressed herein, and may not be modified except in a writing signed by both Parties.

42. This Agreement shall be construed in accordance with the laws of the State of California.

43. In the event any provision of this Agreement is judicially determined to be unenforceable, the Parties shall meet and confer and following such meeting, the Parties may amend the Agreement, or continue the Agreement without amendment, or either Party may terminate the Agreement.

44. This Agreement shall not create any rights in any third party.

45. No failure by a Party to insist on strict performance of any term or condition of this Agreement shall constitute a waiver of such term or condition or a breach hereof.

46. Each Party represents that their respective signatories below have the authority to bind them to the terms of this Agreement.

REVIEWED AND AGREED TO:

Dated: November 30, 2006

Ronald F. Deaton
Ronald F. Deaton
General Manager, Los Angeles Department of Water and Power

The City of Los Angeles
By and Through the
Los Angeles Department of Water and Power

Dated: December 4, 2006

Henry Veatch
Henry "Skip" Veatch
Board Chairman

Great Basin Unified Air Pollution Control District

APPROVED AS TO FORM AND LEGALITY
ROCKARD J. DELGADILLO, CITY ATTORNEY

NOV 30 2006

BY Julie A. Conboy
JULIE A. CONBOY
Deputy City Attorney

List of Exhibits

EXHIBIT 1 -- TOTAL DUST CONTROL AREA MAP

The Total Dust Control Area (TDCA) is comprised of the 2006 Supplemental Dust Control Area (SDCA) and the 2003 Dust Control Area (DCA).

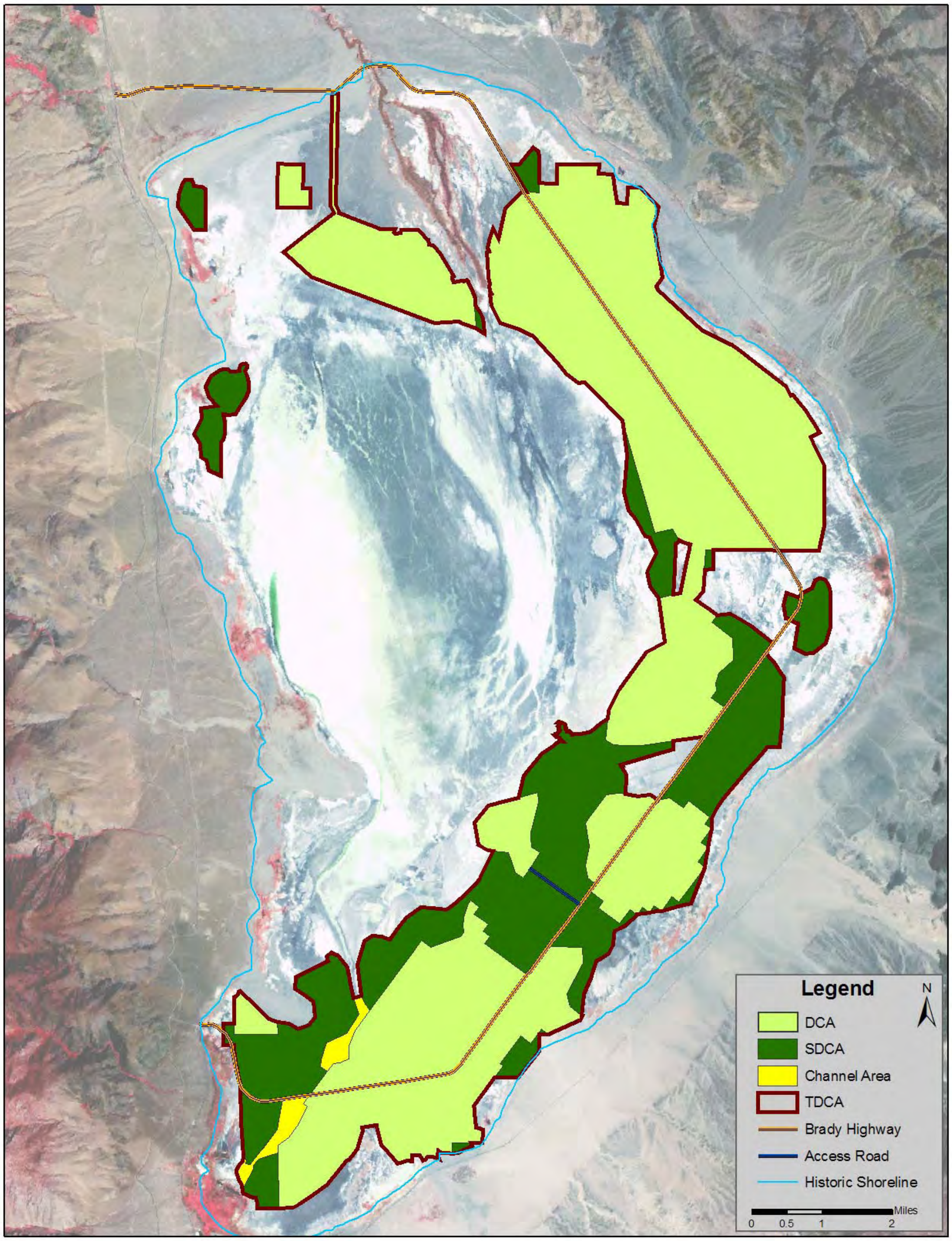

EXHIBIT 2 -- 2006 SUPPLEMENTAL DUST CONTROL AREA COORDINATE DESCRIPTIONS

KEY MAP

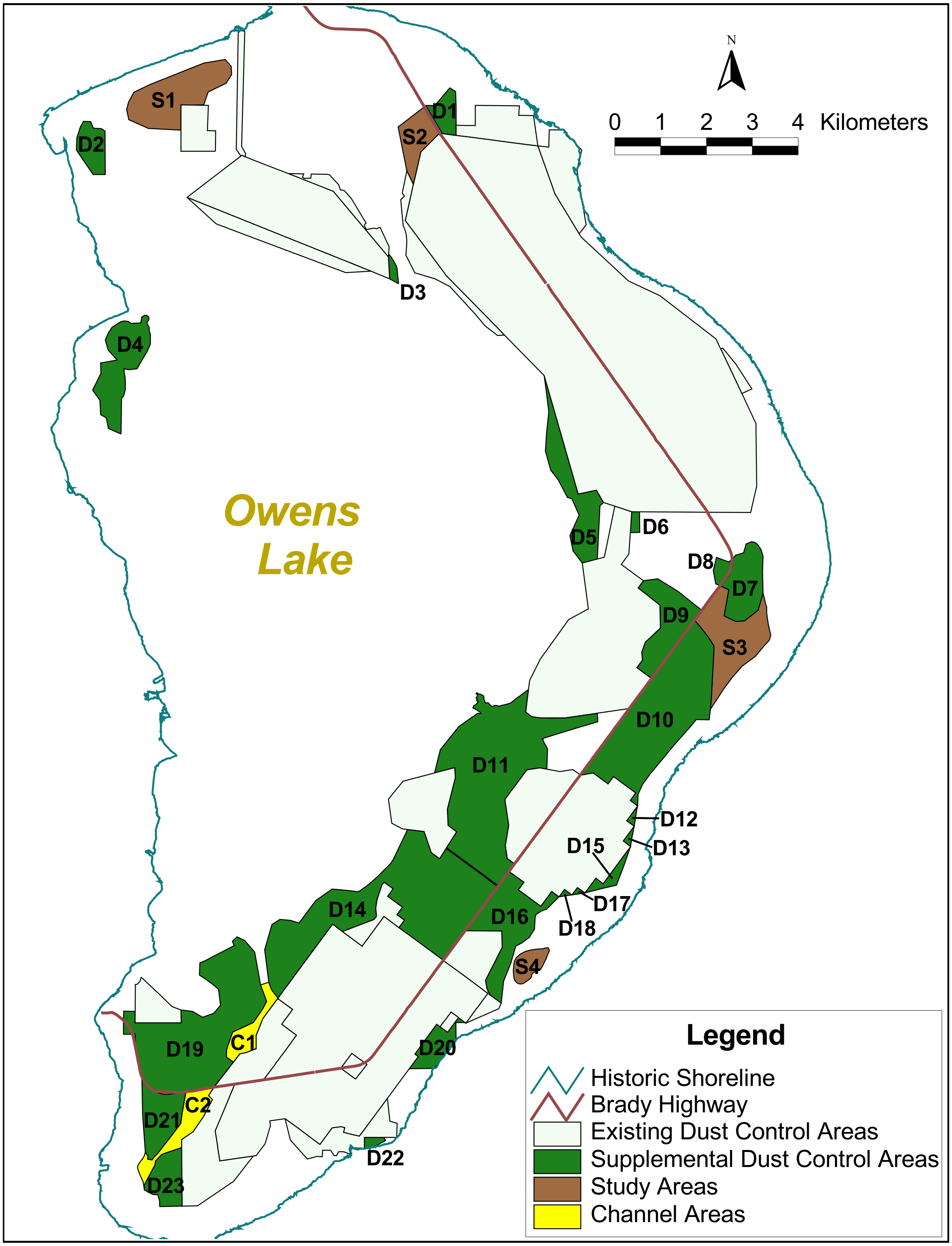

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D1	0.16	SDCA	416,001.0310	4,042,347.3789
			415,701.7500	4,042,385.7617
			415,343.2810	4,042,999.8633
			415,539.4060	4,042,999.0234
			415,866.3750	4,043,383.8359
			415,994.4060	4,043,304.2109
			416,002.6250	4,042,981.9922
			416,005.6250	4,042,568.5234
			416,001.0310	4,042,347.3789
D2	0.21	SDCA	408,085.5000	4,041,493.3164
			407,718.8130	4,042,027.7422
			407,731.5000	4,042,299.3945
			407,804.9060	4,042,524.2148
			407,873.2810	4,042,654.1211
			408,032.2500	4,042,647.6875
			408,089.5630	4,042,502.0625
			408,267.6560	4,042,491.4219
			408,347.0630	4,042,440.3203
			408,348.9690	4,041,492.4844
			408,085.5000	4,041,493.3164
D3	0.03	SDCA	414,747.2500	4,039,108.7500
			414,550.5000	4,039,224.6641
			414,528.0310	4,039,697.5156
			414,532.5000	4,039,759.7891
			414,583.3750	4,039,699.2617
			414,643.3130	4,039,605.6250
			414,700.5000	4,039,498.9766
			414,718.6880	4,039,441.7188
			414,729.1250	4,039,314.2500
			414,747.2500	4,039,108.7500
D4	0.59	SDCA	408,694.5000	4,035,836.9883
			408,417.2190	4,035,957.7344
			408,370.5940	4,036,191.9453
			408,249.5940	4,036,258.3164
			408,231.6880	4,036,571.0625
			408,075.5000	4,036,791.1719
			408,254.4060	4,037,157.2813
			408,249.9060	4,037,387.3789
			408,606.5630	4,037,448.5391
			408,414.0000	4,037,664.3359
			408,348.8750	4,037,888.7227
			408,415.9060	4,038,042.2422
			408,494.0000	4,038,156.0977
			408,687.9380	4,038,284.6484
			408,762.7190	4,038,303.7813
			408,853.0940	4,038,290.2422
			408,911.3130	4,038,246.2109
			409,028.9380	4,038,251.5742
			409,126.1560	4,038,258.7344
			409,134.0630	4,038,309.6602
			409,144.5940	4,038,382.5547
			409,201.0630	4,038,424.0508
			409,255.5940	4,038,422.9180
			409,299.1250	4,038,391.3789
			409,304.7190	4,038,329.9609
			409,254.9380	4,038,259.1797
			409,308.0940	4,038,163.0195
			409,312.7190	4,038,061.7695
			409,335.7190	4,038,017.0195
			409,334.3750	4,037,792.3008
			409,260.5630	4,037,628.4492
			409,184.9060	4,037,508.1055
			409,044.0630	4,037,256.8359
			408,869.9060	4,037,236.6055
			408,755.8130	4,037,260.8867
			408,768.2810	4,037,143.0156
			408,784.9690	4,037,079.6914
			408,789.7190	4,036,817.3555
			408,751.4060	4,036,667.7344
			408,706.5940	4,036,616.2422
			408,694.5000	4,035,836.9883

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D5	0.57	SDCA	418754.0310	4033026.5000
			418552.9690	4033287.6914
			418484.0000	4033621.1133
			418689.0940	4034066.4102
			418529.0310	4034424.5078
			418434.8130	4034452.0664
			418325.1880	4034653.5234
			418224.7810	4034845.3438
			418067.7500	4035047.7852
			417953.1880	4035467.4961
			417980.5000	4035865.3203
			418027.9060	4036319.6094
			417924.4060	4037110.5117
			418666.3750	4034527.9844
			419065.6880	4034610.9648
			419223.4690	4034342.1406
			419141.3750	4034271.8047
			419084.1880	4033110.8086
			418754.0310	4033026.5000
D6	0.03	SDCA	419801.2810	4033687.7539
			419831.7500	4034141.1016
			420006.8130	4034139.3281
			420012.7190	4033690.4844
			419801.2810	4033687.7539
D7	0.43	SDCA	422105.2500	4031749.0176
			421854.9690	4031871.4102
			421952.1880	4032442.4199
			421827.1560	4032498.3555
			421778.4380	4032522.0762
			421882.0310	4032660.6934
			421931.3130	4032728.7031
			421954.3130	4032765.7129
			421966.3130	4032785.8828
			421992.7810	4032841.0703
			422013.5310	4032894.8164
			422030.0630	4032956.1914
			422039.5000	4033014.7422
			422042.1560	4033068.7461
			422042.4380	4033082.8008
			422040.7810	4033127.2188
			422103.3750	4033191.3320
			422274.9380	4033248.8359
			422331.4380	4033437.2383
			422451.9060	4033492.2617
			422530.2190	4033470.0195
			422579.0940	4033430.6797
			422659.7190	4033313.9453
			422698.6880	4033173.2383
			422688.0630	4032830.0469
			422701.7500	4032367.5195
			422592.2190	4031994.7988
			422299.6560	4031762.5020
			422105.2500	4031749.0176
D8	0.06	SDCA	421758.4690	4032529.3477
			421668.6250	4032569.9238
			421615.5310	4032859.4297
			421680.6250	4033146.5156
			421959.5000	4033044.5586
			422021.5000	4033108.1875
			422022.5630	4033079.4023
			422019.3130	4033018.7031
			422010.1880	4032960.1484
			421994.8130	4032902.9766
			421977.7500	4032858.2227
			421948.4060	4032795.7422
			421918.7190	4032746.2988
			421884.3440	4032697.7148
			421806.2810	4032593.7305
			421758.4690	4032529.3477

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D9	0.53	SDCA	420,265.8440	4,030,508.7188
			419,947.7500	4,030,741.5176
			420,067.1880	4,030,907.7324
			420,051.5940	4,031,073.7461
			420,132.5000	4,031,300.5000
			420,460.9690	4,031,604.7441
			420,449.4060	4,032,103.9551
			419,975.9690	4,032,480.4902
			420,091.3750	4,032,635.9316
			420,399.6560	4,032,679.1270
			420,847.1880	4,032,406.2988
			421,363.7810	4,031,994.1230
			420,995.8750	4,031,495.0273
			420,265.8440	4,030,508.7188
D10	1.75	SDCA	419,965.0000	4,027,728.2520
			419,803.2190	4,027,847.7363
			419,922.8440	4,028,009.4902
			419,437.5940	4,028,368.0176
			419,317.9690	4,028,206.2617
			418,994.5310	4,028,445.2656
			418,730.3440	4,028,397.0371
			419,406.8750	4,029,323.4316
			421,010.9060	4,031,484.3145
			421,216.1560	4,031,761.8594
			421,439.0940	4,031,498.2363
			421,631.0310	4,031,208.7773
			421,571.8750	4,030,077.3184
			421,548.9690	4,029,833.7383
			421,523.2500	4,029,607.1328
			421,241.1880	4,029,607.8887
			421,116.0000	4,029,457.7559
			420,776.0000	4,029,075.9551
			420,233.7500	4,028,421.8027
			420,070.9690	4,028,193.2832
			419,973.2500	4,027,978.3457
			419,965.0000	4,027,728.2520
D11	2.32	SDCA	416,924.2190	4,025,991.8965
			416,906.7190	4,026,000.2598
			416,817.3750	4,026,065.2832
			415,808.9380	4,026,810.0977
			415,803.8440	4,026,822.5840
			415,810.1250	4,026,837.9219
			416,016.5310	4,027,163.7559
			415,829.9690	4,027,301.7383
			415,812.0000	4,027,654.7500
			415,987.3440	4,028,348.8008
			415,969.6880	4,028,562.7461
			415,530.3750	4,028,446.4922
			415,660.2500	4,028,955.4551
			416,062.8130	4,029,458.0664
			416,386.1560	4,029,683.9746
			416,436.9060	4,029,720.7148
			416,449.5000	4,029,732.7207
			416,468.5940	4,029,742.7246
			416,489.8750	4,029,746.4355
			416,529.4060	4,029,741.9941
			416,547.9690	4,029,741.4180
			416,541.4060	4,029,755.8789
			416,528.0940	4,029,767.9277
			416,515.2190	4,029,777.7969
			416,501.9690	4,029,786.2637
			416,489.6560	4,029,794.9004
			416,430.1250	4,029,834.6543
			416,415.3750	4,029,843.4570
			416,400.7190	4,029,849.4766
			416,387.3130	4,029,856.1563
			416,372.5940	4,029,860.3105
			416,368.5310	4,029,870.0703
			416,375.7810	4,029,880.6270
			416,384.4690	4,029,895.7617
			416,385.5310	4,029,910.9023
			416,395.3130	4,029,918.6621
			416,406.0630	4,029,922.9727
			416,419.9060	4,029,929.8086
			416,435.1560	4,029,936.6543
			416,449.2500	4,029,947.3340
			416,459.1250	4,029,961.2246
			416,462.9690	4,029,976.8418
			416,471.5630	4,029,988.3965

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D11 continued	2.32	SDCA	416481.0000	4029994.3359
			416483.2500	4030000.4590
			416476.4690	4030004.0684
			416464.6250	4030013.5332
			416452.1250	4030020.7266
			416447.3130	4030031.0762
			416454.8750	4030042.8809
			416467.7500	4030052.9766
			416466.0630	4030067.6035
			416454.5310	4030077.5586
			416440.6250	4030076.0938
			416437.6250	4030084.6914
			416445.8130	4030098.3496
			416459.0310	4030110.6875
			416465.9060	4030126.0488
			416467.1560	4030142.7871
			416461.5310	4030157.1523
			416450.1560	4030168.0938
			416439.0940	4030177.2402
			416443.8750	4030188.7227
			416458.4380	4030192.3809
			416470.3130	4030190.8789
			416479.0310	4030177.9727
			416493.8130	4030171.2637
			416510.6250	4030166.2656
			416527.2190	4030165.8828
			416541.7810	4030161.9238
			416568.0630	4030143.3945
			416585.0000	4030137.3281
			416601.6250	4030130.7734
			416608.7190	4030112.7188
			416614.8750	4030093.7324
			416614.1560	4030081.1367
			416606.9690	4030057.0176
			416610.2810	4030041.6328
			416621.0310	4030029.7910
			416626.8440	4030016.4492
			416634.6560	4030003.4863
			416639.6560	4029988.0273
			416642.2500	4029973.2676
			416656.7190	4029972.4727
			416688.3750	4029977.5293
			416704.9380	4029976.5762
			416715.9690	4029964.5742
			416723.1250	4029949.7949
			416734.4690	4029937.7109
			416747.7190	4029929.2070
			416759.0310	4029916.4004
			416768.4690	4029902.2207
			416781.8130	4029898.3633
			416790.3750	4029900.3945
			416827.0940	4029907.2129
			416838.2500	4029915.7813
			416845.7500	4029917.9492
			416852.5940	4029916.0938
			416867.9690	4029916.1543
			416880.3440	4029917.7637
			416895.6880	4029914.7402
			416925.9380	4029904.3965
			416940.7190	4029903.4805
			416954.8130	4029907.8730
			416966.3750	4029914.2246
			417119.3130	4029946.7070
			417187.6250	4029971.9180
			417582.2500	4030268.0078
			417521.0310	4029772.5176
			417701.5630	4029667.0430
			417771.4380	4029656.0293
			417852.7810	4029647.5566
			418130.3750	4029643.4648
			418383.2810	4029647.0859
			419083.7810	4029748.1953
			419086.1880	4029746.9258
			419093.6560	4029564.0527
			417887.0630	4029198.4668
			417896.1560	4029182.4668
			417881.5000	4029187.7246
			418000.2190	4028968.8594
			417985.8130	4028531.7539
			417825.0940	4028556.4668
			417545.0000	4028513.0254

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D11 continued	2.32	SDCA	417,068.6250	4,027,867.9766
			417,152.6880	4,027,307.1758
			417,077.1880	4,026,864.2910
			417,117.7810	4,026,581.1016
			417,277.7500	4,026,460.9707
			416,924.2190	4,025,991.8965
D12	0.02	SDCA	419,887.8440	4,027,285.2500
			419,726.0310	4,027,404.7344
			419,965.0000	4,027,728.2520
			419,949.5310	4,027,659.1582
			419,887.8440	4,027,285.2500
D13	0.02	SDCA	419,810.5000	4,026,842.2539
			419,648.7190	4,026,961.7383
			419,772.4690	4,027,130.8359
			419,887.8440	4,027,285.2500
			419,880.3750	4,027,234.3164
			419,832.8130	4,026,984.5820
			419,810.5000	4,026,842.2539
D14	2.46	SDCA	412,117.6560	4,023,538.0977
			411,983.4060	4,023,714.6152
			411,915.1560	4,023,883.7793
			411,828.0940	4,024,594.2207
			411,988.0310	4,025,141.2695
			412,161.8440	4,025,254.5859
			412,387.4060	4,025,234.3184
			412,577.3130	4,025,175.8184
			412,752.9380	4,025,413.6777
			412,942.5940	4,025,667.2090
			413,298.0630	4,025,913.1816
			413,700.7190	4,025,878.1113
			413,843.4060	4,025,859.0313
			413,892.3750	4,025,869.0625
			414,103.4380	4,026,021.7207
			414,294.0310	4,026,188.3672
			414,574.5630	4,026,473.5742
			414,628.3130	4,026,552.7695
			414,946.8130	4,027,212.3789
			415,303.7810	4,027,171.2480
			415,463.6880	4,026,711.0117
			415,639.0630	4,026,577.9492
			415,777.6250	4,026,784.4590
			415,787.8440	4,026,793.4668
			415,793.6560	4,026,794.4512
			416,290.3440	4,026,429.5527
			416,545.3750	4,026,241.2695
			416,908.5000	4,025,969.6309
			416,207.2500	4,025,017.7598
			415,765.2810	4,024,422.9277
			415,712.3440	4,024,368.7461
			414,755.6880	4,025,075.7559
			414,875.1560	4,025,237.5156
			414,715.5000	4,025,356.9941
			414,832.8440	4,025,518.7598
			414,509.4060	4,025,757.7637
			414,628.8750	4,025,919.4863
			414,432.8750	4,026,064.2539
			414,383.9380	4,025,997.9883
			414,274.7500	4,025,678.2109
			414,249.7810	4,025,496.0098
			414,266.4690	4,025,323.2305
			414,210.4380	4,025,245.9863
			413,519.9380	4,024,988.5723
			413,307.2500	4,025,145.7637
			413,144.4690	4,024,931.4102
			412,117.6560	4,023,538.0977
D15	0.08	SDCA	418,812.6560	4,025,829.9941
			419,051.1560	4,026,152.9863
			419,213.4060	4,026,034.2168
			419,810.5000	4,026,842.2539
			419,655.1250	4,026,404.8789
			419,499.9380	4,025,999.3496
			419,182.9690	4,025,925.2813
			418,812.6560	4,025,829.9941

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D16	0.70	SDCA	416987.0630	4023427.0801
			416718.5630	4023625.5098
			416734.5310	4023647.0078
			416700.3440	4023672.5195
			416689.5630	4023734.1953
			416678.1560	4023741.8613
			416644.1560	4023925.0195
			417010.6880	4024645.2734
			417000.8130	4024984.0566
			417004.5630	4024995.9414
			416997.8130	4025001.7578
			416224.2500	4025007.0430
			416932.7810	4025971.6777
			417170.5000	4026294.0039
			417483.0940	4026061.2461
			417363.6250	4025899.4863
			417848.8440	4025541.0000
			418087.8130	4025864.5176
			418249.6250	4025744.9961
			417981.1560	4025483.1621
			417862.3130	4025432.8262
			417742.6560	4025357.7832
			417731.0940	4025299.8848
			417711.4060	4025042.9023
			417596.9060	4024857.0391
			417427.9690	4024735.2051
			417308.1560	4024673.9160
			417192.2500	4024288.4082
			417038.6560	4023907.3789
			416987.0630	4023427.0801
D17	0.01	SDCA	418812.6560	4025829.9941
			418722.7810	4025817.3457
			418531.3750	4025787.7188
			418650.8440	4025949.5527
			418812.6560	4025829.9941
D18	0.01	SDCA	418250.0940	4025745.5586
			418369.5630	4025907.3164
			418531.2190	4025787.8750
			418422.7500	4025775.2305
			418250.0940	4025745.5586
D19	1.88	SDCA	410989.2810	4022251.9551
			411145.7810	4022140.5918
			410728.5630	4021605.7773
			410525.7190	4021575.8516
			410434.2500	4021553.4805
			410330.1560	4021538.0020
			410249.0940	4021523.9121
			410165.6880	4021513.8320
			410012.7810	4021489.0801
			409988.7810	4021485.5020
			409958.9380	4021487.3027
			409834.5940	4021472.0918
			409710.8750	4021458.8867
			409588.2190	4021468.2129
			409472.9060	4021506.2676
			409364.2190	4021564.2617
			409273.0310	4021648.9043
			409231.3750	4021698.0781
			409192.6560	4021749.2871
			409142.4380	4021863.0625
			409121.8750	4021936.3730
			409108.8130	4021989.7910
			409094.0000	4022070.1055
			409085.6880	4022117.5977
			409078.5310	4022146.7773
			409061.1250	4022247.9473
			409045.9690	4022310.3633
			409033.1250	4022381.5703
			409029.3750	4022398.8301
			409009.4380	4022518.7207
			409000.8440	4022749.8164
			408748.8130	4022752.2285
			408748.6880	4022994.9199
			408752.0000	4023250.6855
			409002.0630	4023249.9121
			408999.6250	4023000.2637
			410005.0940	4022997.9844
			410001.1880	4023280.3379
			410254.3750	4023245.9746

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
D19 continued	1.88	SDCA	410,472.1880	4,023,123.1172
			410,718.0630	4,023,206.8965
			410,862.1250	4,023,378.8164
			410,821.5940	4,023,731.0039
			410,665.3750	4,023,862.7910
			410,401.5000	4,024,041.8867
			410,411.4380	4,024,308.5215
			410,520.6560	4,024,349.3066
			411,162.2810	4,024,681.8047
			411,124.9690	4,024,778.6250
			411,222.3440	4,024,873.7930
			411,392.4060	4,024,792.1602
			411,607.8130	4,024,539.2461
			411,737.1560	4,023,825.0313
			411,867.2500	4,023,463.2520
			411,784.7500	4,023,306.3613
			411,582.4060	4,023,006.9551
			411,126.7810	4,022,795.5957
			410,994.2500	4,022,416.6367
			410,989.2810	4,022,251.9551
D20	0.21	SDCA	414,982.2190	4,021,997.8164
			415,176.7190	4,022,263.2852
			415,103.2190	4,022,320.4727
			415,581.2500	4,022,965.4922
			415,817.9380	4,022,790.5078
			416,056.9060	4,023,113.9902
			416,207.6250	4,023,003.7656
			415,998.3750	4,023,002.3203
			416,002.5310	4,022,602.1270
			415,526.5000	4,022,002.0215
			414,982.2190	4,021,997.8164
D21	0.39	SDCA	409,784.0630	4,021,446.5840
			409,836.5940	4,021,452.1992
			409,959.4380	4,021,467.4043
			409,986.8440	4,021,465.6152
			410,014.9380	4,021,469.1094
			410,109.0000	4,021,484.2637
			410,027.5940	4,021,036.2754
			409,998.0310	4,020,801.4766
			409,487.5940	4,020,143.3262
			409,409.3130	4,020,065.3262
			409,373.6560	4,020,006.3652
			409,360.9380	4,020,010.4766
			409,276.4690	4,020,023.0879
			409,280.3750	4,020,086.8984
			409,223.5310	4,020,182.5996
			409,166.6250	4,020,986.3672
			409,146.5630	4,021,804.0762
			409,176.1250	4,021,738.1621
			409,218.6880	4,021,681.9980
			409,255.5940	4,021,639.3984
			409,351.8750	4,021,549.4316
			409,464.4690	4,021,488.9551
			409,583.4380	4,021,449.5684
			409,710.2810	4,021,438.8574
			409,784.0630	4,021,446.5840
D22	0.03	SDCA	414,001.2500	4,020,257.5078
			414,001.4690	4,020,502.5137
			414,426.0000	4,020,500.8262
			414,464.0310	4,020,432.0313
			414,293.7190	4,020,338.7207
			414,135.9690	4,020,279.6660
			414,001.2500	4,020,257.5078
D23	0.29	SDCA	409,535.8130	4,018,994.6445
			409,534.9380	4,019,112.7676
			409,493.8750	4,019,250.0898
			409,428.5630	4,019,253.1973
			409,374.7500	4,019,259.9512
			409,200.4380	4,019,355.6914
			409,208.0310	4,019,472.8008
			409,435.7810	4,019,902.2852
			409,445.4060	4,019,983.3887
			409,576.6880	4,020,126.1250
			410,016.9060	4,020,278.1445
			410,025.1560	4,019,002.0527
			409,535.8130	4,018,994.6445

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
S1	0.71	Study	410001.6560	4042464.2656
			409290.7190	4042500.2383
			408861.2190	4042688.4688
			408813.8750	4042910.9609
			408859.4380	4043071.8984
			408972.0940	4043285.6914
			409337.5310	4043461.0000
			410500.6560	4043924.3945
			410962.4690	4044000.3555
			411096.8440	4043852.2109
			411108.0630	4043672.6836
			410984.4380	4043481.0273
			410592.0940	4043294.9219
			410496.6250	4043013.0352
			410003.5310	4043008.3594
			410001.6560	4042464.2656
S2	0.27	Study	415072.8130	4041278.8984
			414928.6560	4041572.7422
			414740.2500	4042529.6992
			415304.2190	4042966.9609
			415642.3130	4042393.3203
			415234.1250	4041986.6914
			415072.8130	4041278.8984
S3	0.72	Study	421548.9690	4029833.7383
			421571.8750	4030077.3184
			421631.0310	4031208.7773
			421439.0940	4031498.2363
			421216.1560	4031761.8594
			421260.3750	4031837.4414
			421371.5310	4031985.9238
			421398.8440	4032023.9863
			421454.5000	4032099.1406
			421509.5310	4032174.3066
			421645.9690	4032358.6465
			421725.3130	4032466.9844
			421769.8440	4032526.2539
			421827.1560	4032498.3555
			421952.1880	4032442.4199
			421854.9690	4031871.4102
			422105.2500	4031749.0176
			422299.6560	4031762.5020
			422592.2190	4031994.7988
			422701.7500	4032367.5195
			422732.5630	4032243.8984
			422746.8130	4032159.0254
			422779.7500	4032064.7734
			422779.7190	4031946.8984
			422793.9060	4031814.8984
			422817.5310	4031682.9316
			422840.9690	4031565.0645
			422869.3130	4031447.2109
			422836.2810	4031338.7852
			422713.7500	4031206.8086
			422529.9380	4030985.2422
			422250.5940	4030779.7578
			422000.0310	4030499.9922
			422006.2810	4030500.0156
			421836.9380	4030271.0234
			421548.9690	4029833.7383
S4	0.15	Study	417410.5630	4023845.5176
			417398.8440	4023845.8750
			417387.4380	4023846.9883
			417377.4060	4023848.7207
			417367.8440	4023851.0527
			417358.9380	4023853.9434
			417350.9380	4023857.4238
			417343.0940	4023861.6250
			417335.2810	4023866.7793
			417327.4690	4023872.8066
			417319.6880	4023879.7500
			417310.5940	4023888.9688
			417301.9690	4023899.1680
			417293.6560	4023910.1230
			417286.2810	4023921.5137
			417281.1250	4023930.3848
			417276.9060	4023939.6543
			417273.1560	4023949.9414
			417269.7190	4023961.3281
			417266.5000	4023975.5664
			417263.6560	4023992.3125

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
S4	0.15	Study	417,257.5630	4,024,036.4043
continued			417,255.7810	4,024,053.0898
			417,254.3440	4,024,071.4844
			417,253.3440	4,024,112.0410
			417,253.6880	4,024,135.3887
			417,256.4690	4,024,211.2207
			417,258.9380	4,024,248.6602
			417,260.8130	4,024,266.7930
			417,266.0630	4,024,299.1426
			417,269.5630	4,024,313.8516
			417,274.6560	4,024,330.5859
			417,281.5940	4,024,349.5684
			417,289.7810	4,024,368.9414
			417,298.0630	4,024,386.4863
			417,306.2810	4,024,401.4785
			417,314.9690	4,024,415.0508
			417,324.0630	4,024,427.2441
			417,333.2500	4,024,437.8730
			417,341.8130	4,024,446.3809
			417,362.2810	4,024,463.6328
			417,374.6880	4,024,472.7871
			417,391.6880	4,024,484.4727
			417,422.5940	4,024,504.8984
			417,438.9380	4,024,515.1504
			417,454.8440	4,024,524.5742
			417,469.5000	4,024,532.6895
			417,483.8130	4,024,540.1250
			417,497.9690	4,024,546.9180
			417,525.0310	4,024,558.3184
			417,537.3130	4,024,562.7500
			417,550.9690	4,024,567.0371
			417,565.6880	4,024,571.1504
			417,595.7190	4,024,578.3379
			417,644.3750	4,024,588.4512
			417,671.1560	4,024,593.2676
			417,699.5630	4,024,597.4395
			417,729.9690	4,024,601.0371
			417,763.4060	4,024,604.2285
			417,801.4380	4,024,607.2109
			417,876.5000	4,024,612.3184
			417,885.9690	4,024,613.4160
			417,906.1880	4,024,617.6074
			417,954.9060	4,024,630.4629
			417,966.3750	4,024,632.8535
			417,976.4690	4,024,634.2813
			417,984.4060	4,024,634.8398
			417,991.7190	4,024,634.7266
			417,998.0940	4,024,633.9082
			418,004.0310	4,024,632.4531
			418,009.1560	4,024,630.2891
			418,013.8130	4,024,627.4102
			418,017.8750	4,024,623.8594
			418,021.4380	4,024,619.5566
			418,027.1560	4,024,609.7598
			418,032.4060	4,024,597.6895
			418,034.6560	4,024,589.4512
			418,035.8750	4,024,580.7773
			418,035.6560	4,024,570.7617
			418,034.0630	4,024,559.9766
			418,031.0630	4,024,548.3418
			418,026.3750	4,024,535.4473
			418,020.4690	4,024,521.3984
			418,000.5310	4,024,478.6465
			417,984.5630	4,024,435.9668
			417,970.9060	4,024,402.7227
			417,957.8130	4,024,373.8125
			417,943.3130	4,024,343.8242
			417,931.2500	4,024,320.3027
			417,918.0940	4,024,295.7734
			417,880.1250	4,024,228.6719
			417,859.5000	4,024,190.0117
			417,854.1250	4,024,181.0176
			417,848.9380	4,024,173.2773
			417,843.6250	4,024,166.4160
			417,838.3130	4,024,160.3535
			417,832.0940	4,024,154.4258
			417,825.1250	4,024,149.1992
			417,816.9690	4,024,144.4160
			417,807.5630	4,024,140.0762
			417,799.1250	4,024,136.8242
			417,789.4690	4,024,133.5957
			417,744.3750	4,024,120.6641
			417,733.3130	4,024,116.6641

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
S4	0.15	Study	417723.6250	4024112.4082
continued			417716.8440	4024108.7773
			417710.6880	4024104.8281
			417693.1880	4024092.0859
			417683.1250	4024084.1797
			417674.4380	4024076.5137
			417667.2810	4024069.1191
			417661.4690	4024061.8086
			417657.0630	4024054.5488
			417654.5000	4024048.2773
			417652.5000	4024040.8516
			417647.9060	4024009.5918
			417646.3750	4024002.8047
			417644.5940	4023996.9746
			417640.7500	4023988.9395
			417636.0310	4023980.8086
			417630.3750	4023972.9629
			417623.6560	4023965.2930
			417617.2810	4023958.7949
			417609.9690	4023952.3184
			417601.7810	4023945.7832
			417592.6250	4023939.0781
			417575.3440	4023927.6641
			417540.5940	4023906.3262
			417526.8440	4023897.4316
			417515.0940	4023889.3320
			417487.6880	4023868.7949
			417472.0940	4023858.9844
			417463.6560	4023854.8926
			417455.1880	4023851.9063
			417444.7810	4023849.1504
			417433.6250	4023847.1348
			417422.1560	4023845.9258
			417410.5630	4023845.5176
C1	0.21	Channel	411145.9380	4022140.5117
			410989.3130	4022252.0020
			410994.2500	4022416.6367
			411126.7810	4022795.5957
			411582.4060	4023006.9551
			411784.7500	4023306.3613
			411867.2500	4023463.2520
			411737.1560	4023825.0313
			411915.1560	4023883.7793
			411983.4060	4023714.6152
			412117.6560	4023538.0977
			411792.0630	4023094.1152
			411782.4060	4023076.2949
			411748.7190	4022994.3965
			411643.6250	4022726.7266
			411641.6880	4022435.3887
			411419.2190	4022347.2383
			411284.5000	4022318.9453
			411145.9380	4022140.5117
C2	0.30	Channel	409201.5000	4019370.5664
			409173.3130	4019532.8418
			409115.7190	4019657.4395
			409058.5940	4019813.5703
			409055.4380	4019859.0117
			409098.6560	4019944.7520
			409192.5940	4020079.2344
			409223.5310	4020182.5996
			409280.3750	4020086.8984
			409276.4690	4020023.0879
			409352.7190	4020011.6758
			409373.6560	4020006.3652
			409409.3130	4020065.3262
			409487.8750	4020143.3594
			409998.1880	4020801.4746
			410027.7500	4021036.2715
			410109.2810	4021484.2578
			410174.2810	4021494.7188
			410242.0940	4021502.6836
			410335.4060	4021518.5000
			410438.7190	4021533.8438
			410529.8750	4021556.1816
			410712.0940	4021583.1074
			410602.7500	4021411.3418
			410686.8440	4021328.9805
			410488.7190	4020946.7344
			410264.6250	4020620.0820
			410015.6880	4020454.4902

EXHIBIT 2 -- Owens Lake 2006 Supplemental Dust Control Area Coordinate Descriptions

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates
C2 continued	0.30	Channel	410,016.9060	4,020,278.1445
			409,576.6880	4,020,126.1250
			409,445.4060	4,019,983.3887
			409,435.7810	4,019,902.2852
			409,208.0310	4,019,472.8008
			409,201.5000	4,019,370.5664

Area ID	Area (miles)	Area type	Coordinates(UTM Zone11 meters NAD83) X-coordinates	Y-coordinates

Total SDCA	12.77
Total Study	1.85
Total Channel	0.50

EXHIBIT 3 -- DUST CONTROL MEASURE MAP

Shown are dust control measures assigned to areas within the SDCA.

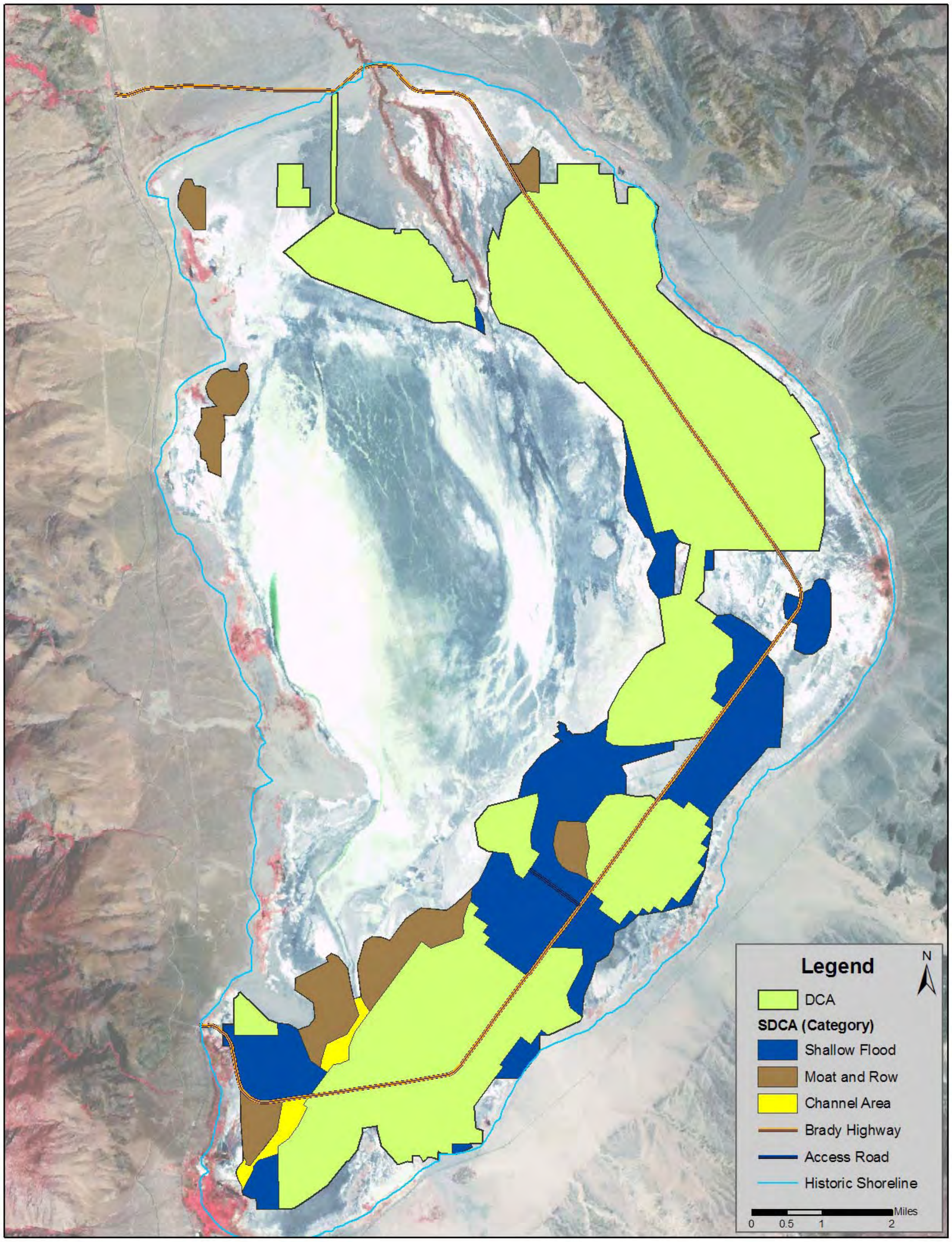

EXHIBIT 4 -- DUST CONTROL MEASURE DESCRIPTIONS

Brief descriptions of dust control measures for use on Owens Lake are given below. More detailed descriptions of the three BACM approved dust control methods (shallow flooding, managed vegetation and gravel) are provided in the 2003 SIP. Modifications to these measures as provided in the Settlement Agreement (Agreement) are noted. All references are to sections of the Agreement; section numbers of the Agreement are contained in square brackets.

Shallow Flooding

The "shallow flooding" (SF) dust control measure involves wetting emissive lake bed surfaces to reduce dust emissions. Performance specifications and a detailed description of the SF measure are provided in the 2003 SIP for achieving 99 percent PM_{10} control efficiency. Otherwise, water shall be applied in amounts sufficient to achieve the required wetness cover as specified in Sections 3 through 5, 25, 26, and 27, or as modified under the provisions of Sections 5, 14, 15, 18, and 29. Satellite imagery, aerial photography or other methods approved by the APCO under the provisions of Section 29 are used to measure wetness cover for compliance.

Managed Vegetation

The "managed vegetation" (MV) dust control measure involves establishing a plant cover on emissive lake bed surfaces to protect them from the wind, thereby reducing dust emissions. Performance specifications and a detailed description of the MV control measure are provided in the 2003 SIP for achieving 99 percent PM_{10} control efficiency. Vegetative cover on the MV site present on the lake bed on January 1, 2007 shall be as specified in Section 6. The performance specification of MV may be modified under the provisions of Section 29. Point-frame measurements satellite imagery or other methods approved by the APCO under the provisions of Section 29 are used to measure plant cover for compliance.

Gravel Cover

The "gravel cover" (GC) dust control measure involves placing a layer of gravel on emissive lake bed surfaces to protect them from the wind, thereby reducing dust emissions. Performance specifications are described in the 2003 SIP.

Moat and Row

The general form of the "moat and row" (MR) measure is an array (see Figure E4-1) of earthen berms (rows) about 5 feet high with sloping sides, flanked on either side by ditches (moats) about 4 feet deep (see Figure E4-2). Moats serve to capture moving soil particles, and rows physically shelter the downwind lake bed from the wind. The individual MR elements are constructed in a serpentine layout across the lake bed surface, generally parallel to one another, and spaced at variable intervals, so as to minimize the fetch between rows along the predominant wind directions. The serpentine layout of the MR array is intended to control emissions under the full range of principal wind directions (see Figure E4-1). Initial pre-test modeling indicates that MR elements' spacing will generally vary from 250 to 1000 feet, depending on the surface soil type and the PM_{10} control effectiveness required on the MR area.

The PM_{10} control effectiveness of MR may be enhanced by combining it with other dust control methods such as vegetation, water, gravel, sand fences, or the addition of other features that enhance sand capture and sheltering or directly protect the lake bed surface from wind erosion. The effectiveness of the array can also be increased by adding moats and rows to the array, which reduces the distance between rows.

The final form of MR will largely be determined from the results of testing on the lake bed as provided in Sections 7 and 8. Final design is subject to test results, required PM_{10} control effectiveness, environmental documentation and permitting, engineering, and monitoring considerations.

In areas where MR is used as a control measure, the City shall implement the measure in a manner consistent with the Agreement, particularly Sections 7 and 8, or as modified by actions pursuant to Sections 18 through 24.

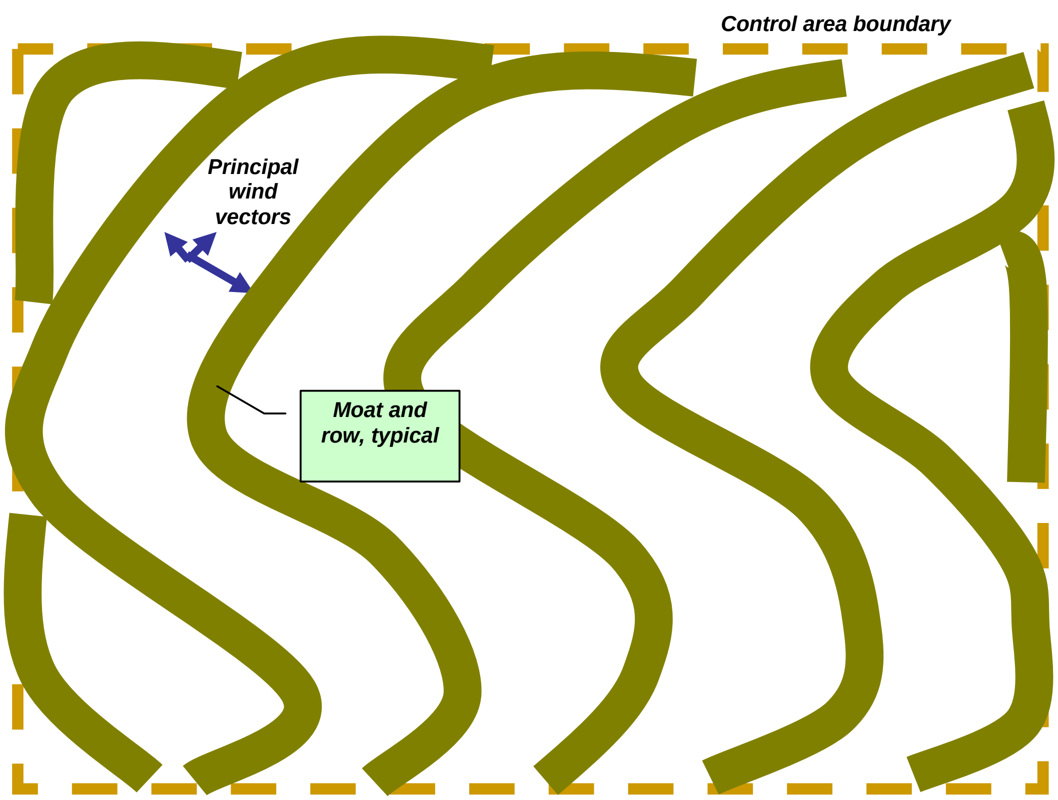

Figure E4-1. Moat and Row Array Plan View (schematic).

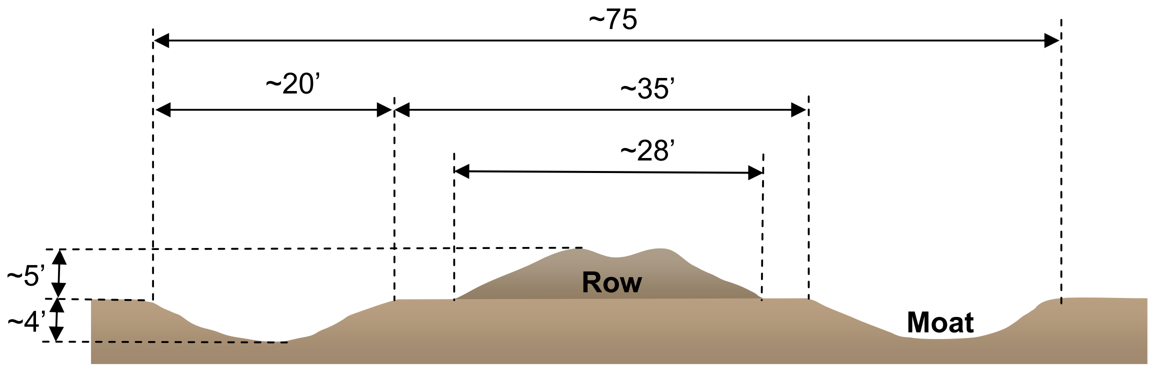

Figure E4-2. Profile of Moat and Row with Approximate Dimensions (schematic).

EXHIBIT 5 -- TDCA MINIMUM DUST CONTROL EFFICIENCY MAP

Shown are MDCEs calculated according to Sections 3 and 4 of the agreement.

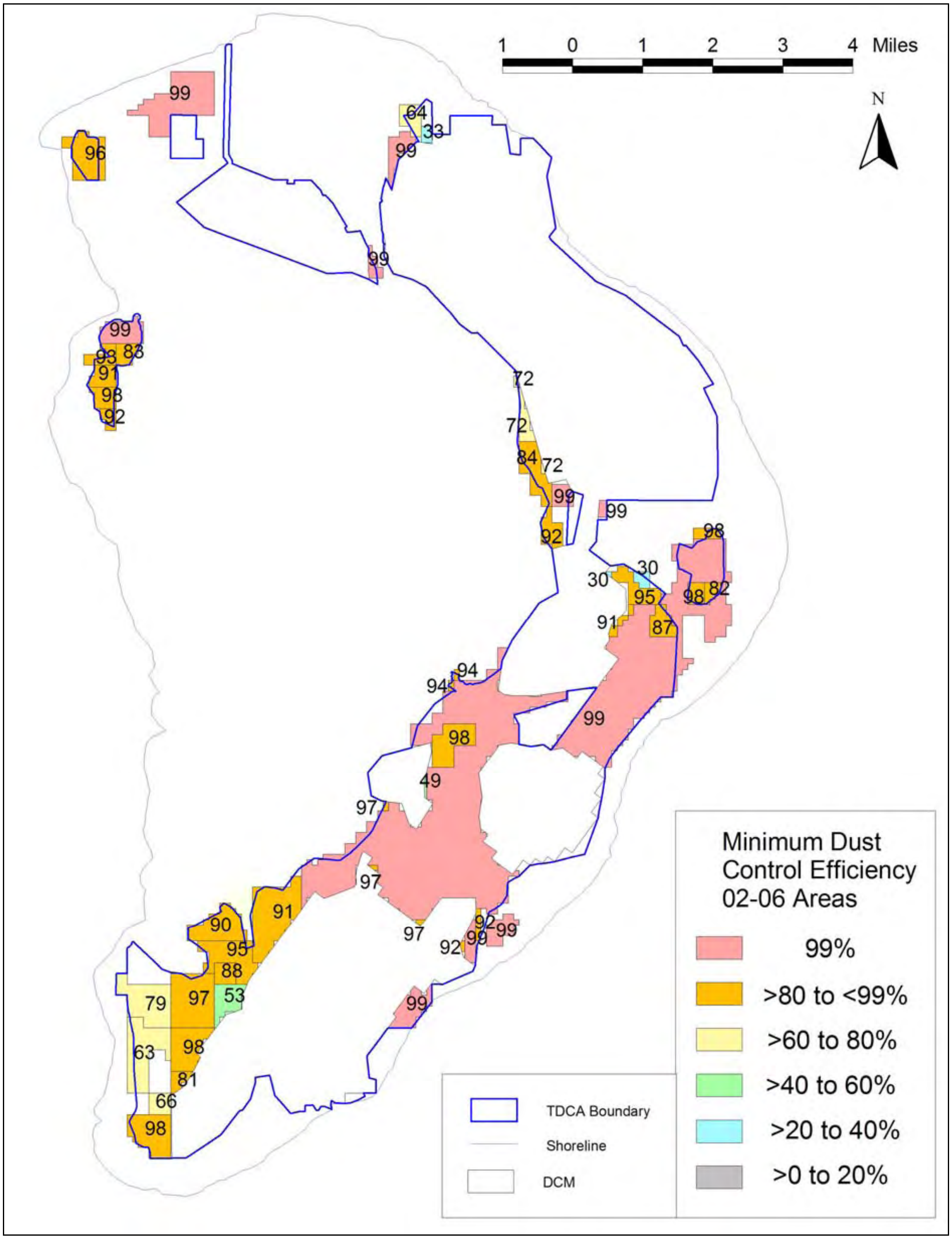

EXHIBIT 6 -- MDCE SELECTION PROCESS

This exhibit summarizes the purpose of the MDCE Selection Process Spreadsheet. A copy of the Process Spreadsheet, which contains a description of the spreadsheet structure and operation, may be downloaded from the District's website at http://www.gbuapcd.org/.

The District developed the Dust ID Model as a tool for identifying dust control areas on the lake bed. The Dust ID Model computes the amount of dust being generated from each source area on the lake bed, but the results cannot be used without additional processing to identify the acceptable combinations of dust control required on each source area (that is, each area's minimum dust control efficiency or "MDCE") to achieve the federal 24-hour PM_{10} standard along the shoreline. There are many possible combinations of MDCEs that could produce the acceptable result of achieving the standard at the shoreline. For example, 50 percent control on hypothetical Area 1 and 99 percent control on Area 2 may produce the same modeled shoreline concentration as 99 percent control on Area 1 and 50 percent control on Area 2. However, the first combination might be more practical and less costly than the second, and for that reason it is important to have a process that can quickly and efficiently identify acceptable combinations. In all cases, the outcome of this process is some combination of area-by-area dust control efficiencies that produces a modeled attainment of the federal PM_{10} standard everywhere along the shoreline.

The process for selecting the acceptable combinations of dust control levels has been, heretofore, a manual process. The MDCE Selection Process Spreadsheet (Process Spreadsheet) was developed to more quickly and efficiently identify combinations of dust controls required to produce compliance with the federal 24-hour PM_{10} standard along the shoreline. The worksheet is set up so that MDCE calculations are automatic, yet it still allows manual adjustments to be made.

EXHIBIT 7 -- SHALLOW FLOOD CONTROL EFFICIENCY CURVE

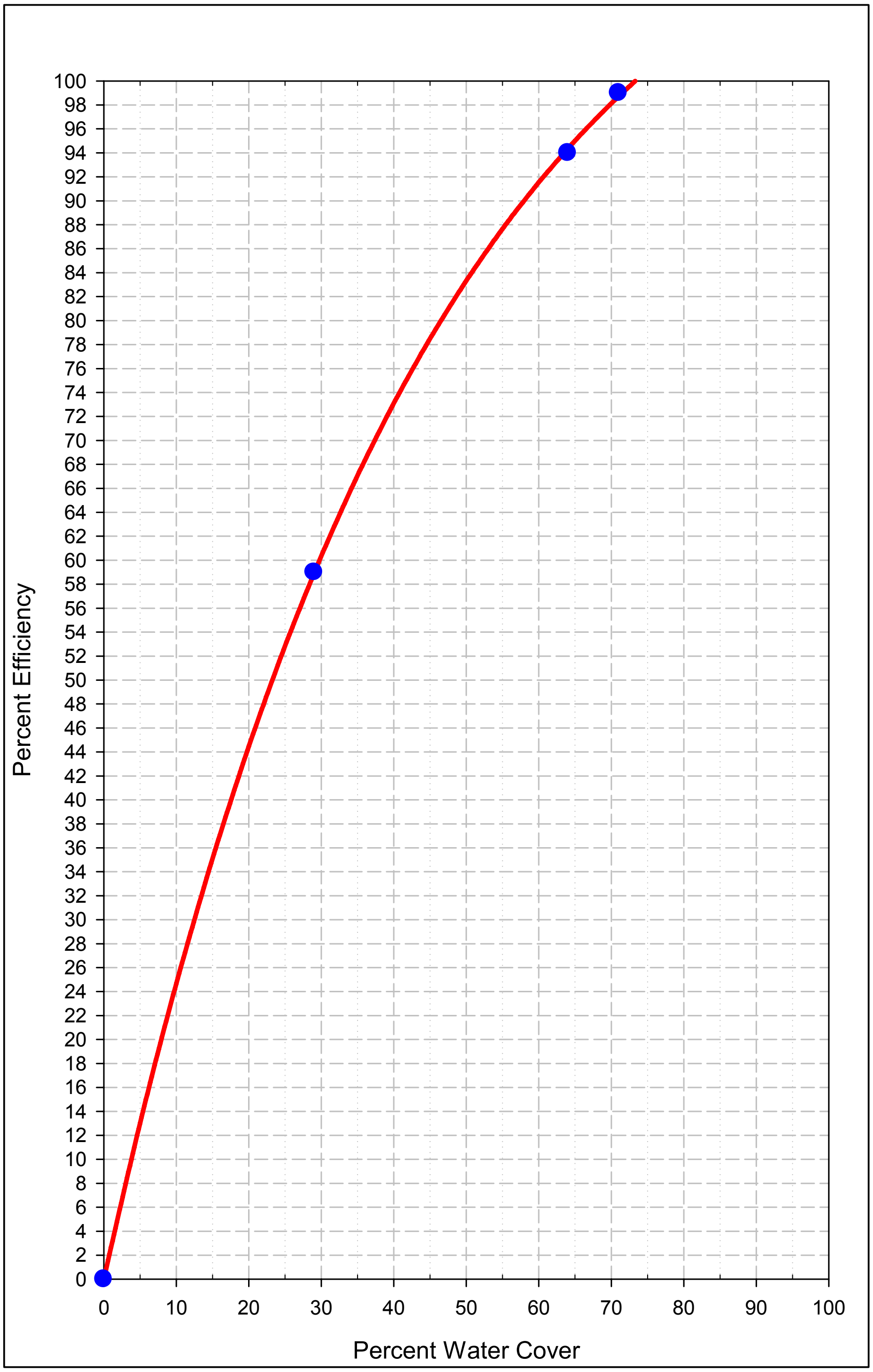

EXHIBIT 8 -- MOAT AND ROW DEMONSTRATION PROJECT LOCATION MAP

Two proposed moat and row demonstration project locations

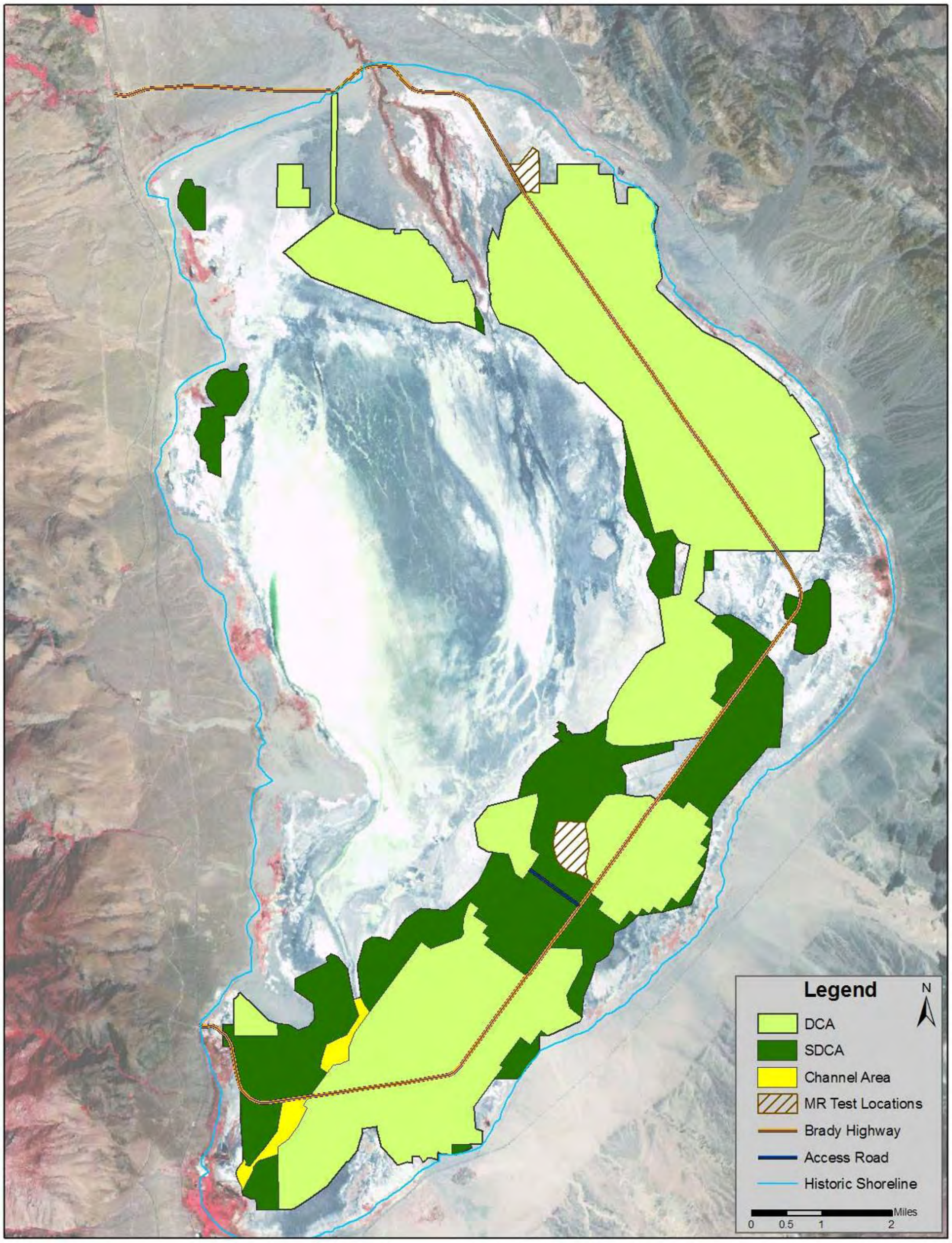

EXHIBIT 9 -- STUDY AREA MAP

Four proposed study area locations

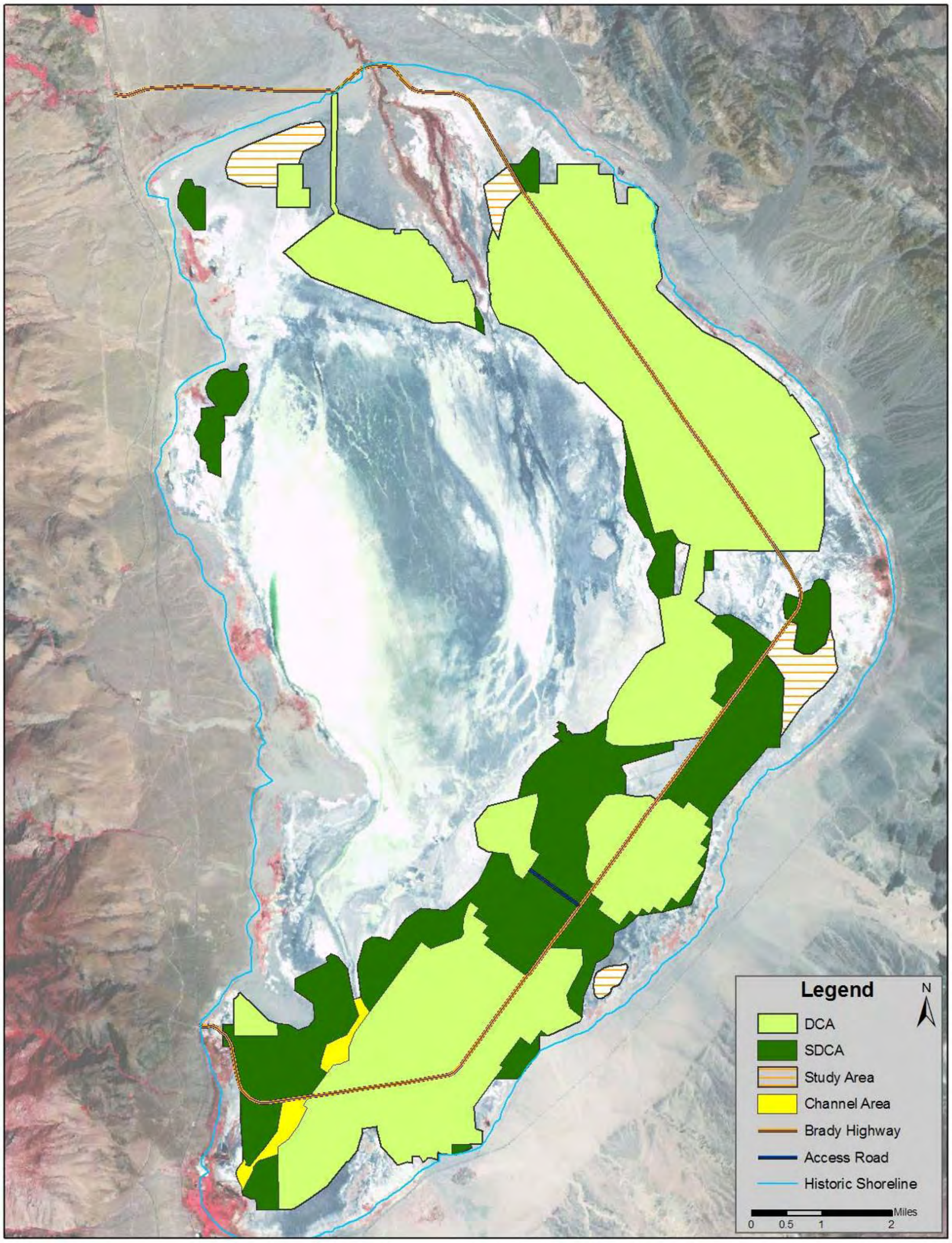

EXHIBIT 10 -- SCHEDULE OF CONTINGENCY MEASURES

Issue	***Resolution***	***Duration***	***Units***
Moat and Row			
Eroded row	Install armoring to prevent further erosion	2	mo/mile
	Install sand fences to prevent further erosion	1	mo/mile
	Reconstruct row in place or adjacent	2	mo/mile
Filled moat	Re-excavate new moat outboard of filled moat, expand existing row onto filled moat	2	mo/mile
Filled sand fence	Clean out or flank with new sand fences	2	mo/mile
Collapsed sand fence	Repair or flank with new sand fences	1	mo/mile
Spacing too large	Pull in intervening sand fence	1	mo/mile
	Add intervening moat and row	3	mo/mile
	Enhance with vegetation and/or wetness	12 to 36	months
	Soil roughening	1 to 3	months/sq mi
	Conversion to reduced BACM/BACM	See Exhibit 11	
Managed Vegetation			
Emissions from bare areas	Enhance/restore vegetation	36	months
	Stabilize by other means (e.g., moisture, sand fences)	1 to 6	months/sq mi
Emissions from vegetated areas	Determine and establish necessary cover	36	months
	Stabilize by other means (e.g., moisture, sand fences)	1 to 6	months/sq mi
Gravel Patches			
Infilling pore spaces	Supplement gravel depth	4	months/sq mi
	Stabilize by other means (e.g., vegetation, wetness, sand fences)	6 to 36	months
Shallow Flood			
Emissions from dry areas (insufficient uniformity of wetting)	Wet dry areas. May require land leveling and/or additional laterals.	12	months
Generally too dry	Increase water application rate relative to ET	1	month
Other features			
Gravel source	Open new or re-open existing quarry	4	months
Emissions from roads, berms, etc.	Increase watering frequency	1	month
	Stabilize by other means (e.g., gravel, stabilizing agents)	1 to 4	months/sq mi

EXHIBIT 11 -- MOAT AND ROW TRANSITION SCHEDULE

Activity	Duration (years)
Shallow flood transition from moat & row	1.9
Managed vegetation transition from moat & row	5.9
Gravel cover transition from moat & row	1.8
Mutually agreeable exceptions:	*Increase over and above durations listed above (years)*
1. Mainline capacity increase	2.1
2. New aqueduct turnout	1.4
3. New power feed	1.0

EXHIBIT 12 -- DCM OPERATION SCHEDULE

Activity	Duration (years)
New area shallow flood DCM[a]	2.9
New area managed vegetation DCM[a]	6.1
New area gravel cover DCM[a]	2.2
Mutually agreeable exceptions:	*Increase over and above durations listed above (years)*
1. Mainline capacity increase	2.1
2. New aqueduct turnout	1.4
3. New power feed	1.0
4. Expanded CEQA triggered	1.4

[a]Assumes that total new area <2 square miles per year

EXHIBIT 13. DEFINITIONS

A. “Background PM_{10} concentration” shall mean the concentration of PM_{10} caused by sources other than from wind blown dust emanating from the Owens Lake bed. For the purpose of modeling air quality impacts, the background concentration is assumed to be 20 $\mu g/m^3$ (micrograms per cubic meter) during every hour at all receptor locations. The monitored and modeled PM_{10} emissions from the Keeler Dunes, which are located off the lake bed are treated as a separate dust source area and are not included in the background concentration.

B. “Best Available Control Measures” or “BACM” shall have the same definition as in the federal Clean Air Act. Approved BACM in the 2003 SIP was associated with PM_{10} emission reductions of at least 99 percent and includes managed vegetation, shallow flood, and gravel cover.

C. “Contingency measures” shall mean dust control measures or modifications to the dust control measures that can be implemented to mitigate dust source areas that cause or contribute to an exceedance of the federal standard at the historic shoreline in the event that a previously approved control strategy was found to be insufficient.

D. “Control Area” shall mean an area on the lake bed for which dust control is required.

E. “Control efficiency” shall mean the relative reduction or percent reduction in PM_{10} emissions resulting from the implementation of a control measure compared to the uncontrolled emissions.

F. “Control measures” shall mean measures effective in reducing the PM_{10} emissions from the lakebed surface over which they are implemented.

G. “Dust control measure” or “DCM” shall mean measures designed to suppress sand motion and reduce dust emissions from the Owens Lake bed.

H. “Dust ID Model” shall mean a computer-based air quality modeling approach developed as part of the 2003 SIP to identify emissive areas on the Owens Lake bed and to estimate the resulting PM_{10} concentrations at the shoreline. See also “Dust ID Program.”

I. “Dust ID Program” shall mean a long-term monitoring and modeling program that is used to identify dust source areas at Owens Lake that cause or contribute to exceedances and violations of the federal PM_{10} standard. The current protocol for conducting the Dust ID Program is included in the 2003 SIP (Exhibit 2 – Attachment 4). See also "Dust ID Model."

J. "Emission rate" shall mean the rate (expressed as mass per unit area per unit time) at which an air constituent (PM_{10}, for example) is transported away from the surface of the lake bed.

K. "Exceedance of the federal standard" or "exceedance" shall mean any single-day PM_{10} concentration that is monitored or modeled to be above 150 $\mu g/m^3$ (24-hour average from midnight to midnight) at any location at or above the historic shoreline.

L. "Historic shoreline" or "shoreline" shall mean the elevation contour line of 3,600 feet above mean sea level at Owens Lake, California.

M. "Lake bed" or "Owens Lake bed" or "playa" shall mean the exposed surface within and below the historic shoreline.

N. "Managed Vegetation" is a Dust Control Measure consisting of lakebed surfaces planted with protective vegetation.

O. "May not lawfully be included in the SIP" shall mean that inclusion of the provision in question in the revisions to the 2003 SIP has been determined by binding judicial order to be unlawful.

P. "MCDE-BACM" shall mean Dust Control Measures that achieve Minimum Dust Control Efficiency and are found to be appropriate for the area of application.

Q. "Minimum Dust Control Efficiency" or "MDCE" shall mean the lowest dust control efficiency, as determined by the Dust ID model, in the Supplemental Dust Control Area necessary to meet the federal standard at the historic shoreline.

R. "Moat and Row" shall mean a Dust Control Measure consisting of arrays of sand breaks that arrest sand motion.

S. "PM_{10}" or "particulate matter" shall mean atmospheric particulate matter less than 10 micrometers in nominal aerodynamic diameter.

T. "PM_{10} monitor" shall mean an instrument used to detect the concentrations of PM_{10} in the air.

U. "Sand flux monitor" shall mean a device used to measure the amount and/or rate of moving or saltating sand and sand-sized particles caused by wind erosion.

V. “Shallow Flood” is a Dust Control Measure consisting of lakebed areas wetted to a specified proportion of surface coverage.

W. “2003 SIP” or “2003 Owens Valley PM_{10} State Implementation Plan” shall mean the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan 2003 Revision – Adopted November 13, 2003.

X. “Supplemental Control Requirements” or “SCR” shall mean Dust Control Measures required by the District on areas outside of the DCA that cause or contribute to an exceedance of the federal PM_{10} standard at the historic shoreline of Owens Lake.

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Board Order 080128-01
Attachment B

2008 Owens Valley Planning Area
Supplemental Control Requirements Determination Procedure

BACKGROUND

The State Implementation Plan (SIP) adopted by the Great Basin Unified Air Pollution Control District (District) in 2003 required the City of Los Angeles (City) to install and operate PM_{10} controls on a total of 29.8 square miles of the dried Owens Lake bed by the end of 2006. The 2003 SIP also contained a provision and procedures for an annual review of air quality monitoring data by the District's Air Pollution Control Officer (APCO) in order to determine if controls were needed on additional areas beyond the 29.8 square miles in order for the Owens Valley Planning Area to attain or maintain the federal 24-hour PM_{10} National Ambient Air Quality Standard (NAAQS). If additional controls were needed, the 2003 SIP provided for the APCO to require the City to implement the necessary controls. This annual review and possible requirement for additional controls is known as the Supplemental Control Requirements (SCR) determination. The 2003 SIP required that SCR determinations use data collected starting July 1, 2002.

In December 2005, after analyzing data collected from July 2002 through June 2004, the District's APCO made the first SCR determination under the provisions of the 2003 SIP. The City objected to the APCO's analysis and submitted an alternative analysis of the data. After reviewing the City's analysis, the APCO revised the SCR determination in April 2006. The City also objected to the revised determination and filed a lawsuit against the District in May 2006. In June 2006 the City and the District entered into settlement negotiations in an attempt to resolve their disputes.

In December 2006 a final Settlement Agreement was approved by the District and the City. This agreement is Attachment A to Board Order 080128-01. Among other issues, the Settlement Agreement provides for modifications to be made to the 2003 SIP's SCR determination procedure. These modifications are incorporated into this revised 2008 SCR determination procedure.

CONDITIONS

The 2008 Owens Lake Dust Source Identification Program Protocol (Protocol) (Attachment C) contains the procedures to collect, screen, analyze and model the data used by the District's APCO to determine if exceedances of the 24-hour PM_{10} NAAQS have occurred and additional Supplemental Controls are necessary on the Owens Lake bed. The following actions may be taken by the APCO and will not be considered a change to the Protocol:

- Add, remove or move PM_{10} monitors and meteorological stations
- Replace TEOMs with any other USEPA-approved Reference or Equivalent Method monitors that collect hourly concentration data
- Replace Sensits with any other sand flux monitor (SFM) that collects hourly data
- Replace Cox Sand Catchers with any other SFM

- Add, remove or move SFMs as long as the maximum grid cell size for modeling remains at one square kilometer
- Calculate "from-the-lake" wind directions for new PM_{10} monitor sites
- Determine default K-factors for new source areas

The Protocol and these Supplemental Control Requirements (SCR) specify many assumptions and decision trees to be followed that may need to be changed in the future. The following changes to the Protocol and the SCR may be made by written agreement of the APCO and the General Manager of the City of Los Angeles (City) Department of Water and Power:

- The background value of 20 $\mu g/m^3$ may be changed to another value or a procedure may be established to calculate the background from upwind/downwind lake bed monitors
- The default K-factors may be updated
- The default seasonal cut points may be updated
- The CalPUFF modeling system may be changed to another USEPA guideline model
- The procedure for determining the sand flux from a Dust Control Measure (DCM) area may be updated
- The K-factor screening criteria may be updated
- From-the-lake wind directions in Attachment B, Table 1 may be changed to avoid including off-lake sources
- Non-reference or non-equivalent method special purpose PM_{10} monitors may be added
- Procedures for determining source area boundaries may be updated
- Methods for directly measuring source area emission rates may be implemented

DEFINITIONS

A ***shoreline or near-shore PM_{10} monitor*** is a fixed or portable USEPA-approved Federal Reference Method or Equivalent Method PM_{10} Monitor located approximately on the 3600-foot elevation (historic shoreline) contour, or within the Owens Valley Non-Attainment Area above the 3600-foot elevation. The existing shoreline or near-shore PM_{10} monitors are at Keeler, Flat Rock, Shell Cut, Dirty Socks, Olancha, Bill Stanley and Lone Pine (see Attachment B, Map 1).

A ***special purpose PM_{10} monitor*** is a fixed or portable USEPA-approved Federal Reference Method or Equivalent Method PM_{10} monitor installed upwind of or near potential dust source areas on the lake bed below the 3600-foot elevation. These lake bed PM_{10} monitors will be used to monitor new dust sources areas to generate new K-factors and to evaluate model predictions at the PM_{10} sites. They shall not be used to monitor compliance with the NAAQS and the data will not be submitted to USEPA's Aerometric Information and Retrieval System (AIRS).

An ***exceedance*** is a midnight to midnight Pacific Standard Time 24-hour average PM_{10} concentration greater than 150 $\mu g/m^3$ measured by a shoreline or near-shore PM_{10} monitor.

From-the-lake wind directions are determined by extending two straight lines from the PM_{10} monitor site to the points on the 3600-foot contour of the Owens Lake bed that maximize the angle in the direction of the lake bed between the two straight lines. From-the-lake and non-lake wind directions for the existing PM_{10} monitor sites are shown in Attachment B, Table 1.

Physical evidence of a source area boundary consists of Global Positioning System (GPS) data, visual observations, photographic observations, video observations, or any other method described for this purpose in the Dust ID Protocol.

BACM are Best Available Control Measures/Most Stringent Measures (MSM) defined as the dust controls determined to be BACM/MSM for Owens Lake in Paragraphs 15, 16 and 17 of Board Order 080128-01. If, in the future, the District changes or deletes existing BACM or adds new BACM, then the dust controls are those as revised by the latest District action.

Implements BACM control measures means BACM are constructed and meeting the performance standards outlined Paragraphs 15, 16 and 17 of Board Order 080128-01.

Extreme violators are areas currently required to implement BACM, but BACM are found to be insufficient to adequately control emissions.

Environmental analysis document complete means that a project level environmental document has been certified covering the location and the BACM/MSM selected for implementation by the City.

GENERAL SCR DETERMINATION PROCEDURE

1. If the City is in compliance with Paragraphs 1 and 3 of Board Order 08128-01 regarding the amount, timing and operation of existing and future dust controls, the APCO will not issue additional written SCR determinations until after May 1, 2010 and will not use data collected prior to April 1, 2010 for new determinations, except for Study Areas as provided in Paragraph 2, below. This will allow the City time to complete construction and implementation of the additional PM_{10} controls within the 2008 Total Dust Control Area.

2. After May 1, 2010, the APCO will recommence written SCR determinations using the latest SCR procedure. Recommenced determinations will use data collected only after April 1, 2010, except in those areas delineated as Study Areas. SCR determinations for Study Areas shall use data collected after July 1, 2006. The APCO shall make SCR determinations at least once in every calendar year. SCR determinations shall make reasonable efforts to account for impacts caused by Dust Control Measure construction activities.

3. If, pursuant to Paragraph 2, herein, the APCO determines that a monitored or modeled exceedance of the federal 24-hour PM_{10} NAAQS caused by emissions from the lake bed has occurred at or above the historic shoreline:

   A. The APCO, based on all available information, including, visual observation, physical evidence, monitoring and modeling, and in consultation with the City, will identify the need for additional controls, monitoring, or both.

      (i) If the APCO identifies the need for additional controls and/or increased MDCE on existing controls, the APCO shall issue a written SCR determination to the City.

(ii) If the City does not agree with the APCO's determination, the City may, within 60 days of the APCO's determination, submit to the District an alternative analysis of the data used by the APCO to make the determination.

(iii) If the City submits an alternative analysis, the APCO shall consider the City's analysis and has full and sole discretion to withdraw, modify or confirm the SCR determination. If the APCO takes action to withdraw or modify the SCR determination, he shall do so within 60 days of the City's submittal of the alternative analysis.

(iv) If the APCO issues a modified SCR determination or confirms the initial SCR determination and the City does not agree with the APCO's action, the City may initiate the Dispute Resolution Process pursuant to Paragraph 32 of the 2006 Settlement Agreement between the District and the City (Attachment A to Board Order 080128-01). The APCO may modify the SCR determination based on the outcome of the Dispute Resolution Process.

(v) In the event the Parties are unable to resolve disagreements over the APCO's SCR determinations through the Dispute Resolution Process, the City may appeal the APCO's SCR determinations to the California Air Resources Board (CARB) under the provisions of Health and Safety Code Section 42316. The CARB will act within 90 days on the City's appeal.

(vi) The implementation of additional control measures under the SCR determination process will be considered contingency measures under Section 172(c)(9) of the federal Clean Air Act and will be implemented automatically upon final action of the SCR determination.

B. The City shall prepare and submit for the APCO's consideration and written approval, which approval shall not be unreasonably withheld, a Remedial Action Plan as described in Paragraph 6 to address the exceedance(s). The City shall submit the Remedial Action Plan within 60 days of the date the SCR determination becomes final.

C. If the City proposes in their Remedial Action Plan to decrease the control efficiency in any previously controlled dust source area, the City must demonstrate that the proposed strategy will control dust sources to the extent that there are no modeled exceedances at the shoreline based on:

(i) new dust event(s) that caused or contributed to a modeled or monitored exceedance,

(ii) dust events that took place from July 2002 through June 2006 based on the results of the MDCE Selection Process Spreadsheet as set forth in the 2006 Settlement Agreement, and

(iii) that previously determined control efficiency levels are maintained in (a) all areas that are required to have 99% control efficiency or higher in the 2003 SIP Dust Control Area and (b) new dust source areas that are not included in the MDCE Selection Process Spreadsheet.

D. The District may, as appropriate, also issue Notices of Violation.

4. In the event:

A. The APCO has made a written determination pursuant to Paragraph 3 that an exceedance of the federal standard, occurring after April 1, 2010, resulted from a Control Area or portion of a Control Area treated with the Moat & Row PM_{10} control measure; and

B. That Control Area or portion of a Control Area causing the exceedance was remediated by the City as provided in Paragraph 6 below; and

C. That Control Area or a portion of that Control Area is subsequently the sole cause of an exceedance of the federal standard at or above the historic shoreline, (i.e., an exceedance occurred after the City's initial attempt to remediate that area under Paragraph 6);

then the City shall convert that Control Area, or that portion of that Control Area, from Moat & Row to MDCE-BACM or BACM as described in Paragraphs 15, 16 and 17 of Board Order 080128-01, to address the exceedance described in Paragraph 4.C., for all or the portion of that Control Area that caused the subsequent exceedance, under the time deadlines provided for in Paragraph 9.

5. If the APCO determines that Moat & Row constitutes BACM or MDCE-BACM as provided for in Attachment D of Board Order 080128-01, "2008 Procedure for Modifying Best Available Control Measures (BACM) for the Owens Valley Planning Area," then upon issuance of such written determination, the provisions of Paragraph 4 that require the City to convert to BACM or MDCE-BACM may be satisfied by applying the BACM or MDCE-BACM approved under this Paragraph 5.

6. A Remedial Action Plan prepared by the City pursuant to Paragraph 3.B will contain a description of:

A. Any and all needed changes, repairs or enhancements to DCMs, including one or some combination of the following:

(i) Maintenance of facilities (*e.g.*, berms, moats and rows);

(ii) Changes to Shallow Flood or Managed Vegetation facilities or operations (*e.g.*, increase in wetness cover extent, improved wetness cover distribution, enhancement of vegetation);

(iii) Augmentation (*e.g.*, more moats and rows) or enhancement (*e.g.*, surface-protecting elements) of Moat & Row areas;

(iv) Transition of Moat & Row areas to BACM, or MDCE-BACM.

B. Any and all needed expansion of DCMs, and specific plans for expanding the measures.

C. A schedule for the work to be performed to implement the changes, clearly indicating the point at which facilities will be operational and effective at design levels.

7. The Schedule of Contingency Measures incorporated as part of this Procedure as Attachment B, Exhibit 1 sets forth a non-exclusive list of items that shall be included by the City in its Remedial Action Plans, described in Paragraph 6, and the timing required for their implementation.

8. Before any full-scale Moat & Row areas are operational, the City shall submit to the District a conceptual design and schedule for possible implementation of BACM or MDCE-BACM to each Moat & Row area consistent with Paragraph 4. These designs and schedules are the potential contingency measures to be implemented by the City where a transition from Moat & Row to another DCM is needed, or where such transition is required pursuant to Paragraph 4.

9. Areas to be transitioned from Moat & Row to BACM or MDCE-BACM will be operational within the times set forth in the Moat & Row Transition Schedule incorporated as Attachment B, Exhibit 2. DCMs for new areas will be operational within the times set forth in the DCM Operation Schedule incorporated as Attachment B, Exhibit 3. In all cases, the time allowed for implementation of control measures shall not include any time between the City's appeal to the California Air Resources Board under the provisions of Health and Safety Code Section 42316 and resolution of such an appeal.

DETAILED SCR DETERMINATION PROCEDURE

Exceedances of the federal 24-hour PM_{10} National Ambient Air Quality Standard of 150 µg/m³ at or above the historic shoreline of Owens Lake (elevation 3600 feet above mean sea level) can either be measured directly via a PM_{10} monitor or they can be modeled using the procedures set forth in the latest Owens Lake Dust Source Identification Program Protocol. Set forth below are the two procedures to be used by the APCO in making SCR determinations: the first uses directly monitored exceedances and the second uses modeled exceedances.

A. MONITORED EXCEEDANCES

A.1 – Do lake bed source areas cause or contribute to a monitored 24-hour average PM_{10} concentration greater than 150 µg/m³ at an historic shoreline PM_{10} monitor or at a near-shore PM_{10} monitor?

Any event that causes a monitored 24-hour average PM_{10} concentration greater than 150 µg/m³ at a shoreline or near-shore PM_{10} monitor will be evaluated to determine if lake bed dust source areas caused or contributed to the exceedance. The following steps will be used to screen hourly PM_{10} concentrations to determine if a lake bed source area caused or contributed to a monitored exceedance:

1) For hourly average from-the-lake wind directions, use the recorded hourly PM_{10} concentration.
2) For hourly average non-lake wind directions or missing data, replace the recorded hourly PM_{10} concentration with the background concentration of 20 µg/m^3.

3) Average the adjusted hourly concentrations from steps 1 and 2 for the 24-hour period from midnight to midnight, Pacific Standard Time.

If the 24-hour average of the adjusted hourly PM_{10} concentrations exceeds 150 µg/m³ at the monitor site, go to A.2. If not, go to B.1.

A.2 – Is there physical evidence of lake bed emissions and/or air quality modeling sufficient to define boundaries for the area to be controlled?

Source Delineation.
If possible, the boundary of a dust source area will be delineated by a GPS survey. Under certain circumstances, the surveyed boundary of the dust source area will not result in a closed polygon. If the GPS survey yields a partial boundary and not a closed polygon, then the polygon area may be closed, if the length of the closure is equal to or less than one-half kilometer or is less than 20 percent of the surveyed source area perimeter, whichever is smaller. The ends of the partial surveyed area boundary will be completed with a straight line, unless survey notes or visual observations indicate that a different shaped boundary should be used. If the surveyed source area boundary has a complex shape, then the partial boundary to be closed will use the best available field and visual data to connect the two ends and form the polygon. Boundaries of existing controlled areas or other previously located boundaries will be used in place of a GPS survey boundary, if the survey notes or visual observations indicate the erosion area extends to that boundary.

If the GPS boundary described above is not available, the area will be defined by any one or a combination of GPS surveying, visual observations, and video observations or any other method described in the Dust ID Protocol (Attachment C).

If neither the GPS boundary nor other physical evidence, as described above, is available, the default area size will be one square kilometer centered on the sand flux monitor (SFM), or one grid cell if the SFMs are in a closer array.

If there is physical evidence, as described above, to define the boundaries for the area to be controlled, and no K-factor for that area or no sand catch data above one gram for the sampling period from a sand flux sampler located within a 30 degree upwind cone centered on the wind direction of the defined source, then modeling cannot be performed. Go to A.3.

Modeling.
If sand flux data is available for the exceedance identified in A.1, the District will model the event. Modeling will be performed following the latest Dust ID Modeling Protocol using the source area determined above.

The order of priority for applying K-factors in the model will be:

1) When available, the District will use event specific storm-average K-factors to model dust events at the PM_{10} monitor if there are three or more hours of screened hourly K-factors for a 48-hour period. If not,

2) The District will use the most recent temporal and spatial 75-percentile hourly K-factors to model events, if there are nine or more screened hourly K-factors for a period and they are determined by the methods described in the most current Dust ID Protocol. If not,

3) The District will use the default K-factors in Attachment B, Table 2 to model events, based on the month of the event being investigated and the K-factor area.

Only those on-lake and off-lake dust sources with sand flux data will be included in the model. All data collected by the District pursuant to this Section shall be shared with the City within 30 days of final data review.

The modeling results will be used to prioritize multiple upwind source areas for control, or to determine the fraction of a single upwind source area that needs to be controlled.

Go to A.3

If neither physical evidence nor model results are available, go to A.5.

A.3 – District directs City to implement dust controls.

Source areas in A.2 that cause or contribute to an exceedance may be new source areas, or may be emissions from areas with existing dust controls. The APCO will determine, in writing, that conditions specified in Section A.1 were met for a specified area determined by A.2. For emissions from areas with existing dust controls, the City will have the choice of increasing the controls in the existing dust control areas or controlling other contributing sources that will result in lowering the monitored impact below the 150 $\mu g/m^3$ exceedance threshold, if such areas exist. If the APCO identifies the need for additional controls, the APCO shall issue a written SCR determination to the City.

If the City does not agree with the APCO's determination, the City may, within 60 days of the APCO's determination, submit to the District an alternative analysis of the data used by the APCO to make the determination. If the City submits an alternative analysis, the APCO shall consider the City's analysis and may withdraw, modify or confirm the SCR determination. If the APCO takes action to withdraw or modify the SCR determination, he shall do so within 60 days of the City's submittal of the alternative analysis.

If the APCO issues a modified SCR determination or confirms the initial SCR determination and the City does not agree with the APCO's final action, the City may initiate the Dispute Resolution Process pursuant to Paragraph 32 of the 2006 Settlement Agreement between the District and the City (Attachment A to Board Order 080128-01). The APCO may modify the SCR determination based on the Dispute Resolution Process.

In the event the Parties are unable to resolve disagreements over the APCO's SCR determinations through the Dispute Resolution Process, the City may appeal the APCO's SCR determinations to the California Air Resources Board (CARB) under the provisions of Health and Safety Code Section 42316 (Section 42316). The CARB will act within 90 days on the City's appeal.

The City shall prepare and submit for the APCO's consideration and written approval, which approval shall not be unreasonably withheld, a Remedial Action Plan as described in Paragraph 6 to address the exceedance(s). The City shall submit the Remedial Action Plan within 60 days of the date the SCR determination becomes final.

Go to A.4.

A.4 – City implements dust controls.

DCMs for new areas will be operational within the times set forth in the DCM Operation Schedule incorporated as Attachment B, Exhibit 3. The City is solely responsible for all environmental impact analyses required by the California Environmental Quality Act and for all required permits and leases.

A.5– District collects additional physical evidence and installs sand flux monitors in suspected areas.

If there is insufficient physical evidence and no sand flux monitor data to determine the emissive area on the lake bed that caused the monitored or modeled exceedance, the District will install Sensits and Cox Sand Catchers (CSC) sand flux monitors in the suspected area in a sampling array with a maximum spacing of one kilometer. The District will also continue to collect other physical evidence.

B. Modeled Exceedances

B.1 – Does the Dust ID model predict a 24-hour shoreline concentration greater than 150 µg/m³, including background?

Dispersion Modeling Analysis.
At least once a year, the District will examine the Dust ID information and dispersion model to determine if there have been any modeled shoreline exceedances since the period included in the last model run. Modeling will be performed following the 2008 Owens Lake Dust Source Identification Program (Dust ID) Protocol (Attachment C).

K-factors.
New K-factors may be generated from PM_{10} concentrations measured at any shoreline or near-shore PM_{10} monitor using the methods described in the Dust ID Protocol. The order of priority for applying K-factors in the model will be:

1) The current temporal and spatial 75th percentile hourly K-factors. The District will use the current modeling period temporal and spatial 75th percentile hourly K-factors to model events, if there are nine or more hourly K-factors for an agreed upon seasonal period and area determined by the methods described in the most current Dust ID Protocol.

2) If there is no agreement on seasonal cut-points, the default cut points, as shown in Attachment B, Table 2, will be used with number 1, above.

3) If there is no agreement on area, the default areas, as shown in Attachment B, Map 1, will be used with number 1, above.

4) If there are fewer than nine hourly K-factors for any area and period, go to 5), below.

5) Default K-factors from Attachment B, Table 2. The District will use the K-factors in Attachment B, Table 2 to model events, based on the month of the event being investigated and the K-factor area. If the new dust source area is not within a K-factor area shown in Attachment B, Table 2, the APCO shall determine the default K-factor for the new source area based on the default K-factors of areas with similar soil characteristics.

Source Area Size, Location and Sand Flux.
The boundary of a dust source area will be delineated by a GPS survey. Under certain circumstances, the surveyed boundary of the dust source area will not result in a closed polygon. If the GPS survey yields a partial boundary and not a closed polygon, then the polygon area may be closed, if the length of the closure is equal to or less than one-half kilometer or is less than 20 percent of the surveyed source area perimeter, whichever is smaller. The ends of the partial surveyed area boundary will be completed with a straight line, unless survey notes or visual observations indicate that a different shaped boundary should be used. If the surveyed source area boundary has a complex shape, then the partial boundary to be closed will use the best available field and visual data to connect the two ends and form the polygon. Boundaries of existing controlled areas or other previously located boundaries will be used in place of a GPS survey boundary, if the survey notes or visual observations indicate the erosion area extends to that boundary.

If the GPS boundary described above is not available, the area will be defined by any one or a combination of GPS surveying, visual observations, and video observations or any other method described in the Dust ID Protocol.

The details of how to delineate source area boundaries are contained in the Dust ID Protocol.

If neither the GPS boundary nor the other physical evidence as described above is available, the default area size will be one square kilometer centered on the SFM, or one grid cell if the SFM are in a closer array.

All data collected by the District pursuant to this Section shall be shared with the City within 30 days of final data review. If the modeling shows that lake bed source areas have caused or contributed to any modeled shoreline PM_{10} impact greater than 150 μg/m³ for a 24-hour average, go to B.7. If not, go to B.2.

B.2 – Is the modeled concentration less than 100 μg/m³?

This refers to the modeled concentration calculated in B.1 and includes the background PM_{10} level of 20 μg/m³. If yes, go to B.6. If no, go to B.3.

B.3 – District directs the City to commence environmental impact analysis, design and permitting.

The APCO will direct the City in writing to choose the BACM it wishes to implement in the area identified in B.1.

The City will develop a scope of work for the identified potential source areas, including: (1) a summary of the sites pertinent conditions, features, and location, (2) appropriate control alternatives and approach, including a conceptual layout of dust control and integration into the TDCA (roads, water supply, drainage, and power), (3) standard and site-specific permitting considerations, (4) anticipated environmental documentation considerations and approach, and (5) an approximate timetable for implementation beginning at an undefined start date that might coincide with a future SCR determination . City shall complete these steps within 180 days of the date of the written direction from the APCO. Go to B.4.

B.4 – District deploys reference and/or non-reference method Special Purpose PM_{10} monitor(s) to confirm model (if not already deployed).

The District will deploy reference and/or non-reference method Special Purpose PM_{10} monitor(s) on the lake bed upwind and downwind of the identified emissive area, if there are no existing monitors at locations that can be used in Section B.5 to refine the model predictions. Monitors will be sited between 250 and 5000 meters outside of any GPS'd or observed source area boundaries. These PM_{10} monitoring sites may be removed after the model confirmation procedure described in B.5. Shoreline and near-shore PM_{10} monitors that are sited to confirm the model may be used for NAAQS compliance, if an exceedance is monitored. Go to B.5.

B.5 – Is the refined model prediction greater than 150 μg/m³?

For each event measured under Section B.4 that results in a 24-hour monitored concentration of greater than 100 μg/m³, the event-specific K-factor (defined in the Dust ID Protocol) will be used to model the concentration at the shoreline receptors. If the event-specific K-factor was derived for the same year and season as the original event modeled in B.1, the Section B.1 event will be remodeled using the new K-factor. If either that remodeled concentration for the Section B.1 event, or the new modeled concentration for the on-lake monitored event, is greater than 150 μg/m³ at a shoreline receptor, go to B.7. If not, go to B.6.

The District will make a determination if any currently modeled event within the same season and K-factor area using the appropriate K-factors as determined by this procedure causes a shoreline receptor to exceed 150 μg/m³. If yes, go to B.7.

B.6 – No action required.

No action is required of the City at this time. Data collected during this period can be used in conjunction with data collected at a later time to define emissive areas on the lake bed according to this protocol and to develop K-factors for emissive areas.

B.7 – District directs the City to implement dust controls.

Source areas in B.1 and B.5 that cause or contribute to an exceedance may be new source areas or existing source areas with less than the required level of control (MDCE not high enough to prevent exceedances).

The APCO will determine, in writing, that conditions specified in Sections B.1 or B.5 were met for the specified area. Within 30 days of that determination by the APCO, the City will be notified of that determination in writing. If possible, the City will have the choice of increasing the control efficiencies on existing dust control areas and/or controlling other contributing sources that will result in lowering the modeled impact below the 150 μg/m³ exceedance threshold. If the APCO identifies the need for additional controls, the APCO shall issue a written SCR determination to the City.

If the City does not agree with the APCO's determination, the City may, within 60 days of the APCO's determination, submit to the District an alternative analysis of the data used by the APCO to make the determination. If the City submits an alternative analysis, the APCO shall consider the City's analysis and may withdraw, modify or confirm the SCR determination. If the APCO takes action to withdraw or modify the SCR determination, he shall do so within 60 days of the City's submittal of the alternative analysis.

If the APCO issues a modified SCR determination or confirms the initial SCR determination and the City does not agree with the APCO's final action, the City may initiate the Dispute Resolution Process pursuant to Paragraph 32 of the 2006 Settlement Agreement between the District and the City (Attachment A to Board Order 080128-01). The APCO may modify the SCR determination based on the Dispute Resolution Process.

In the event the Parties are unable to resolve disagreements over the APCO's SCR determinations through the Dispute Resolution Process, the City may appeal the APCO's SCR determinations to the California Air Resources Board (CARB) under the provisions of Health and Safety Code Section 42316 (Section 42316). The CARB will act within 90 days on the City's appeal.

The City shall prepare and submit for the APCO's consideration and written approval, which approval shall not be unreasonably withheld, a Remedial Action Plan as described in Paragraph 6, above, to address the exceedance(s). The City shall submit the Remedial Action Plan within 60 days of the date the SCR determination becomes final.

Go to B.8.

B.8 – City implements BACM.

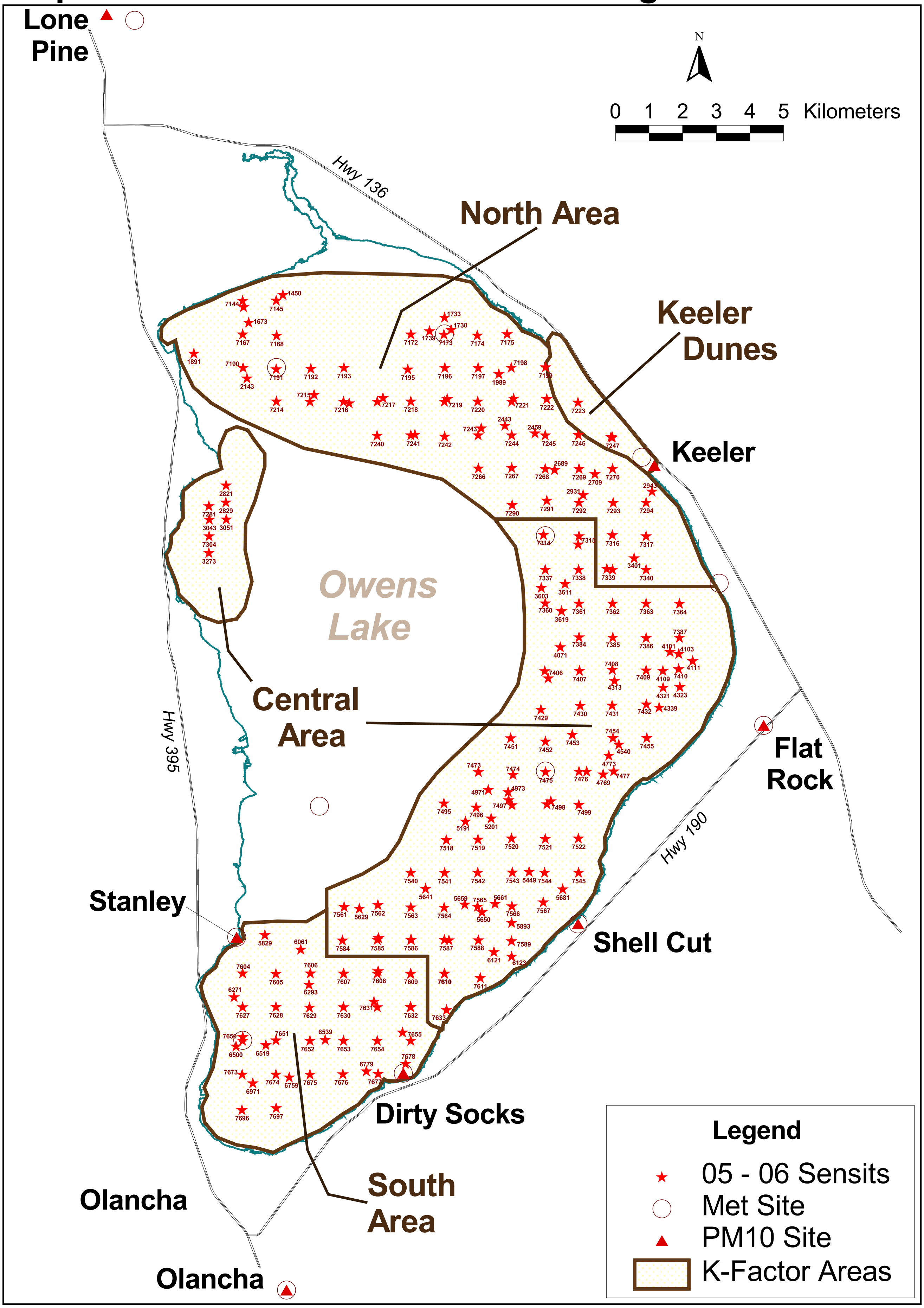
DCMs for new areas will be operational within the times set forth in the DCM Operation Schedule incorporated as Attachment B, Exhibit 3. The City is solely responsible for all environmental impact analyses required by the California Environmental Quality Act and for all required permits and leases.

For source areas that arrive at B.7 from B.5, all time periods in the above referenced implementation schedule in B.8 shall apply but be reduced by the time period elapsed since the date of the written direction from the APCO described in Section B.3, or one year, whichever is less.

Attachment B Enclosures

Map 1: Owens Lake Dust ID Monitoring Map
Table 1: From-the-lake and Non-lake Wind Directions for PM_{10} Monitor Sites
Table 2: Default Spatial and Temporal K-factors for the Dust ID Model
Exhibit 1: Schedule of Contingency Measures
Exhibit 2: Moat & Row Transition Schedule
Exhibit 3: DCM Operation Schedule

Map 1 - Owens Lake Dust ID monitoring network



Attachment B - Table 1

From-the-Lake and Non-Lake Wind Directions for PM_{10} Monitor Sites

PM_{10} Monitor Site	From-the-Lake Wind Dir. (Deg.)	Non-lake Wind Dir. (Deg.)	Met Tower
Lone Pine	126≤WD≤176	WD<126 or WD>176	Lone Pine
Keeler	147≤WD≤290	WD<147 or WD>290	Keeler
Flat Rock	224≤WD≤345	WD<224 or WD>345	Flat Rock
Shell Cut	WD≥227 or WD≤ 33	33<WD<227	Shell Cut
Dirty Socks	WD≥234 or WD≤50	50<WD<234	Dirty Socks
Olancha	WD≥333 or WD≤39	39<WD<333	Olancha
Bill Stanley	WD≥349 or WD≤230	WD<349 or WD>230	Bill Stanley
New Sites	TBD	TBD	TBD

TBD – From-the-lake and non-lake wind directions will be determined for new sites by the APCO when sites are selected.

Attachment B - Table 2

Default Spatial and Temporal K-factors for the Dust ID Model

AREA	**K-factor Jan.– Apr. & Dec.**	**K-factor May-Nov. (These are the default cutpoints.)**
Keeler Dunes	7.4×10^{-5}	6.0×10^{-5}
North Area	3.9×10^{-5}	1.5×10^{-5}
Central Area	12.0×10^{-5}	6.9×10^{-5}
South Area	4.0×10^{-5}	1.9×10^{-5}

Attachment B - Exhibit 1: Schedule of Contingency Measures

From 2006 Settlement Agreement

EXHIBIT 10 -- SCHEDULE OF CONTINGENCY MEASURES

Issue	Resolution	Duration	Units
Moat and Row			
Eroded row	Install armoring to prevent further erosion	2	mo/mile
	Install sand fences to prevent further erosion	1	mo/mile
	Reconstruct row in place or adjacent	2	mo/mile
Filled moat	Re-excavate new moat outboard of filled moat, expand existing row onto filled moat	2	mo/mile
Filled sand fence	Clean out or flank with new sand fences	2	mo/mile
Collapsed sand fence	Repair or flank with new sand fences	1	mo/mile
Spacing too large	Pull in intervening sand fence	1	mo/mile
	Add intervening moat and row	3	mo/mile
	Enhance with vegetation and/or wetness	12 to 36	months
	Soil roughening	1 to 3	months/sq mi
	Conversion to reduced BACM/BACM	See Exhibit 11	
Managed Vegetation			
Emissions from bare areas	Enhance/restore vegetation	36	months
	Stabilize by other means (e.g., moisture, sand fences)	1 to 6	months/sq mi
Emissions from vegetated areas	Determine and establish necessary cover	36	months
	Stabilize by other means (e.g., moisture, sand fences)	1 to 6	months/sq mi
Gravel Patches			
Infilling pore spaces	Supplement gravel depth	4	months/sq mi
	Stabilize by other means (e.g., vegetation, wetness, sand fences)	6 to 36	months
Shallow Flood			
Emissions from dry areas (insufficient uniformity of wetting)	Wet dry areas. May require land leveling and/or additional laterals.	12	months
Generally too dry	Increase water application rate relative to ET	1	month
Other features			
Gravel source	Open new or re-open existing quarry	4	months
Emissions from roads, berms, etc.	Increase watering frequency	1	month
	Stabilize by other means (e.g., gravel, stabilizing agents)	1 to 4	months/sq mi

Attachment B - Exhibit 2

From 2006 Settlement Agreement

EXHIBIT 11 -- MOAT AND ROW TRANSITION SCHEDULE

Activity	Duration (years)
Shallow flood transition from moat & row	1.9
Managed vegetation transition from moat & row	5.9
Gravel cover transition from moat & row	1.8
Mutually agreeable exceptions:	*Increase over and above durations listed above (years)*
1. Mainline capacity increase	2.1
2. New aqueduct turnout	1.4
3. New power feed	1.0

Attachment B - Exhibit 3

From 2006 Settlement Agreement

EXHIBIT 12 -- DCM OPERATION SCHEDULE

Activity	Duration (years)
New area shallow flood DCM[a]	2.9
New area managed vegetation DCM[a]	6.1
New area gravel cover DCM[a]	2.2
Mutually agreeable exceptions:	*Increase over and above durations listed above (years)*
1. Mainline capacity increase	2.1
2. New aqueduct turnout	1.4
3. New power feed	1.0
4. Expanded CEQA triggered	1.4

[a]Assumes that total new area <2 square miles per year

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Board Order 080128-01
Attachment C

2008 Owens Lake Dust Source Identification Program Protocol

Great Basin Unified Air Pollution Control District
157 Short Street, Bishop, California 93514
Telephone (760) 872-8211

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2008 Owens Lake Dust Source Identification Program Protocol

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Glossary of Terms and Symbols

AIRS	US Environmental Protection Agency's Aerometric Information and Retrieval System
ATV	All-Terrain Vehicle
APCO	Air Pollution Control Officer
BACM	Best Available Control Measure
BACT	Best Available Control Technology
CAAA	Clean Air Act Amendments of 1990
CALMET	A meteorological preprocessor program for CALPUFF.
CALPUFF	An air pollution model
CARB	California Air Resources Board
CSC	Cox Sand Catcher, a passive sand flux measurement device.
DCA	Dust Control Area
DCM	Dust Control Measure
Dust ID Program	Owens Lake Dust Source Identification Program
EIR	Environmental Impact Report
Event-specific K_f	Weighted-average of hourly K-factors for a dust event, weighted by the hourly PM_{10} concentration
Exceedance	Modeled or monitored PM_{10} > 150 µg/m^3 at the shoreline
FTEE	Full-time equivalent employee
GBUAPCD	Great Basin Unified Air Pollution Control District
GIS	Geographic Information System
GPS	Global Positioning System
KE	Kinetic energy
K-factor	Proportionality constant for sand flux and PM_{10} emissions, K_f
LADWP	City of Los Angeles Department of Water and Power (also City)
m^3	cubic meter
met	meteorological
mg	milligram
MSM	Most Stringent Measure
NAAQS	National Ambient Air Quality Standards
NEAP	Natural Events Action Plan
OVPA	Owens Valley PM_{10} Planning Area
PC	Particle count
PM_{10}	Particulate matter less than 10 microns aerodynamic diameter
QA	Quality Assurance
RASS	Radio Acoustic Sounding System
RSIP	Great Basin APCD 2003 Owens Valley PM_{10} Planning Area Revised State Implementation Plan

Sensit	An electronic sand motion detector.
Settlement Agreement	2006 Settlement Agreement between LADWP and GBUAPCD
Storm-average K_f	Arithmetic average of hourly K-factors for a dust event
SCR	Supplemental Control Requirements of the 2003 SIP
SFM	Sand flux monitor
TEOM	Tapered-Element Oscillating Microbalance, measures PM_{10}.
USEPA	United States Environmental Protection Agency
USGS	US Geological Survey
WD	Wind direction
2003 SIP	Great Basin APCD 2003 Owens Valley PM_{10} Planning Area Revised State Implementation Plan
µg	microgram

2008 Owens Lake Dust Source Identification Program Protocol

1. Program Overview

1.1 Introduction

The objective of the Owens Lake Dust Source Identification (Dust ID) Program is to identify dust source areas at Owens Lake that can cause or contribute to violations of the National Ambient Air Quality Standards (NAAQS) for PM_{10}. The Dust ID Program is a long-term monitoring program that is intended to identify dust source areas for control under the provisions of the Supplemental Control Requirements (SCR) in the 2003 revised Owens Valley PM_{10} State Implementation Plan (RSIP) and the 2006 Owens Lake Settlement Agreement (Settlement Agreement). The text of the Settlement Agreement and SCR provisions is included in the appendices to this document.

The RSIP and Settlement Agreement require the City of Los Angeles Department of Water & Power (City) to control all sources of wind blown dust from the lake bed of Owens Lake that cause or contribute to an exceedance of the PM_{10} NAAQS at the historic shoreline (3,600-foot contour line). Based on dust events that occurred between January 2000 and July 2006, 43 square miles of the lake bed were found to cause or contribute to NAAQS violations. Dust controls are required to be implemented on 29.8 square miles of the lake bed by December 31, 2006, and an additional 13.2 square miles by April 1, 2010.

Provided that these control measures are implemented in accordance with the RSIP and Settlement Agreement, the District will suspend making determinations to control additional dust source areas from December 4, 2006 until May 1, 2010. During this period, all monitoring, modeling and observations will continue as described in this Dust ID Program Protocol. Data and information collected during this period will be used to determine any control requirements for Study Areas as described in the Settlement Agreement, and to advise the City on any monitored dust emissions from the lake bed and surrounding areas. If any new lake bed dust source areas are identified from data collected after April 1, 2010, they will be subject to dust control requirements as provided for in the Settlement Agreement and any future revisions to the Owens Valley PM_{10} State Implementation Plan. SCR determinations shall make reasonable efforts to account for impacts caused by Dust Control Measure (DCM) construction activities.

1.2 Locating Dust Source Areas

A network of sand flux samplers, PM_{10} monitors, meteorological towers and remote camera sites will be used to monitor and locate dust source areas at Owens Lake. Figure 1.1 shows a map of the Dust ID network at Owens Lake. As configured in 2003, the Dust ID network included: sand flux monitors at 136 lake bed sites at 1-km spacing, 7 PM_{10} monitors, 13 met towers, 8 observation sites, and 10 time-lapse cameras at 7 sites. At the discretion of the Air Pollution Control Officer, additional sand flux, PM_{10} and met sites will be added as necessary to collect information that can be used to monitor and model the impact from new areas that may become emissive on the lake bed.

The automated monitoring network will be augmented with information from observers who will map dust source locations from off-lake sites when dust events take place during normal work hours. These maps will be used to help document source areas that may be outside the sand flux network or that may be within the network, but missed by the samplers. Field personnel will inspect active source areas and map the source area boundaries using a GPS (Global Positioning System) as conditions allow. Data collected from the sand flux network, visual mapping and GPS surveys will be included in a Geographic Information System (GIS) database for mapping and analysis. Maps generated using these different methods will be compared qualitatively to help delineate source area boundaries.

1.3 Monitored Exceedances

Analysis of hourly PM_{10} concentrations at shoreline and off-lake monitoring sites may show that lake bed source areas cause or contribute to PM_{10} exceedances. Monitoring of PM_{10} concentrations will be done using US EPA-approved monitors. Currently, hourly PM_{10} readings are obtained using TEOM (Tapered-Element Oscillating Microbalance) PM_{10} monitors manufactured by R&P, Inc. If a PM_{10} exceedance is monitored, PM_{10} concentrations will be paired with the local wind direction for each hour of that event to determine if lake bed source areas caused or contributed to the exceedance.

Twenty-four hour average PM_{10} monitor concentrations will be adjusted for winds coming from the direction of the lake to the monitor (from-the-lake) and from directions not from the lake to the monitor (non-lake). PM_{10} concentrations during any hour with winds from a non-lake wind direction will be assumed to have an average background concentration of 20 $\mu g/m^3$ and from-the-lake wind directions will be given their hourly value. If the adjusted 24-hour average is greater than 150 $\mu g/m^3$, then an exceedance will have been monitored from a lake bed source or sources.

If a lake bed source area causes or contributes to an exceedance, hourly PM_{10} concentrations and wind directions will be reviewed to see if a new source area (or areas) is associated with that exceedance. If sand flux data are available that show erosion activity in the direction of a new source area, this event will also be modeled as described in the air quality modeling protocol. If the PM_{10} monitor data indicate that a new source area caused or contributed to an exceedance, DCMs may be required under the provisions of the Settlement Agreement or current SIP.

1.4 Modeled Exceedances

Air quality modeling will be performed with the CALPUFF modeling system or other United States Environmental Protection Agency (USEPA) approved modeling method. At least once a year, the Dust ID information will be examined and the model will be run to determine if there were any modeled shoreline exceedances since the period covered by the last model run. PM_{10} emissions for the model will be based on hourly sand flux measured at lake bed sites and spatial and temporal factors derived using the empirical relationship between sand motion on the lake

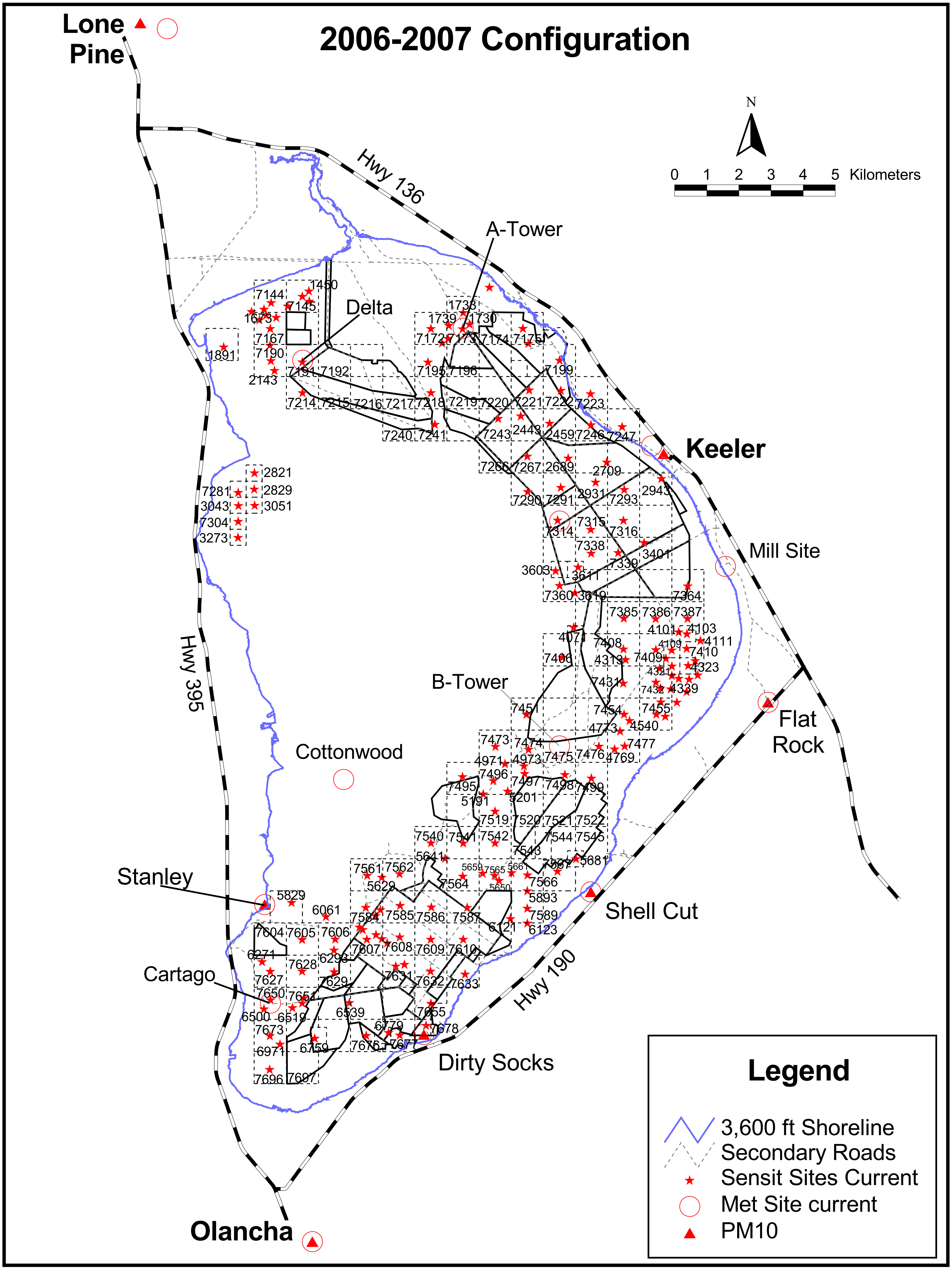

Figure 1.1 - Owens Lake Dust ID monitoring network

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bed and measured PM_{10} values. CALPUFF will be run using the following equation to estimate emissions and to model PM_{10} impacts at the shoreline:

<u>Equation 1.1</u>

$$PM_{10} = K_f \times q$$

where,

q = Sand flux measured at 15 cm above the surface [$g/cm^2/hr$]
K_f = K-factor, empirically-derived ratio of the PM_{10} emission flux to the sand flux at 15 cm.

The ratio of PM_{10} to sand flux (K_f) is referred to as the K-factor. The initial Dust ID program results showed that K-factors could be derived empirically by comparing model predictions to monitored PM_{10} concentrations. Initial studies also showed that average K-factors can vary spatially and seasonally at Owens Lake. Default K-factors will be used with Equation 1.1 to estimate hourly PM_{10} emissions unless new K-factors are generated from future dust events following the modeling procedures in this program protocol. If the CALPUFF model results indicate that a new lake bed source area caused or contributed to an exceedance at a shoreline location, dust controls may be required under the provisions of the 2006 Settlement Agreement or the current SIP.

1.5 Sand Flux Measurements

Sand flux is measured using a combination of Cox Sand Catchers (CSC) and Sensits. CSCs are sand collection devices that provide a mass collection amount for a certain time period (about 1 to 3 months), and Sensits are electronic sand motion detectors used to time-resolve the collected mass to estimate hourly sand flux rates. The sand flux rate is applied to the area represented by the sand flux sampling site, which may vary in size and shape depending on the source area delineated by field observations.

1.6 Dust ID Program Protocol Content

Section 2 of the Dust ID Program Protocol describes the methods and instrumentation that will be used to monitor sand flux with Sensits and CSCs on the lake bed. Section 3 provides a brief description of the PM_{10} and meteorological monitoring network that will be used to monitor PM_{10} exceedances, develop K-factors and to call public health advisories. Section 4 describes methods that will be used by visual observers and field personnel to map lake bed dust source areas and delineate boundaries using GPS. Section 5 explains the procedures for developing K-factors using air quality modeling and monitoring data. Section 6 provides the protocol for dispersion modeling.

2. Protocol for Measuring Sand Flux Rates and Operation of the Sensit and Cox Sand Catcher Network

2.1 Objective

Sand flux measurements will be used as a surrogate to estimate PM_{10} emissions coming off the lake bed. The objective of the sand flux measurements is to provide an hourly emissions estimate for all active source areas on the lake bed.

2.2 Methods and Instrumentation

Sand flux will be measured with Sensits and Cox Sand Catchers (CSCs). Collocated Sensits and CSCs are used to measure hourly sand flux rates at different locations on the lake bed. The 2006-2007 Sensit/CSC network locations are shown in Figure 1.1. The instruments are placed with their sensors or inlets positioned 15 cm above the surface. Sensits are electronic sensors that measure the kinetic energy or the particle counts of sand-sized particles as they saltate, or bounce, across the surface. Sensits are used to time-resolve the CSC mass to provide hourly sand flux rates.

Figure 2.1 shows a Sensit suspended above the ground on the right, and a CSC in the ground to the left. The photo was taken at a site that was used to test the accuracy of Sensits and CSCs before the Dust ID Program began. The battery powered Sensits are augmented with a solar charging system. A datalogger records 5-minute Sensit data during active saltation periods. Data collection is triggered by particle count activity and continues until particle counts are zero for an hourly period. Each datalogger has a radio transmitter that sends Sensit data to the District's Keeler field office once a day to provide updates on erosion activity at each site. These daily updates are used to alert field personnel to active source areas for possible Global Positioning System (GPS) mapping and inspection. Daily transmission of the data may be temporarily suspended if the solar battery power is low due to extended days of cloud cover.

CSCs are passive collection instruments that capture windblown, sand-sized particles. These instruments were designed and built by the District as a reliable instrument that could withstand the harsh conditions at Owens Lake. CSCs have no moving parts and can collect sand for a month or more at Owens Lake without overloading the collectors. Field personnel visit CSC sites to measure the mass of the collected sand catch. A diagram of the CSC is shown in Figure 2.2. Not shown in the diagram is an internal sampling tube that can be seen in the photo in Figure 2.3. The internal sampling tube is removed from the PVC casing to measure the sand catch sample. The lengths of the sampling tubes and casings are adjusted during construction to accommodate the amount of sand flux in each area and to avoid overloading the CSC. The CSC length ranges from about one to three feet. Because the PVC casing is buried in the ground, an adjustment sleeve is used to keep the inlet height at 15 cm to compensate for surface erosion and deposition. Field techs use a standardized measuring device to check or adjust the sampling inlets to 15 cm after collecting each sample.

Figure 2.4 shows an example of the linear relationship between the CSC collected sand mass and the kinetic energy measured with a co-located Sensit. Sensits measure saltation in terms of

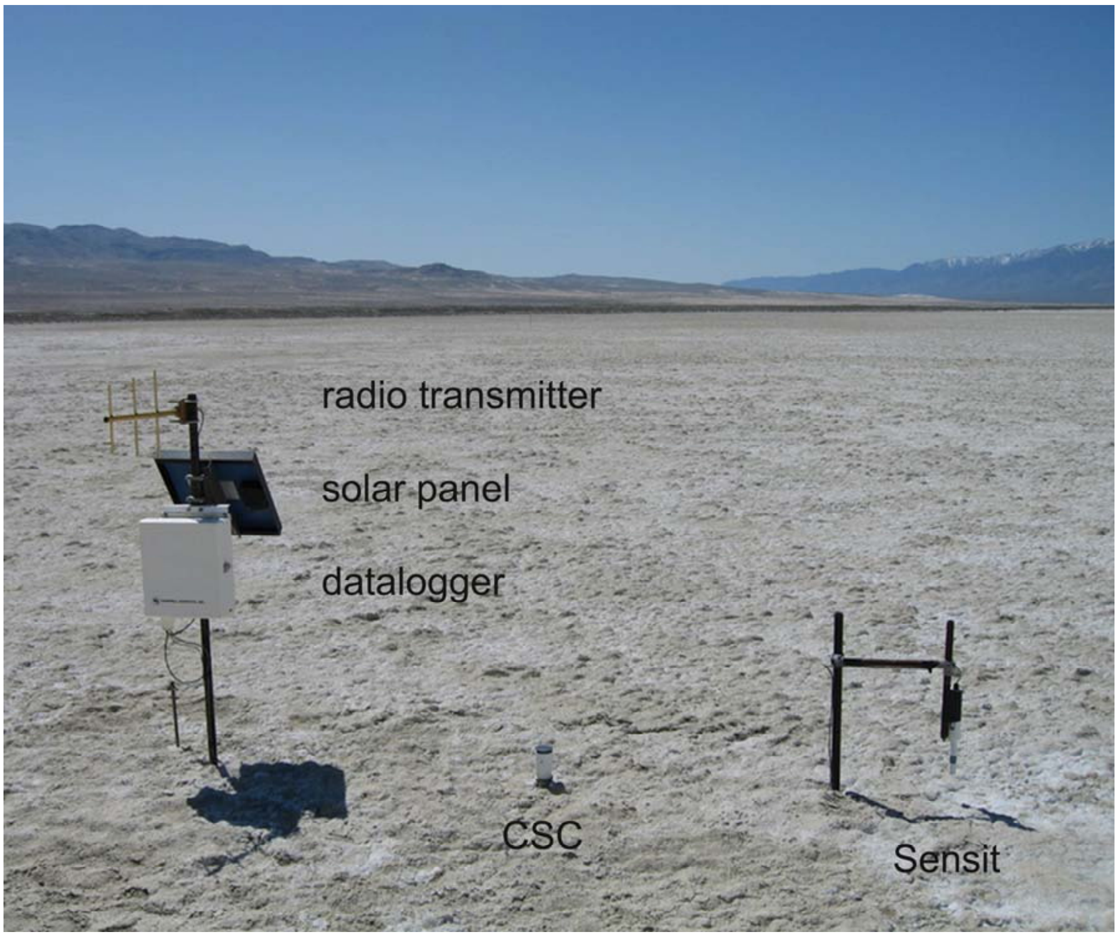

Figure 2.1 - Dust ID sand flux monitor sites measure wind erosion activity using CSCs to collect sand-sized particles and Sensits that electronically detect moving particles. Sensit data are recorded on dataloggers and transmitted by radio from each site to the District's office in Keeler.

Figure 2.2 - Diagram of the Cox Sand Catcher (CSC) used to measure sand flux at Owens Lake.

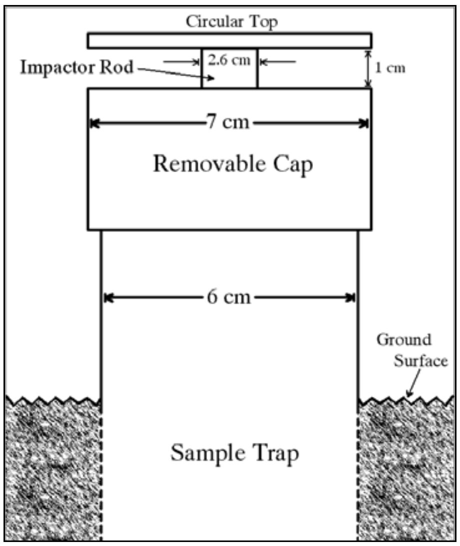

Figure 2.3 - Example of a Cox Sand Catcher (CSC) with the inner sampling collection tube removed.

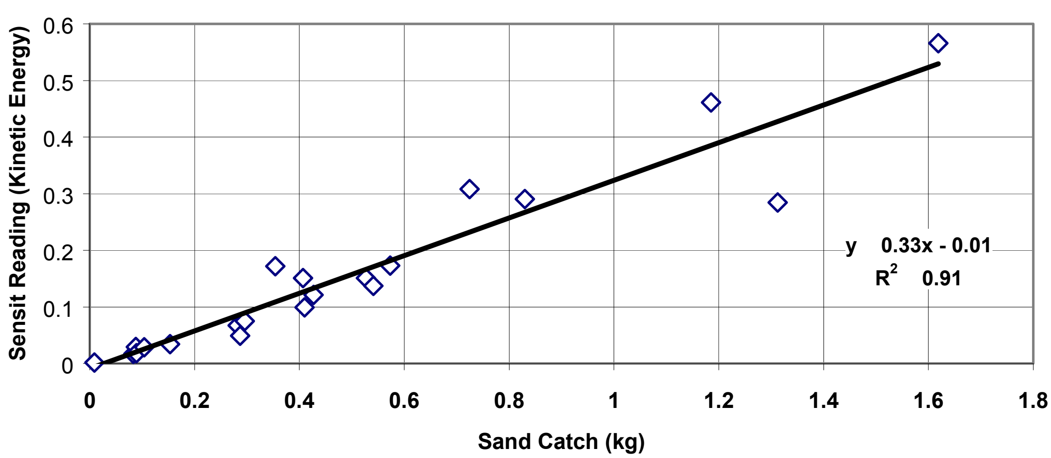

Figure 2.4 - Example of the linearity between CSC mass and a Sensit reading using kinetic energy reading (Sensit No. 7291).

kinetic energy (KE) and particle count (PC). The District uses the output (KE or PC) that provides the best precision and accuracy for the range of saltation activity expected at each site.

Because the electronic Sensit response to the saltation flux can vary, Sensits were used in combination with CSCs to determine hourly sand flux rates. This combination takes advantage of the good precision and accuracy of the CSC sand catch data, and the ability of Sensits to time-resolve the sand flux for each hour of the CSC sampling period. In this way, the sum of the hourly sand catches always matches the CSC sand catch for each sampling period, and it minimizes the error in the hourly sand flux.

Changes to the sand flux monitoring network are made as necessary to improve the characterization of dust source areas on the lake bed. Sand flux sampler sites are added to the network to monitor new source areas or to improve the sand flux estimates for known dust source areas. Although the sand flux network was originally designed in a fixed grid pattern with 1 km site spacing, the current practice is to place the samplers at sites that represent smaller source areas. Some sites may be less than 250 m apart, and their locations may be off the regular grid pattern to better represent sand flux activity in the dust source area. In addition, many of the original sampling sites that are now in flooded portions of the shallow flood DCM were removed, since PM_{10} emissions from the flooded sites can be assumed to be zero in the Dust ID model.

2.3 Operating Procedures

Sand captured in the CSCs will be weighed in the Keeler lab to the nearest tenth of a gram. A field technician will visit each site every one to three months to collect the sample tubes. The following procedures will be used when collecting the CSC samples and downloading Sensit data:

1) Park field vehicle 10 meters or more east of the site and walk the remaining distance to the sampling site. Field personnel will access all Sensit and CSC sites from an easterly approach to minimize upwind surface impacts near the sampling sites.
2) Measure and record the inlet height above the surface to the middle of the inlet.
3) Remove the sample collection tube from the CSC.
4) Verify collection tube number corresponds to site number on the field form.
5) Weigh and record the gross weight of the collection tube and sample to the nearest 1 gram using a field scale.
6) If any soil material is visible in the tube, seal the collection tube and place it in the tube rack for transport to the lab. If no soil material is visible, note this on the collection form and reuse the collection tube for the next sampling period.
7) Place a clean collection tube in the CSC and record the collection tube number.
8) Replace the CSC inlet and adjust the height to 15 cm ($\pm$1 cm).
9) Download Sensit data from the datalogger to a storage module.
10) Measure and record the Sensit sensor height above the surface to the center of the sensor using the Height Adjustment Tool, and adjust if necessary to 15 cm. See Figure 2.5.
11) Inspect the sensor and radio transmitter wiring and clean or repair, if needed.

12) A field operational response test on the Sensit will be completed during each visit and the Sensit will be replaced, if it fails the test.
13) CSC samples will be removed from the sample collection tubes and weighed on a calibrated bench-top scale in the Keeler lab to the nearest 0.1 gram.
14) Wet samples will be removed from the collection tubes and oven dried before weighing in the lab.

2.4 Data Collection

A field form will be used to document the information for the CSC and Sensit (see example in Figure 2.6). The form will have the site number, date and time of measurement (Pacific Standard Time), "as is" CSC inlet and Sensit sensor height (± 1 cm), tube tare weight prior to sand catch (± 0.001 kg), total sand catch weight (± 0.001 kg), and post-catch tube weight (± 0.001 kg), Sensit response test (particle counts or kinetic energy), operator's initials, and a comments section where the condition of the sampler and any other relevant factors, such as surface condition will be documented. The Data Processing Department will calculate the net sand catch weight from the CSC during data analysis. CSC lab weights, measured to the nearest 0.1 g will be recorded on the Lab Form shown in Figure 2.7. After completion of the forms, the field technician will make a copy of the completed forms and file the copies at the Keeler office. The original forms will be sent to Data Processing in the Bishop office. Data Processing will enter the data into an electronic file. The original hard copy forms will be filed in the Bishop office.

Each day, dataloggers for all Sensit sites will be downloaded by radio transmission to the Keeler Field office. Data from the storage modules will be downloaded to the computer at the Keeler office by the field technician at the end of a collection period. The radio transmitted Sensit data will be used as the data of record. Storage module data will be collected at least quarterly and will serve as a back-up file.

Technicians will keep a log of all the repairs, maintenance, or replacement of Sensits or CSCs, radio transmitters, and datalogger equipment. This log will be kept in a field notebook and the field forms sent to Data Processing as they are completed. It is the technician's or operator's responsibility to review the data and notify the Air Monitoring Specialist and Data Processing who will decide whether any data should be edited or deleted and why.

2.5 Chain of Custody

Each field form will be initialed and dated by the field technician during each site visit. The form will be signed and dated by the person receiving the data when delivered to the Bishop office. If no person is available to sign the form in the Bishop office, the delivery person will sign and date the form and place it in the Data Processor's box.

2.6 Quality Assurance

All field and lab scales will be checked at least every two months using Class F weights. Field scales will also be checked with a 100-gram weight at each sample site before weighing the sand catch and the weight recorded on the field form. The bench-top scale in the Keeler office will be

Figure 2.5 - A Height Adjustment Tool is used to measure the height of Sensits and CSCs and to adjust the sensor and inlet height to 15 cm above the soil surface.

CSC Field Form.xls

Technician: Date (mm/dd/yyyy): / /

Site #	Time PST	Pre-Sensit Height, cm	Sensit Response	Final Sensit Height, cm	Pre-CSC Inlet Height, cm	Field Cal Weight, kg	CSC Full, kg	CSC Tare, kg	Final CSC Height, cm	No VP
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	:					.	.	.		
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Marble Rankings: 0=No Crust 1=Complete Damage 2=Indent or Surface Damage 3=No Damage 4=Wet

Site #	Rank	Surface Description	Comments and Maintenance

Delivered By:	Date:
Received By:	Date:

Figure 2.6 - Example of a CSC and Sensit Field Documentation Form

CSC Lab Form.xls

Lab Technician:	Tare Date (mm/dd/yyyy):	/	/
Lab Technician:	Post Date (mm/dd/yyyy):	/	/

Site Tube #	Tube Tare, g	Tube/Catch Weight, g	Catch Weight, g	Comments
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Figure 2.7 - Example of a CSC laboratory documentation form

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checked with the Class F weights before each set of sand catches are weighed. The test weights will be recorded on the scale log sheet in the laboratory. Both scales will be calibrated and certified at least once every year. Ten percent of the CSC sand catch samples will be stored for at least one year from the date of collection before discarding.

2.7 Calculating Hourly Sand Flux

For modeling purposes discussed in Section 6, hourly sand flux is calculated for each Sensit/CSC site using the sand catch to Sensit reading ratio for each collection period and apportioning the sand catch to the hourly Sensit reading. The hourly sand flux is divided by 1.2 cm^2, which is the equivalent inlet opening size of the CSC for flux calculation purposes.

For Sensits using kinetic energy,

Equation 2.1

$$q_{n,t} = \left(S_{n,t} - S_{n,bg}\right) \times \frac{CSC_{n,p}}{\sum_{t=1}^{N}\left(S_{n,t} - S_{n,bg}\right)} \times \frac{1}{1.2} \quad [\text{g/cm}^2/\text{hr}]$$

Where,
$q_{n,t}$ = hourly sand flux at site n, for hour t [g/cm^2/hr]
$CSC_{n,p}$ = CSC mass for site n, for collection period p [g]
$S_{n,t}$ = Sensit total KE reading for site n, for hour t [non-dimensional]
$S_{n,bg}$ = Sensit KE background reading for site n, [non-dimensional]
N = Total number of hours in CSC collection period p.

For Sensits using particle count,

Equation 2.2

$$q_{n,t} = S'_{n,t} \times \frac{CSC_{n,p}}{\sum_{t=1}^{N} S'_{n,t}} \times \frac{1}{1.2} \; [\text{g/cm}^2/\text{hr}]$$

Where,
$S'_{n,t}$ = Sensit total PC reading for site n, for hour t [non-dimensional]

2.8 Sensit Calibration and Data Analysis

2.8.1 Sensit Calibration Check

Data Processing will track Sensits by their serial number. After each sample collection period, Sensit and CSC data will be added to data from other sample collections. Data Processing will determine the average sand catch to Sensit ratio for each Sensit. Sensit readings will be collected for particle counts and kinetic energy for each Sensit. Due to differences in individual Sensit responses, some Sensits have a more consistent sand flux to Sensit reading ratio using particle count rather than kinetic energy. This normally depends on the manufacturer's electronic design. At high sand flux sites, kinetic energy provides a more linear response for most Sensits. If KE is used, a background KE is subtracted from the reading if it is not zero. A background KE is determined from the KE reading when the PC reading is zero.

The ratio of the Sensit response to the collected mass will be compared for each collection period to previous ratios for the same instrument to ensure that the Sensit is responding consistently. As seen in Figure 2.4 this ratio can vary, especially at low collection masses, so large deviations in the ratio should only be used as an indicator for a possible problem. Sensits will be replaced if they show no readings with significant sand associated CSC collection, have significant readings during calm wind periods, have an erratic response as compared to previous collection periods, or if they fail the field operational response test.

2.8.2 Replacing Missing Sand Catch Data

Sand catch data can be lost if the CSC collector tube is full, or damaged, or if the sample is spilled during weighing. The lost sand catch data will be estimated using Sensit data. A cumulative sand catch to Sensit ratio is calculated by adding all of the valid sand catches and all of the corresponding Sensit data for that particular Sensit/CSC pair, and then dividing them to obtain the total ratio. The cumulative ratio is applied to the Sensit data to estimate the hourly sand flux. If there was a Sensit change, only data generated after the Sensit change is used to calculate the cumulative sand catch to Sensit ratio.

CSC collection tubes will be weighed and reset at the same time as any Sensit change at a site in order to maintain the time correlation between the two devices.

2.8.3 Replacing Missing Sensit Data

Sensit data can be lost when the datalogger or Sensit fails. In such cases, the sand catch data will be time resolved using a neighboring site. The historical hourly sand flux data are compared to determine which neighboring site behaves most similarly to the site with the lost data. The correlation coefficients between the data sets will be used to determine which site behaves most similarly. If no adjacent sites were active during the period of lost Sensit data, then the nearest active sites will be used for comparison.

3. Protocol for Measuring Ambient PM_{10} and Meteorological Conditions

3.1 Objective

Ambient PM_{10} monitors will be placed at locations generally around the shoreline of Owens Lake and in local communities to monitor the ambient air for exceedances of the PM_{10} NAAQS and to develop K-factors for modeling PM_{10} emissions from lake bed sources. PM_{10} monitors may be placed on the lake bed for short-term special-purpose monitoring studies.

3.2 Methods and Instrumentation for PM_{10} and Meteorological Data

PM_{10} monitoring will be performed using USEPA-approved reference or equivalent method monitors. The current monitoring network shown in Figure 1.1 includes seven PM_{10} monitor sites – Keeler, Lone Pine, Olancha, Dirty Socks, Shell Cut, Bill Stanley and Flat Rock. Each PM_{10} site is equipped with a Tapered Element Oscillating Microbalance (TEOM) PM_{10} monitor. TEOM monitors are capable of measuring hourly PM_{10} concentrations. The Dust ID Program will rely on the TEOM to determine if an exceedance is caused by a lake bed source, since the data can be correlated with hourly wind directions to determine dust source directions. TEOM data will also be used to generate K-factors to model the PM_{10} emissions from lake bed sources.

Ten-meter meteorological towers will be located near each PM_{10} monitor site and at other locations around the lakeshore and on the lake bed. The current met sites are shown in Figure 1.1. The met data are used to create wind fields with the CALMET model that are used with CALPUFF to model air quality impacts. All met towers include instrumentation to measure wind speed and wind direction. Two lake bed met sites (A & B Towers) measure wind speed at different heights (0.5, 1, 2, 5 and 10 m) to determine surface roughness and vertical wind speed profiles. Some met sites also measure temperature, relative humidity, barometric pressure, and/or precipitation.

3.3 Operating Procedures, Instrument Calibration and Quality Assurance

PM_{10} monitoring will be performed in accordance with USEPA monitoring guidelines found in 40 CFR, Part 58 and meteorological monitoring will be performed in accordance with USEPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes I, II, and IV.

3.4 Data Handling and Data Access via Modem

TEOM PM_{10} data will be delivered to Data Processing on a routine monthly schedule. After the data pass the proper data review and QA checks they will be submitted to the USEPA's AIRS database. PM_{10} data from special-purpose monitors that may be located on the lake bed will not be submitted to the AIRS database.

All the PM_{10} sites and some met sites are equipped with modem links that allow for access to the hourly concentrations. These data are useful for alerting field personnel to possible new sources of PM_{10}, and for alerting the public in case of high concentrations. For hourly concentrations above 400 $\mu g/m^3$ the District will issue public health advisories when the communities of Keeler, Lone Pine or Olancha are affected. The public can view real-time wind speed, direction and PM_{10} data from the Dust ID monitoring network on the District's website at www.gbuapcd.org/data.

4. Protocol for Observing and Mapping Source Areas and Dust Plume Paths

4.1 Objective

The objective for source area mapping is to use the best available information from visual observations, GPS mapping, and sand flux measurements to delineate the boundaries of dust source areas for as many events as possible. This information will be used to help delineate the control area boundaries for new sources.

4.2 Methods and Instrumentation

The Dust ID Program includes four methods to help locate dust source areas and to delineate the source area boundaries. The methods are: 1) visual mapping by trained observers, 2) time-lapse cameras, 3) surface inspections with GPS mapping, and 4) sand flux activity (as measured with Sensits and CSCs).

4.2.1 Mapping Dust Source Areas from Off-Lake Observation Sites

One or more trained observers will complete observations from viewpoints to best observe the active dust source areas. For instance, two observers may be at viewpoints on the east side of the dust plume in the Inyo and Coso Mountains and a third may be on the west side in the Sierra. The observers will create hourly maps of the visible boundaries of any dust source areas, their plume direction and note if the visible plume crosses the shoreline. To the extent practicable, all lake bed and off-lake dust sources will be included in the observations. Figure 4.1 shows an example of sand flux measurements and the cumulative information that can be collected by observers mapping the dust plumes from different locations.

4.2.2 Video Cameras

Remote time-lapse video cameras will record dust events during daylight hours. This information will be reviewed to help identify source areas that may have been missed by observers, or to help confirm source area activity detected by PM_{10} monitors or the sand flux network. Remote time-lapse video can also be used to help verify modeled impacts that were not monitored by the PM_{10} network, to check compliance of dust control areas, and to identify off-lake sources not measured by any of the other methods.

4.2.3 Mapping Using GPS

4.2.3.1 “Trigger” Levels for Initiating Field Inspections and GPS Surveys

Dust observations, Sensit activity, elevated PM_{10} concentrations and video will be used as “trigger data” to determine the time and location for a Dust Source Area Survey (survey). Sensit and PM_{10} data will be automatically collected via radio transmission every workday. A technician will summarize and review the data each workday. The summary will list all Sensit activity greater than background output levels, and hourly TEOM PM_{10} concentrations over

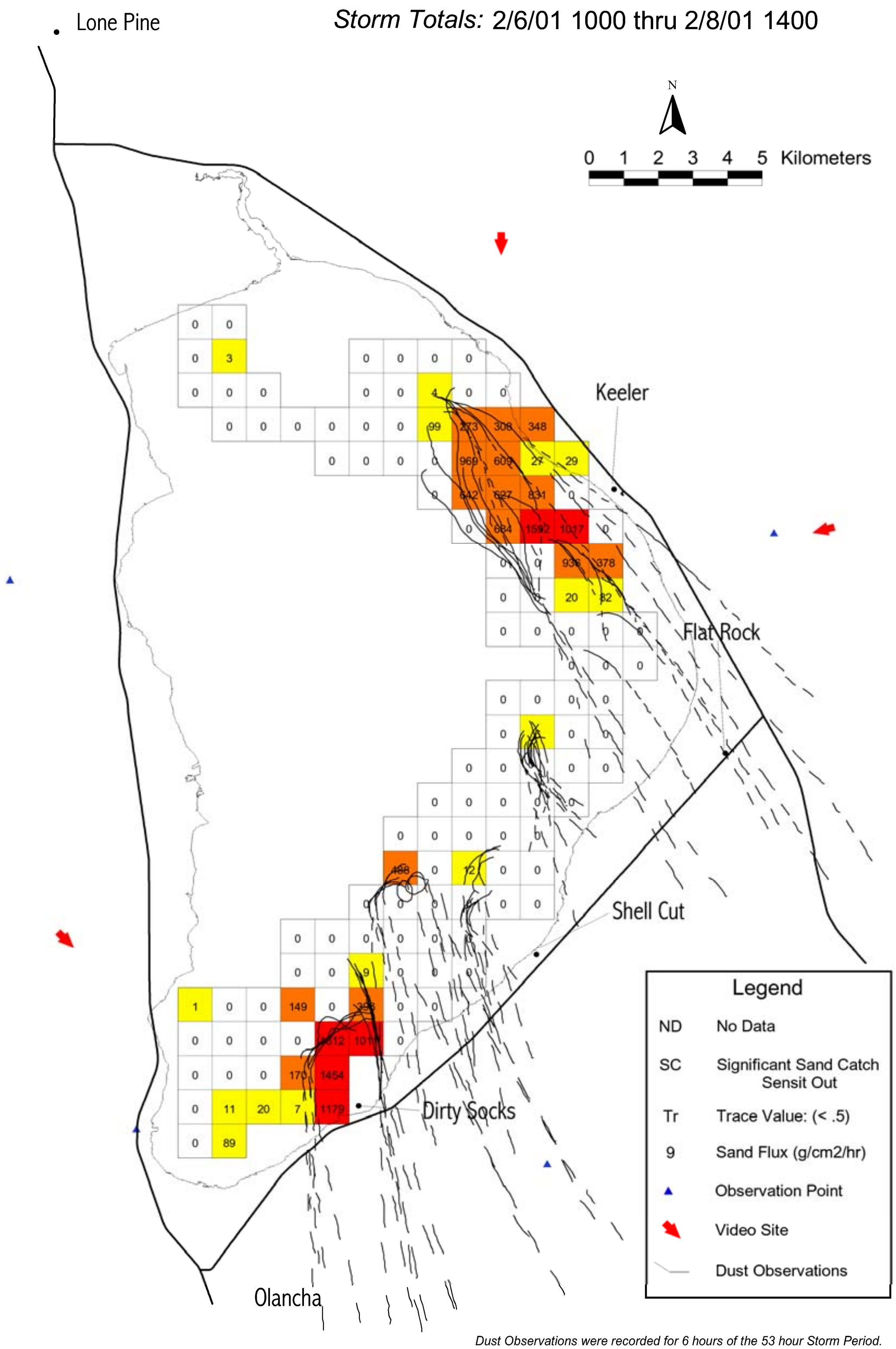

Figure 4.1 - Example of dust plume maps drawn by observers during daylight hours and total sand flux for a dust event on February 6-8, 2001.

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50 µg/m^3 with corresponding wind speed and direction data. If dust observations are available from a recent dust storm, they will be used to confirm the location of the dust source(s) that correspond with the Sensit activity and elevated PM_{10} concentration. Video will be used to identify a source or sources that were not identified by observations, Sensit data or PM_{10} information. Wind speed and wind direction data will be used to help determine if a lake bed dust source could have caused elevated PM_{10} concentrations. All of the trigger information will be used to identify any lake bed dust source area to initiate a dust source survey and/or surface inspection. The survey should be completed the same day if weather conditions are favorable. For larger areas, surveying may continue for several days or until precipitation obscures the boundaries of the source area.

In addition to the above process, general field inspections will be completed after dust storms to verify lake bed emission activity and the need for a survey. A survey will be completed if the trigger data and /or field inspections indicate emissive conditions in an area that has not been previously surveyed during the current dust period (Section 4.3) or in an area that has been previously surveyed but has increased in size since its last survey. The priorities for completing a survey are:

1) new lake bed source areas outside the instrumented Sensit network;
2) new lake bed source areas that have not been surveyed within the instrumented Sensit network; and
3) lake bed source areas that have previously been surveyed.

4.2.3.2 GPS Mapping Procedures

After a dust source is identified by dust observation, Sensit data, sand catch data, video, PM_{10} concentration or inspection of the lake bed surface, District staff will map the exterior boundary of as many of the source areas identified as possible during daylight hours, as weather conditions allow. The mapping will begin as soon as possible after a dust storm and continue until all the identified areas are mapped or precipitation occurs. The boundary of the emissive area(s) will be mapped using a Global Positioning System (GPS). Surveyors conducting the mapping will ride an ATV or walk around the outer boundary of the wind-damaged surface surveying a line with the GPS. A wind-damaged surface is defined as a soil surface with wind erosion evidence and/or aeolian deposition that has not been modified to an unrecognizable point by precipitation since the last identified dust storm.

GPS line data should be collected at an interval of one record every 10 seconds or less. Data should be collected in NAD83 UTM Zone 11 coordinates. Only GPS units capable of continuously recording line data will be used. Data should be processed and corrected using base station data (either from a commercial correction service or using data from the District’s Keeler base station) to ensure positional accuracy.

Before beginning a survey, the edge of the source area is determined by a visual review of the surface conditions within a representative one square meter area along the edge of the source area. An undamaged surface is evident if there is no visible evidence of a disturbed lake bed surface due to wind damage. As an aid to calibrate the level of disturbed surface, a surveyor will begin each survey by estimating the percentage of surface that is undamaged by the wind. The surveyor visually determines where a surface with 70 to 80 percent of undisturbed surface is located. The surveyor completes the survey by following a line of travel that closely represents the initial one-meter calibration. The following defined list, Boundary Conditions and Survey Procedures (see below), can be used to determine how to map the source boundary under differing surface boundary conditions.

Boundary Conditions and Survey Procedures:

Distinct Boundary: A visibly sharp transition, 25 feet or less in width, between a wind-damaged lake bed surface and an undamaged lake bed surface. The surveyor should travel directly along this distinct outside edge, if possible, and may deviate 25 feet to the inside or outside on occasion. Small (25-foot wide or less) channels, boundary indentations, roads, mounds, and other obstacles may be directly crossed if the continuation of the main source boundary is clearly visible on the opposite side.

Diffuse Boundary: A visibly distinct transition, 25 to 100 feet in width, between a wind-damaged lake bed surface and an undamaged lake bed surface. Every effort should be made to travel along the outermost edge of the visible distinction.

Indistinct Boundary: **A** boundary that is not obvious to the surveyor where the edge of the source is located. Mapping would be stopped at this point until a Distinct or Diffuse Boundary can be located.

Generally the surveyor will maintain a constant course of travel following the Distinct Boundary of the wind-damaged area. As the boundary becomes less distinct, it is recommended to move the course of travel further into or outside the source to maintain recognition of surface damage. It is acceptable to travel within approximately 50 feet of the outer or inner edge of the larger more noticeable active area if the boundary is Diffuse. When encountering an Indistinct Boundary condition, the surveyor should note if the boundary can be found or if the boundary cannot be mapped during the existing survey and why. If the boundary cannot be mapped, the survey shall end at that point leaving an unclosed source area polygon.

It is possible for the surveyor to find himself or herself greater than 50 feet within or outside of the source area boundary. When this happens, the surveyor should turn perpendicular to the direction they were traveling and travel in the direction where the distinct edge should be located. For example, if the surveyor were inside the source area, they would turn in the direction where erosion evidence was not observed earlier along their path. If the surveyor were outside the source area, they would turn toward the side where they previously observed the source. Boundary loss may occur because of an Indistinct Boundary or unfavorable lighting conditions. The time and coordinates should always be noted when it is necessary to relocate the boundary during a survey.

Another alternative for relocating a source area edge is to pause the GPS unit from recording data until the boundary is located and then resume with data collection. This allows the surveyor to travel in any direction until the edge is relocated or end the survey if an edge cannot be located. The line produced between the point where the GPS unit was paused and then restarted would be deleted and considered un-surveyed during post processing.

The presence of Indistinct Boundaries or conditions that cause the ending of a survey must be annotated on the GPS data or explained in the field notes, including point coordinates. Examples would include dust storm, precipitation, lightning, mud, and channel with flowing water, pond, and time constraint or equipment malfunction.

4.2.4 Using Sand Flux Monitors to Map Source Area Boundaries

Dust source area boundaries can be delineated or refined using default cell boundaries represented by active sand flux monitors. The area represented by the active SFM site may be shaped to exclude known non-emissive areas, such as; DCM areas, wetlands, or areas with different soil texture where there is evidence that it is non-emissive.

4.3 Composite Dust Source Map Development

Data Processing will compile the cumulative mapping information from the visual observers and field inspections using the GPS into a GIS database for two periods each year, December through June and July through November. A new composite map will be developed for each period containing only those data collected during that period. Hand drawn observation maps will be scanned and translated into the GIS database. Observation maps will be compared with source area locations from other methods through the GIS generated layers. Overlays of the maps generated from sand flux monitors, video cameras, visual observers and GPS'd source areas will be compared qualitatively, considering the information may have been collected at different times.

5. Protocol for Determining K-factors and PM_{10} Emission Rates from Sand Flux Data

5.1 Objective

The objective of this portion of the Dust ID Program is to estimate the PM_{10} emission flux for each cell or source area using the relationship *PM_{10} emission flux = sand flux x K-factor*. PM_{10} emissions for each area will be used with the CALPUFF modeling system or other USEPA approved model to determine if the PM_{10} emissions will cause or contribute to a NAAQS violation at the shoreline.

5.2 Method for Determining PM_{10} Emissions and New K-factors

5.2.1 PM_{10} Emission Flux = Sand Flux x K-factor

PM_{10} emissions will be estimated using the sand flux for each area represented by a Sensit and CSC and an appropriate K-factor for the area and period. The sand flux values will come from the Sensit and CSC data as discussed in Section 2. New K-factors for each area and period will be developed as discussed in this section, and default K-factors will be used to model dust events unless newer K-factors are determined.

5.2.2 Default Temporal and Spatial Storm-average K-factors

PM_{10} emissions may be estimated from default K-factors that were developed from previous dust events that occurred in the same area and the same range of calendar months in previous years.

The areas for K-factor groupings are shown in Figure 1.1: North Area, Central Area, Keeler dunes, and the South Area. Any new source area within the depicted boundaries will be associated with that area for the spatial grouping of new K-factor values. If a new source area and K-factor is developed for an area outside these boundaries, the area and default K-factor will be associated with the K-factor for an existing area with the most similar surface soil texture. The determination of the most similar existing area will be made by the Air Pollution Control Officer.

5.2.3 Method to Determine Sand Flux from Areas with Implemented Dust Control Measures (DCM)

Sand flux will be measured at sites within the shallow flood and managed vegetation DCM areas. Sensits and CSCs will be sited on dry areas within the shallow flood DCM to represent dry areas near the site. DCM areas covered with standing water will be assumed to have zero sand flux. For the Managed Vegetation DCM, sand flux sites will be placed in spatially representative areas and in areas within the DCM where wind blown dust may have been previously observed.

5.2.4 New K-factors Seasonal Cut-points

The APCO will review the K-factor data and propose seasonal cut-points to the LADWP. LADWP will respond to the proposed cut-points within 30 days. If no agreement can be reached within 60 days, the default periods will be used.

The two default periods to be used are: the winter/spring period that includes the months of December, January, February, March and April, and the summer/fall period that includes May through November. These same calendar months will be used to generate new temporal K-factors for each area and to generate new 75-percentile hourly K-factor values for modeling PM_{10} emissions.

5.2.5 Using CALPUFF Modeling System to Generate New K-factors

New hourly K-factors can be inferred from the CALPUFF model by using hourly sand flux as a surrogate for PM_{10} emissions. Modeled PM_{10} predictions can then be compared to monitored concentrations at PM_{10} monitor sites to determine the K-factor that would correctly predict the monitored concentration for each hour. More information on the modeling procedures is included in Section 6.

A K-factor of 5×10^{-5} will be used initially to run the CALPUFF model and to generate concentration values that are close to the monitored concentrations. Hourly K-factor values will then be adjusted in a post-processing step to determine the K-factor value that would make the modeled concentration match the monitored concentration at the PM_{10} monitor site. The initial K-factor will then be adjusted using Equation 5.2.

<u>*Equation 5.2*</u>

$$K_f = K_i \left(\frac{C_{obs.} - C_{bac.}}{C_{mod.}} \right)$$

Where,

K_i = Initial K-factor (5×10^{-5})
$C_{obs.}$ = Observed hourly PM_{10} concentration. [$\mu g/m^3$]
$C_{bac.}$ = Background PM_{10} concentration
$C_{mod.}$ = Model-predicted hourly PM_{10} concentration. [$\mu g/m^3$]

5.2.6 Screening Hourly K-factors

K-factors will be calculated for every hour that has active sand flux in cells upwind from a PM_{10} monitor. These hourly K-factors will be screened to remove hours that did not have strong source-receptor relationships between the active source area (target area) and the downwind PM_{10} monitor. For example, the screening criteria will exclude hours when a PM_{10} monitor site is located on the edge of a dust plume. Because the edge of a dust plume has a very high concentration gradient, a few degrees error in the plume direction could greatly affect the calculated K-factor.

The following criteria will be used to screen the hourly K-factors:

<u>Initial K-factor Screen</u>

1) Wind speed is greater than 5 m/s at 10 m height at any network site.

2) Hourly modeled and monitored PM_{10} concentrations were both greater than 150 $\mu g/m^3$ at the same monitor-receptor site.

3) Hourly wind direction as listed in Table 5.1 for each monitor site.

4) The mean sand flux for all sites with non-zero sand flux is greater than 0.5 $g/cm^2/hr$.

<u>Final K-factor Screen</u>

5) At least one sand flux site located within the target area and within a 30-degree upwind cone has sand flux greater than 2 $g/cm^2/hr$.

6) All sources are within a distance of 15 km of the receptor.

7) More than 65 percent of the PM_{10} contribution at a monitor site came from the target source area (North Area, South Area, Central Area or Keeler dunes).

8) Eliminate hours when sand flux data are missing from one or more cells that are located within a 30-degree upwind cone and within 10 km of the shoreline monitor. For Olancha and Lone Pine, which are both located 5 to 10 km from the lake bed, the distance limitation is changed to 10 km upwind of the shoreline.

Table 5.1 Wind Directions for the Initial K-factor Screen

PM_{10} Monitor Site	From-the-Lake Wind Dir. (Deg.)	Met Tower
Lone Pine	$110 \leq WD \leq 190$	Lone Pine
Keeler	$130 \leq WD \leq 330$	Keeler
Flat Rock	$210 \leq WD \leq 360$	Flat Rock
Shell Cut	$WD \geq 210$ or $WD \leq 50$	Shell Cut
Dirty Socks	$WD \geq 220$ or $WD \leq 65$	Dirty Socks
Olancha	$WD \geq 320$ or $WD \leq 55$	Olancha
Bill Stanley	$50 \leq WD \leq 190$	Bill Stanley
New Sites	TBD	TBD

The from-the-lake wind directions for the initial K-factor screening criterion 3) are shown in Table 5.1. From-the-lake wind directions for any new PM_{10} sites will be determined by the APCO as needed for the initial K-factor screen. Note that ‘From-the-Lake’ wind directions for assessing the lake bed impacts at PM_{10} monitor sites (see 2008 SIP) are different from these K-factor screening wind directions.

Hourly K-factors that pass through the screening criteria will be used to develop new event-specific spatial K-factors, and new 75-percentile hourly average temporal and spatial K-factors, if enough K-factors are available.

5.3 Temporal and Spatial Event-specific K-factors

5.3.1 Event-Specific K-factors

Screened hourly K-factors will be used to generate event-specific K-factors for the active source areas. The event-specific K-factor will be calculated as the arithmetic average using all the hours when the hourly K-factor passes the screening criteria for the target area.

5.3.2 Temporal & Spatial 75-Percentile K-factors

The statistical 75-percentile value will be determined from the distribution of the hourly K-factors that pass the screening criteria for that area and period, whenever there are nine or more hourly K-factors. The 75th percentile will be calculated using the Microsoft Excel PERCENTILE function. The Microsoft Excel PERCENTILE function works by sorting values from lowest to highest, then assigns the 0th percentile is the lowest value, the 100th percentile is the largest value, and the values in between as (k-1)/(n-1) where n is the number of data values in the list and k is index of the kth lowest value in the list. Thus, each value is placed 1/(n-1) apart. If a requested percentile does not lie on a 1/(n-1) step, then the PERCENTILE function linearly interpolates between the neighboring values.

5.3.3 Default K-factors

Table 5.2 shows the default K-factors for each of the K-factor areas and periods. These K-factors are derived for the temporal and spatial 75-percentile values from the screened hourly K-factors for the 30-month Dust ID period used for the RSIP. Each of the two temporal periods combines hourly K-factors from the same calendar periods for 2 or 3 years.

Table 5.2 - Default Spatial and Temporal K-factors for the Dust ID Model

AREA	K-factor Jan.– Apr. & Dec.	K-factor May-Nov.
Keeler Dunes	7.4×10^{-5}	6.0×10^{-5}
North Area	3.9×10^{-5}	1.5×10^{-5}
Central Area	$12. \times 10^{-5}$	6.9×10^{-5}
South Area	4.0×10^{-5}	1.9×10^{-5}

6. Protocol For Dispersion Modeling

This section of the *Protocol* discusses the dispersion model methods planned for the simulation of wind blown dust at Owens Lake using data from the Dust ID Program. The modeling procedures follow the methods used in the RSIP, with refinements based on experience and modifications to support the provisions of the SCR. The modeling techniques will be used both diagnostically to infer emission rates for source areas and prognostically to predict PM_{10} concentrations at the historic shoreline. Following an overview of the modeling approach, the remainder of this section discusses construction of the meteorological data set, dispersion model options, background concentrations and source area characterization.

6.1 Overview of Modeling Procedures and Rationale for Model Selection

The CALPUFF modeling system was used in the RSIP and has been selected for continuing studies in the Dust ID Program. CALPUFF is the USEPA recommended modeling approach for long-range transport studies and USEPA has proposed CALPUFF as a *Guideline Model* to be included in the *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W). Recently the modeling system is also being applied to near-field dispersion problems where the three-dimensional qualities of the wind field are important and for stagnation episodes when pollutants remain within the modeling domain over periods of several hours or more. Dust events on Owen Lake are sometimes influenced by complex wind patterns, with plumes from the North Sand Sheet traveling in different directions than plumes from the South Sand Sheet.

The proposed model domain shown in Figure 6.1 includes a 34 km-by-48 km area centered on Owens Lake. The meteorological and computational grid will use a one-kilometer horizontal mesh size with ten vertical levels extending from the surface to four kilometers aloft. The extent of the model domain was selected to include the "data rich" Dust ID Program study area, terrain features that act to channel winds, and receptor areas of interest. This same model domain and mesh size were used in the simulations supporting the RSIP.

6.2 Meteorological Data Set Construction

Three-dimensional wind fields for CALPUFF will be constructed from surface and upper air observations using the CALMET meteorological preprocessor program and the procedures employed in the RSIP. CALMET combines surface observations, upper air observations, terrain elevations, and land use data into the format required by CALPUFF. Winds are adjusted objectively using combinations of both surface and upper air observations according to options specified by the user. In addition to specifying the three-dimensional wind field, CALMET also estimates the boundary layer parameters used to characterize diffusion and deposition by the CALPUFF dispersion model.

6.3 CALPUFF Options and Application

Surface Observations. The necessary surface meteorological data will come from the District's network of ten-meter towers shown in Figure 1.1. The District may also install additional stations to better characterize winds near suspect source areas not currently near an existing site. Very few periods of missing data are typically contained in the District's database. Periods of missing data will be flagged and CALMET will construct the wind fields using the data from the remaining stations. In addition to the District's network, surface data from other field programs at Owens Lake will be used when available.

Cloud Cover Data. The current version of CALMET also requires cloud cover and ceiling height observations. Cloud cover is a variable used by CALMET to estimate the surface energy fluxes and, along with ceiling height, is used to calculate the Pasquill stability class. Hourly cloud cover and ceiling height observations are being collected from the surrounding surface airways observations at China Lake and Bishop Airport. During dust event conditions, the sensitivity of the CALPUFF modeling system to these variables is reduced, as the stability class becomes neutral under moderate to high winds. Algorithms within the modeling system that depend on the surface energy fluxes are dominated by the momentum flux and tend to be insensitive to cloud cover under high winds. For these reasons, the absence of local cloud cover and ceiling height measurements are not expected to significantly affect the results of the modeling study.

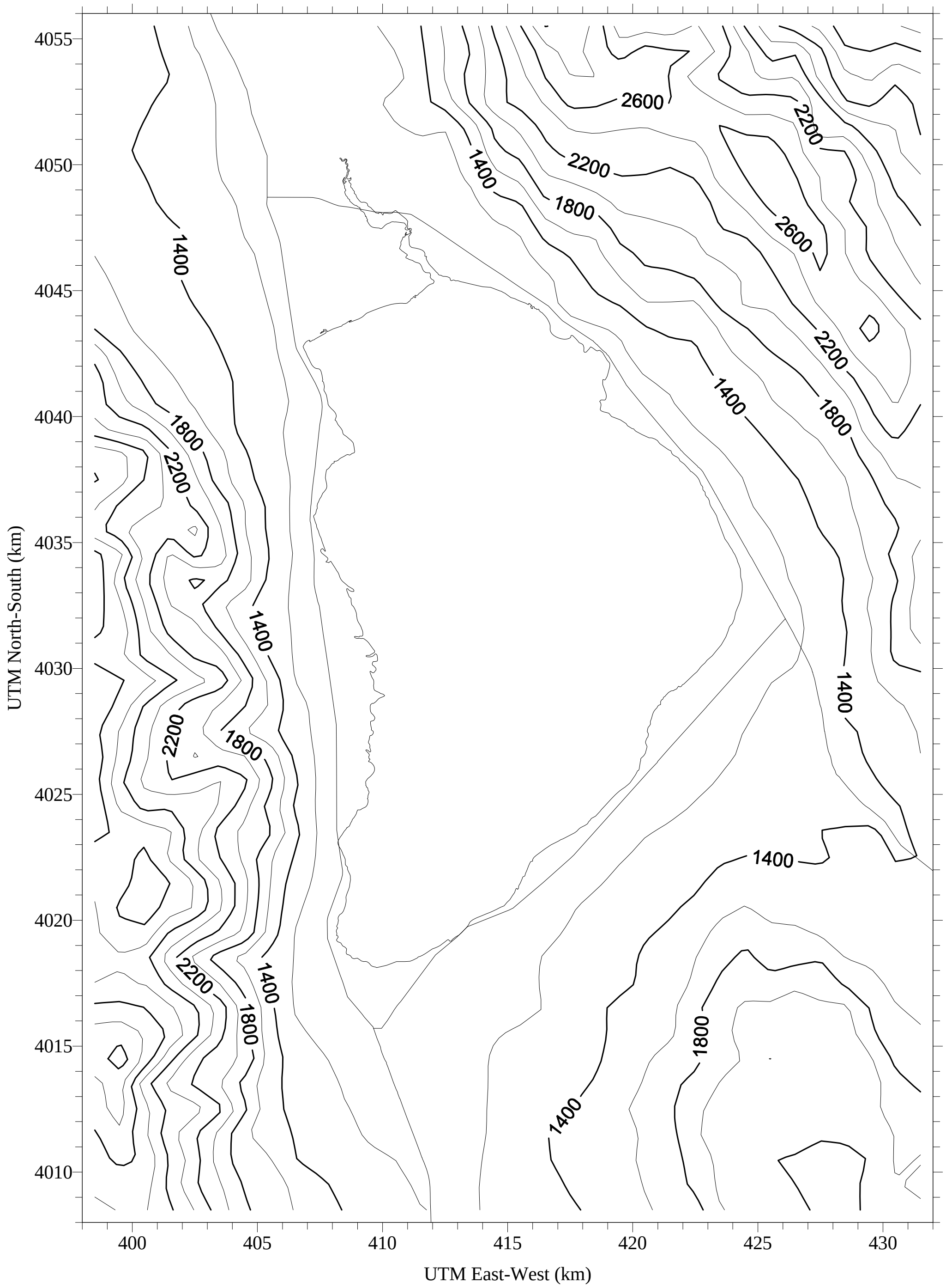

Figure 6.1 - Model Domain, elevation contours and UTM coordinates for the Dust ID Model

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Surface Characteristics and Terrain. The CALPUFF modeling system requires land use and terrain data. These data are used by CALMET to adjust the wind field and affect the calculations performed by the CALPUFF dispersion model. CALPUFF considers spatial changes in land use, including the surface roughness, and the input data are specified on a horizontal grid. The terrain data influence the constructed wind fields and plume trajectories in regions of sparse observations. Land use and terrain data have been obtained from the U.S. Geological Survey (USGS) data sets on the Internet. The resolution of these land use and terrain data sets are 200 m and about 30 m, respectively. The District has prepared these data sets using the pre-processing software provided with the CALPUFF modeling system. The resulting grids have been plotted and checked against data from the District's GIS database where the modeling domain overlaps the District's data. The 1-km mesh size terrain used by CALMET and CALPUFF is shown in Figure 6.1.

Upper air data. Upper air data will be collected from a number of different sources for construction of the wind fields and estimation of mixing heights with CALMET. In the RSIP, both local and regional data were collected as follows:

- A 915 MHz Radar Wind Profiler and Radio Acoustic Sounding System (RASS) were used to collect upper level wind and temperature measurements. The Wind Profiler was initially located at Dirty Socks then moved to the Mill Site during the 4th quarter of 2001. The District discontinued measurements with the Wind Profiler on June 30, 2003. The Wind Profiler with RASS samples wind and temperature from 100 m, up to 5000 m with a vertical resolution as low as 60 m depending on the clutter environment, atmospheric scattering conditions, and pulse length. Experience at Owens Lake indicates wind data recovery is sometimes poor above 1000 m due to the dry environment and the RASS data are limited to the lower levels during windy conditions.

- Regional twice-daily upper air soundings from Desert Rock Airport (Mercury, Nevada) and China Lake Naval Air Station.

During high wind events, observations from the Wind Profiler at both the Mill Site and Dirty Socks indicate very little wind speed or wind direction shear with height. Previous CALPUFF simulations suggest concentrations predicted at PM_{10} monitoring sites and at the historical shoreline are not usually influenced by upper level winds because the sources are ground based. The highest impacts occur close to the source areas, and there is very little wind shear during high winds.

Following removal of the Wind Profiler, soundings from China Lake and Desert Rock will be used to construct the data set. The China Lake and Desert Rock sounding will primarily be used for upper level temperature lapse rates. Winds aloft will be based on extrapolation of the surface wind measurements. The default algorithms employed by CALMET based on Similarity Theory often adjust the winds in the wrong direction and predict too much increase in wind speed with height even for very small surface roughness lengths. As an alternative, wind speeds aloft will be adjusted using the empirical results suggested by the previous Wind Profiler measurements. No wind direction turning with height will be assumed except near the Wind Profiler site where the actual data will be used until this program is discontinued.

CALMET options. The options employed for the application of CALMET to construct the wind fields were provided in the “Modeling Protocol” (MFG, 2001). The majority of the selected model options are based on the defaults incorporated in the code by the model author. Notable model options include:

- Ten vertical levels varying geometrically from the surface to 4000 m. The geometric spacing provides better resolution near the surface and the upper limit is high enough to be above the boundary layer height.

- Vertical extrapolation of surface winds aloft using the results of the Wind Profiler studies.

- Less than default smoothing of wind fields. LADWP contractors Air Sciences and Environ suggested less smoothing of the wind fields by CALMET after review of the *Owens Valley PM_{10} Attainment Demonstration Modeling Protocol*.

Wind fields constructed with CALMET will be randomly checked by plotting the resultant fields and the surface observations on a base map. The CALDESK™ software package will also be used to view the CALMET wind fields.

The application of CALPUFF involves the selection of options controlling dispersion. Although the simulations are primarily driven by the meteorological data, emission fluxes, and source characterization, the dispersion options also affect predicted PM_{10} concentrations. The model options used in the RSIP will continue to be used for the Dust ID Program. In this study, the following options will be used for the simulations:

- Dispersion according to the conventional Pasquill-Gifford dispersion curves. Sensitivity tests were also performed by applying CALPUFF with dispersion routines based on Similarity Theory and estimated surface energy fluxes. These tests did not indicate improved performance over the Pasquill-Gifford based simulations.
- Near-field puffs modeled as Gaussian puffs, not elongated “slugs.” CALPUFF contains a computation intensive “slug” algorithm for improved representation of plumes when wind directions vary rapidly in time. This option was tested, but did not significantly influence the CALPUFF predictions.
- Consideration of dry deposition and depletion of mass from the plume. The particle size data used will be based on measurements taken within dust plumes on Owens Lake as discussed below.

Dry deposition and subsequent depletion of mass from the dust plumes depend on the particle size distribution. Several field studies have collected particle size distributions within dust plumes at Owens Lake. Based on results from Niemeyer, *et al*. (1999), the CALPUFF simulations will assume a lognormal distribution with a geometric mean diameter of 3.5 µm and a geometric standard deviation of 2.2.

6.4 Background PM_{10} Concentrations

The dispersion model simulations include only wind blown emissions from the source areas with sand flux activity measurements. During high wind events other local and regional sources of fugitive dust can contribute to the PM_{10} concentrations observed at the monitoring locations. In the RSIP a constant background concentration of 20 µg/m^3 was added to all predictions to account for background sources. The constant background was calculated from the average of the lowest observed PM_{10} concentrations for each dust event when 24-hour PM_{10} concentrations at any of the sites were above 150 µg/m^3. To avoid including impacts from lake bed dust source areas in the background estimate, the procedures used a simple wind direction filter to exclude hours when the lake bed may have directly influenced observed PM_{10} concentrations. Such hours were removed and daily average background concentrations were recalculated based on the remaining data.

Additional PM_{10} monitors are proposed for installation at Owens Lake. These monitors can be used to measure hourly PM_{10} concentrations upwind from lake bed source areas. Some of these monitors may be representative of regional PM_{10} concentrations and others may be influenced by local sources that may indicate a higher PM_{10} concentration than the regional background level. A method to calculate background concentrations based on upwind monitor concentrations for each modeled-event approved by both the APCO and the General Manager of the LADWP may be developed in the future. Meanwhile, a default background of 20 µg/m^3 will be added to the model prediction for each receptor location.

6.5 Area Source Characterization

CALPUFF simulations at Owens Lake are sensitive to source configuration. Emissions will be varied hourly according to the methods described in Section 6.6 and dust sources represented as rectangular area sources. CALPUFF contains an area source algorithm that provides numerically precise calculations within and near the area source location. The area source configuration used for the Dust ID model run for the period from July 2002 through June 2003 is shown in Figure 6.2. The paired Sensit and CSC measurements were assumed to be representative of the horizontal sand flux for irregularly shaped source areas near the sand flux site. Field observers determined the size and shape of the source areas based on GPS mapping after the storms, observation maps made during the storms, and physical surface characteristics. All source areas were represented by sand flux measured at a single site that was applied to a series of 250 m x 250 m cells that were configured to conform to the general shape of the source area represented by the sand flux site.

The following general rules are used to characterize and map source areas on the lake bed:

- Actual source boundaries will be used when available to delineate emission sources in the simulations. Actual source boundaries will be determined using a weight-of-evidence approach considering visual observations, GPS mapping, and surface erosive characteristics. Erosive characteristics that might be considered when defining a source boundary include properties of the soil, surface crusting, wetlands, and the proximity of the brine pool and existing DCMs.

- Source boundaries will also be defined based on the DCM locations. For example, sand flux measurements outside the DCM will be assumed to apply up to the boundary of the DCM. Sand flux measurements inside the DCM will be assumed to apply to the area inside the DCM.

- All source areas will be represented by a series of 250 m x 250 m cells that generally conform to the shape of the source area and share the same hourly sand flux rates as the sand flux site representing that source area. Cells small than 250 m x 250 m may be used near the shoreline to better represent source areas where predicted concentrations are expected to be particularly sensitive to the source area configuration. (Figure 6.2)

6.6 Estimation of PM_{10} Emissions

Hourly PM_{10} emissions for each source area will be estimated using Dust ID sand flux data and K-factors following the procedures described in Section 5. See also SCR Section 1.2 and 2.1 regarding the order of priority for using K-factors for modeling.

6.7 Simulation of Shoreline Concentrations

Under the provisions of the SCR in the RSIP, CALPUFF simulations will be used to assess whether lake bed source areas cause or contribute to an exceedance of the PM_{10} NAAQS in areas without PM_{10} monitoring sites. Predictions will be obtained using the RSIP receptor network that contains more than 460 receptor locations placed at the historic shoreline (approximately at the 3600' elevation) of Owens Lake (see Figure 6.2). The receptor spacing along the historic shoreline ranges from 100 to 200 m. Note in several locations along the shoreline, receptors are very close to or even within potential source areas (see Figure 6.3).

7. Owens Lake Safety & Training Program

7.1 Objective

All field personnel that work at Owens Lake are required to complete special training courses to deal with the unique hazards and environmental precautions that must be considered when working on the lake bed. Training includes: first aid and CPR training, proper ATV use, respiratory protection and dust safety, lake bed access reporting, and snowy plover protection.

7.2 Safety Requirements

Safety is the first priority while working at Owens Lake. Training requirements are required for every worker at the lake for their own safety. Dust storms can start within minutes exposing workers to dust and sand. Lightning storms often occur in the summer. Winters have sub-freezing temperatures and summers have temperatures well above 100 degrees. Access is usually restricted to ATV’s and can change often throughout each year. The objective of all the training requirements is to put safety as the highest priority at all times.

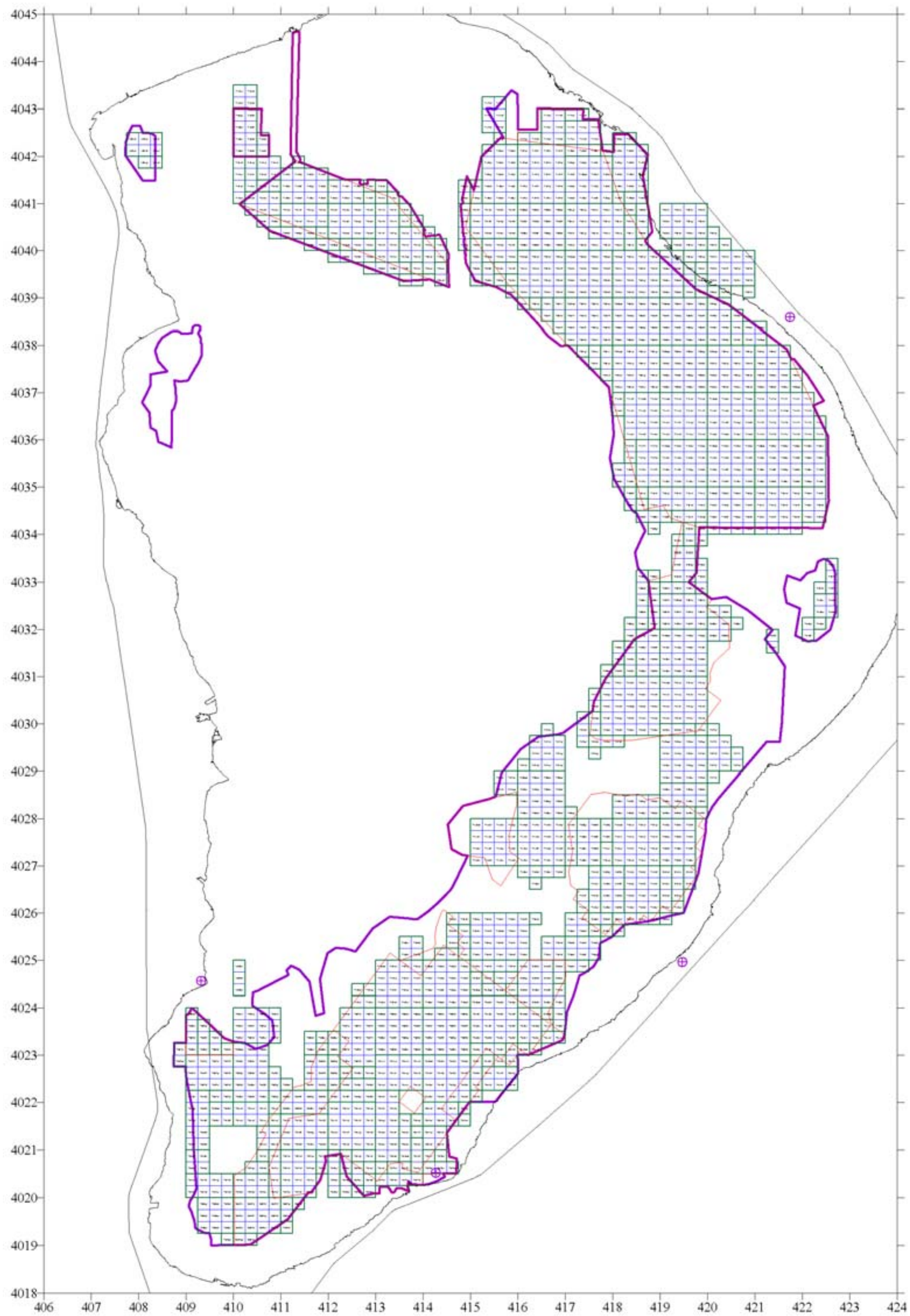

Figure 6.2 - Area source configuration using 250 m x 250 m cells for July 2002 through June 2003 Dust ID model run. Purple lines represent the control area boundary used with the Settlement Agreement.

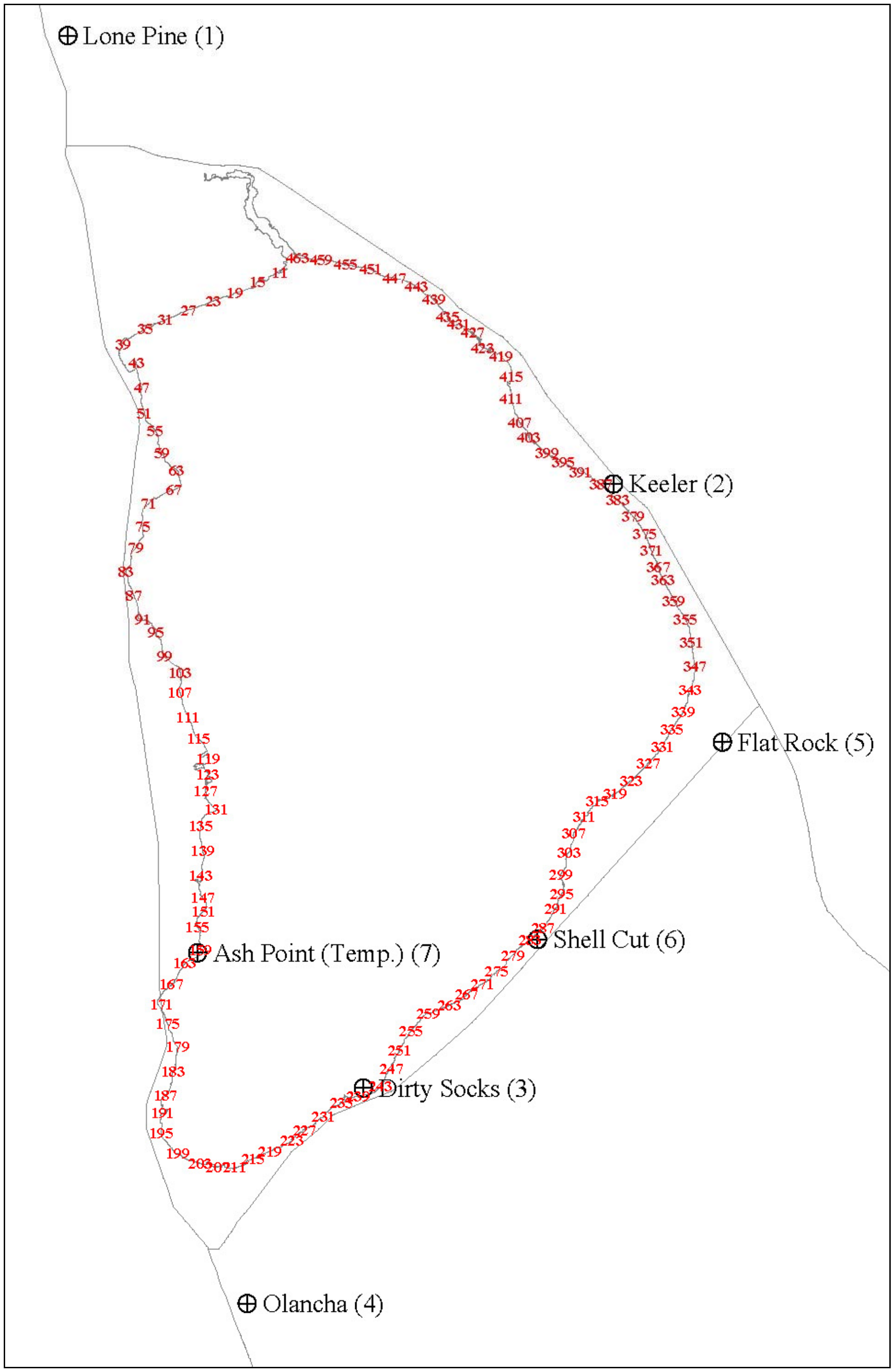

Figure 6.3 -The Dust ID model evaluates PM_{10} impacts at over 460 receptor locations around Owens Lake.

All personnel that are involved with any fieldwork under the Dust ID Program are required to complete all safety training before working on the lake. Everyone must report going onto and leaving the lake. Workers are required to stop work and leave the lake when a dust storm starts. Every field worker will be issued a respirator, goggles for eye protection and earplugs to be used when caught in a dust storm while leaving the lake. Workers are required to leave the Keeler office when the dust impacts Keeler and the TEOM monitor reading exceeds 1000 $\mu g/m^3$. Respirator training and face fits will be completed annually. First Aid and CPR training and successful certification is required every three years. Snowy Plover training is required before any new worker can start work on the lake. Other safety issues that all workers will be informed of include the proper use of tools, special weather conditions such as temperature extremes, rain and lightning and training in the operation of ATVs.

7.3 Reporting Procedure for Working on the Lake and Contacts

1. Normal work hours on the Owens Lake are defined as sunrise to 4:45 PM, Monday through Friday. The lake is defined as any area below the 3600 ft. contour.

2. Every person or group must call the Bishop office and leave a message or speak to the Administrative Specialist (AS) to notify that they are working on the lake. They also must inform the AS what area of the lake they will be working. Examples: DIVIT, Dirty Socks sand sheet, “A” Met tower or any commonly used identifiable name of a site or area you will be working.

3. The AS will record the person’s name (s) and area of the lake they are working on.

4. Every person or group working on the lake must notify the Bishop office before 4:45 PM on the same day; that they have left the lake OK. This must be done or a person will be sent out to look for you! False alerts will not be appreciated.

5. The AS will call the Director of Technical Services (DTS) in Keeler or one of the back up persons in order on the list below, and report the missing person if not notified before the specified time. An attempt will be first made to contact the missing person by phone and determine their situation. The DTS or an assigned person will begin a search for the missing person if the person cannot be contacted by phone. The search will continue until dark or unsafe conditions at which time the Inyo Sheriff will be notified for assistance.

6. Everyone may work outside normal work hours Monday through Friday <u>at your own risk.</u> However, they must call the Bishop office before the designated time and notify the AS that they will be working past 4:45 PM and call again and leave a message that they left the lake OK before 8:00 AM the next day.

7. The AS will check the messages every morning and record the information. The DTS will be notified if a person that worked after normal hours did not call and leave a message that they left the lake OK. The DTS or an assigned person will follow the procedure for a missing person outlined in step 5.

8. Nobody may work on the lake after 4:45 PM on Friday, all day Saturday or Sunday unless they receive special permission from their direct supervisor. The supervisor will be responsible for making sure the worker left the lake OK and responding to an emergency or search if necessary. The worker must notify their supervisor when they leave the lake OK during these periods.

Emergency Assistance Reporting Contacts and Phone Numbers (Area Code 760):

Call 911 first if you have an emergency!

Bishop Office AS	872-8211	
Bill Cox (DTS)	876-8103	Cell 937-2886
Earl Wilson	876-8104	Cell 937-1060
Nik Barbieri	876-1803	Cell 937-6696
Grace Holder	872-8211	Cell 937-2887
Guy Davis	876-8115	Cell 937-1766
Dan Johnson	876-4544	Cell 937-1715
Ted Schade	872-8211	Cell 937-3360

7.4 Snowy Plover Training and Other Wildlife Protection Procedures

Field technicians and other District personnel and contractors are required to take precautions to avoid disturbing western snowy plovers during the nesting and brooding season which is from March 15 through August 30 each year. All lake bed personnel must complete snowy plover awareness and avoidance training before venturing onto the lake bed during snowy plover season. A qualified biologist will provide training for all lake bed personnel. In addition to completing snowy plover training, the plover protection program requires the following:

- Report snowy plover sightings to the District's biological resources monitor for dissemination to all lake bed personnel and for scientific data collection purposes. The biological resources monitor will map and mark the sightings in the case of nesting pairs, and will map the last known locations of broods. Lake bed workers will be responsible for checking the latest maps before encroaching onto potential snowy plover use areas.

- If snowy plover nests are found within areas of potential conflict with Dust ID monitoring, they will be marked in the field with green stakes. Within the buffer area demarked by stakes, the maximum allowable time per visit is 10 minutes.

- Field personnel should use established ATV and 4WD vehicle trails to approach and depart monitoring sites. The maximum allowable speed on ATV and off-road 4WD on the lake bed is 15 mph during the snowy plover season.

All existing and new Dust ID monitoring installations will be fitted with raptor perching deterrent (eg., Nixalite) at potential perch sites with a height of greater than 60 inches above the playa surface. Maintenance of perching deterrents will be routinely performed. Any new construction that causes new ground disturbance during the snowy plover season will require a pre-construction survey for snowy plover use. A qualified biologist will perform the survey within 1 week prior to the start of construction.

Monitoring will be performed on site in a manner that is least disturbing to wildlife and plant resources as possible. Potentially affected upland resources (those located outside the playa) that could be disturbed during any new ground-disturbing construction activities were identified during District environmental analyses. The animals that use upland areas vary seasonally, with nesting and foraging birds, mammals, reptiles, and invertebrates occurring during the period of dust monitoring. No special training is required to work in upland areas during the dust monitoring season, however pre-construction wildlife and rare plant surveys are required if placement of new facilities at any time of year will cause new ground disturbance.

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Board Order 080128-01
Attachment D

2008 Procedure for
Modifying Best Available Control Measures (BACM)
for the Owens Valley Planning Area

The City may transition from one approved BACM to another provided that the performance standard of one or the other BACM is met at all times during the transition, and that the City makes a complete and technically well-supported written demonstration of that performance, with a built-in margin of safety, to the satisfaction of the APCO in advance of any actions by the City to transition. There are three circumstances under which temporary modifications may be allowed to the BACM identified in this SIP, if certain conditions are met. The circumstances are:

1. Adjustments to existing BACM. Research to demonstrate that sufficient PM_{10} control efficiency during the dust season can be achieved and the NAAQS can be attained everywhere on or above the historic shoreline with a different performance standard for an existing BACM.

2. Research on new BACM

3. Transition from one BACM to another that requires a time period where neither BACM's performance standards can be met.

The City may make an application for any of these modifications in writing to the APCO. The complete application must include all necessary data and other technical information to support the application. Except for the specific limitations set forth below for BACM adjustments to Shallow Flooding, the APCO shall have full and sole discretion to accept, reject or condition the City's application for modifications to BACM on Owens Lake, to require additional technical information, and/or to independently monitor the results of the project, and shall provide her/his decision in writing. This same discretion shall apply to the APCO's consideration of each of the other applications that the City may make as further described below. The APCO will consider and respond to comments made by the City regarding any decision by the APCO to reject, condition or modify an application. Failure by the City to comply with any condition of the project approval may result in the APCO revoking the project approval and directing closure procedures be implemented for the project.

The flexible BACM description under the terms of the Order preclude the application of the U.S. Environmental Protection Agency's Natural Events Policy for monitoring data used to make the determinations in this Attachment. All monitored PM_{10} concentrations that meet the EPA quality-assurance requirements contained in 40 CFR Part 58 and are measured at stations located at or no more than 3 kilometers above the historic shoreline (shoreline monitors) will be used in the analysis. The monitored values will be used as measured, and will not be adjusted for from-the-lake and non-lake wind directions as they are for the Supplemental Control Requirements.

The modeling for the determinations will be performed in accordance with the 2008 Owens Lake Dust Source Identification Program Protocol (Board Order 080128-01, Attachment C).

1. ADJUSTMENTS TO EXISTING BACM

A. BACM Adjustments to Shallow Flooding

1. After approval of the 2008 SIP, the City shall have the option to conduct field testing to refine the wetness cover requirement to achieve 99 percent control efficiency in Shallow Flood areas within the boundaries of the 2003 Dust Control Area (Shallow Flood Cover Test).

   A. The Shallow Flood Cover Test shall occur on one or more areas totaling not more than 1.5-square-miles, to be selected by the City and approved by the APCO, which approval shall not be unreasonably withheld, from within the TDCA areas requiring 99 percent control.

   B. The Shallow Flood Cover Test design shall be prepared by the City and approved by the APCO, which approval shall not be unreasonably withheld, prior to implementation. Based on that design, the APCO will reasonably determine wetness cover requirements for the Shallow Flood Cover Test.

   C. The City will be CEQA lead agency for the Shallow Flood Cover Test and shall secure all required responsible agency approvals, permits and leases.

2. If the APCO reasonably determines in writing that the PM_{10} Dust Control Measures in the 2008 Total Dust Control Area (TDCA) have been operational for one continuous year (defined as 365 consecutive days) with no exceedance of the federal standard at monitors located at or above the historic shoreline caused solely by sources within the 2008 TDCA, the City shall be permitted to reduce the wetness cover by an average of 10 percent over those Shallow Flood areas requiring 99 percent control efficiency, excluding areas identified in Section A.2.C, below, provided that:

   A. Application of the 10 percent reduction in wetness cover during the May 16 through June 30 Shallow Flood areal wetness cover reductions provided for in Paragraphs 15.A.ii and 15.B.ii of Board order 080128-01 shall result in the lower of:

      i. The areal cover resulting from a 10 percent reduction; or

      ii. The areal cover required in Paragraphs 15.A.ii and 15.B.ii of Board Order 080128-01.

   B. To implement the reductions set out in this Section, the City shall be required to first submit a written Wetness Cover Plan to the District for reducing the wetness cover on the eligible areas. The Wetness Cover Plan shall take into account:

i. The results of testing carried out pursuant to Section A.1, if conducted; and

ii. The results of fall and spring Shallow Flood wetness cover reduction operations carried out pursuant to Paragraphs 15.A.ii and 15.B.ii of Board Order 080128-01.

C. If, in any year, the Wetness Cover Plan proposes reductions in wetness cover greater than 10 percent in any portion of the Shallow Flood areas covered by the Plan (consistent with the 10 percent limit on the overall average reduction), the City shall obtain the additional written approval of the APCO, which approval shall not be unreasonably withheld.

D. In the event shoreline monitors show an exceedance of the federal standard, whether that exceedance is caused by sources within, outside, or both within and outside of the 2008 TDCA, no further reductions in wetness cover shall be permitted for any Shallow Flood area that has contributed to the exceedance, as determined by the methodology in the "2008 Owens Valley Planning Area Supplemental Control Requirements Procedure" (Attachment B) and subject to the provisions of Section A.4, below.

E. Except as provided in Section A.4, below, the City may continue to operate using reductions of wetness cover pursuant to a previously approved Wetness Cover Plan.

3. For each Dust Control Season (October 1 of each year through June 30 of the next year) that wetness cover reductions have taken place under the provisions of Section A.2, the City shall prepare and submit to the District a written report summarizing the results of the wetness cover reductions within 90 days after conclusion of the corresponding Dust Control Season. The report shall document the percentage of wetness cover for Shallow Flood areas and the effect(s) of wetness cover reductions on PM_{10} concentrations at the historic shoreline.

4. Any areas for which wetness cover has been reduced pursuant to Section A.2 and that cause or contribute to an exceedance of the federal standard at the historic shoreline shall be remediated by the City under the Remedial Action Plan prepared pursuant to the requirements of Attachment B.

A. Subject to APCO written approval, which approval shall not be unreasonably withheld, the City may further reduce the wetness cover beyond that allowed in Section A.2 provided that:

i. The maximum 24-hour PM_{10} shoreline monitor values for at least 365 consecutive days of operation following initiation of the last approved Wetness Cover Plan does not exceed 130 $\mu g/m^3$; and

ii. The City demonstrates to the reasonable satisfaction of the APCO that the modeled contributions from the lake bed for the same time period set forth in

Section A.4.A.(i) plus the background of 20 µg/m^3 do not exceed 120 µg/m^3 at the historic shoreline.

B. If the monitored values at the historic shoreline exceed 130 µg/m^3, and it is determined that non-lake bed sources are contributing greater than 20 µg/m^3, then the District will expeditiously seek to identify and require control of those non-lake bed sources so that the City may continue to implement efficient DCMs on the lake bed.

C. If the City is entitled to further reduce wetness cover pursuant to this Section, the City shall prepare and submit an updated Wetness Cover Plan to the District to describe the wetness cover proposed for the subsequent, applicable Dust Control Season. The updated Wetness Cover Plan shall include:

i. A map that depicts the eligible Shallow Flood areas;

ii. The proposed amount of wetness cover for each eligible Shallow Flood area; and

iii. The method for determining effectiveness of the proposed wetness cover.

D. The Wetness Cover Plan shall be subject to approval of the APCO, which approval shall not be unreasonably withheld.

B. BACM Adjustment to Measures Other than Shallow Flooding within Existing Dust Control Areas

Requirements to Begin the Process

At least once per calendar year after May 1, 2010, the District's APCO will make a written determination as to whether the Owens Lake bed will require additional PM_{10} controls in order to attain or maintain the federal 24-hour PM_{10} NAAQS. The APCO will use the procedure forth in Board Order 080128-01 to make the determination.

If the APCO determines that there were no monitored or modeled exceedances of the PM_{10} NAAQS as described above for the previous calendar year, each calendar year the APCO will do the following:

1) determine from the modeling if there are shoreline receptors where the model shows the combined predicted yearly maximum 24-hour contribution from all source areas on the lake bed contributing to those receptors plus background (24-hour average of 20 µg/m^3) is less than 120 µg/m^3, and

2) determine that there were no concentrations greater than 120 µg/m^3 measured at any shoreline or near-shore monitoring site in the area of those receptors.

The City may perform an independent assessment using the data and methods of the Dust ID Protocol in order to confirm the APCO's findings. The APCO will consider and respond to the

City's assessment before making his/her final determination. The APCO has full and sole discretion to make this determination.

First Step on Test Areas

If there are receptors that meet the requirements described above, and provided that the City is in compliance with SIP control requirements on all areas of the lake bed, the APCO will inform the City that they may submit an application to reduce the level of control within a 1 to 2-square-mile test area of an existing Shallow Flooding Dust Control Measure (DCM) area or within a 160 to 320 acre test area of an existing Managed Vegetation DCM area that the modeling shows contributes to, and only to, the shoreline receptors described above where the yearly maximum 24-hour contribution from the lake bed plus background is less than 120 $\mu g/m^3$. Application may be made for more than one area to be tested simultaneously provided the test areas do not impact any of the same modeled shoreline receptors or monitors (no overlapping impacts). The above limitations on test area size and location do not apply outside the boundaries of existing Dust Control Areas.

For the Managed Vegetation DCM, the cover may be reduced by no more than 5%, e.g. 50% to 45%, (one step). For other BACM or changes to compliance averaging areas (e.g., one acre for Managed Vegetation), the APCO will determine the permitted test area size, averaging area, test location and step amount. An area with a non-zero contribution to a receptor will be considered not to contribute to a receptor if the contribution from that area is less than 5 $\mu g/m^3$ and the yearly maximum 24-hour contribution from the lake bed plus background (20 $\mu g/m^3$) to that receptor is less then 140 $\mu g/m^3$. (A "zero contribution" is defined by the accuracy of the instruments used to collect the data, but in no case shall it be greater than 1 $\mu g/m^3$.) The City may also satisfy the requirements of a BACM test for Managed Vegetation with documentation of a site-specific BACM test, along with written justification for more general application of the results of this test.

The City's application to reduce the level of control over any area within the boundaries of existing Dust Control Areas must be accompanied by a modeling analysis that demonstrates that increasing PM_{10} emissions within the test area will not cause the predicted yearly maximum 24-hour concentrations along the shoreline to exceed 120 $\mu g/m^3$, including background (20 $\mu g/m^3$).

The application must also include, but is not limited to:

1) a project description,
2) site plan,
3) any necessary environmental documentation, responsible agency approvals, permits and leases,
4) a protocol to measure PM_{10} emissions and performance standards,
5) a time frame for project milestones and completion,
6) plans to control PM_{10} emissions if they exceed project limits,
7) project closure procedures if the project is discontinued,
8) soil texture information, soil chemistry, groundwater chemistry and applied water chemistry, and

9) a protocol to evaluate control effectiveness, estimate emissions and determine whether the results are transferable to other areas of the lake bed.

For BACM other than Shallow Flooding, the City will submit a relationship between control efficiency and performance standards based upon research results. The APCO has full and sole discretion to accept, reject, or modify that relationship. All modeling will be done according to the Dust ID Protocol.

Rectified aerial or satellite images of the area of adjusted BACM, or any other method approved by the APCO, will be used by the APCO to determine the performance standards for the adjusted BACM for this step and all subsequent steps.

All raw data must be shared with the APCO, and all data screening criteria must be approved (or disapproved) in writing by the APCO. The APCO may terminate the test at any time if modeling or monitoring show that modeled (including background of 20 μg/m^3) or monitored emissions are increasing above trigger levels set by the APCO based upon a 140 μg/m^3 modeled or monitored PM_{10} concentration at the shoreline, or if the City is not following the APCO-approved protocol. The APCO has full and sole discretion to determine whether these conditions have been met.

The APCO has full and sole discretion to approve or reject the City's application or require conditions. The APCO will take action and notify the City in writing within 90 days of receipt of the written application. No changes may be made to BACM in advance of the APCO's approval. Any adjustments to BACM will be reported to EPA by the APCO within 60 days of the APCO's approval.

<u>Subsequent Steps on Test Areas</u>

The adjusted BACM shall be maintained by the City for one year. No other adjustments to BACM may be made during that year that impact any of the same set of model shoreline receptors. At the end of the year, the City may submit a new application to the APCO to reduce the level of control in the test area by another step provided:

1) the modeled yearly maximum 24-hour contribution at all of the shoreline receptors identified above from all lake bed sources including the test area, plus background (20 μg/m^3), during the test period is less than 120 μg/m^3, and

2) no concentrations greater than 120 μg/m^3 were measured at any shoreline monitor in the area of those receptors during the test period.

The new application must contain all the same elements as the original application, and all the data and modeling from the first step of the test.

The APCO has full and sole discretion to approve or reject the City's application, or to require conditions. Subsequent steps may be made in the same manner. The APCO will take action and notify the City in writing within 90 days of receipt of the written application.

Requirement to Increase Controls on Test Areas

If, at the end of the year or any subsequent year before the SIP Revision to adjust BACM is approved by USEPA, the predicted yearly maximum 24-hour contribution from all lake bed sources including the test area plus background (20 $\mu g/m^3$) exceeds 140 $\mu g/m^3$ at any of the shoreline receptors identified above, and/or concentrations greater than 140 $\mu g/m^3$ were measured at a shoreline monitor in the area of the identified receptors, then the City must increase the control efficiency on the test area to the last step that achieved concentrations below the 140-$\mu g/m^3$ threshold. For Managed Vegetation, this action must be taken within 12 months of the written determination by the APCO that the requirements for adjusting BACM were not met. For all other PM_{10} control measures, this action must be taken within 60 days of the written determination by the APCO that the requirements for adjusting BACM were not met. The APCO has full and sole discretion to make that determination. The APCO will determine the time scale for compliance for other BACM as part of the approval of the application.

SIP Revision for BACM for the Test Area

After three consecutive years of successful operation of the adjusted-BACM test area (modeled and monitored concentrations less than 140 $\mu g/m^3$ as described above), the City may apply to the District for a SIP Revision to redefine BACM for that test area on the Owens Lake bed provided:

1) the predicted yearly maximum 24-hour PM_{10} contribution for each year of the test from the test area plus background (20 $\mu g/m^3$) at all shoreline receptors is 140 $\mu g/m^3$ or less, and

2) no PM_{10} concentrations greater than 140 $\mu g/m^3$ were measured at any shoreline monitor during the three years of the test.

The APCO has full and sole discretion to determine whether these conditions have been met. After public notice and comment and a public hearing, the District Board has full and sole discretion to determine whether to adopt the SIP revision.

Lake-Wide SIP Revision for BACM for a Soil Type

If, after three consecutive years of successful operation of the adjusted-BACM test area, the predicted yearly maximum 24-hour contribution from the test area and all source areas on the lake bed plus background (20 $\mu g/m^3$) at all shoreline receptors for all three years of the test is 140 $\mu g/m^3$ or less and no concentrations greater than 140 $\mu g/m^3$ were measured at any shoreline monitor during the three years of the test, the research conducted on these test areas can be used to determine the relationship between the PM_{10} emissions, control efficiency and DCM performance standards. After the relationship has been identified, the City will use the research results in an updated modeling analysis that applies the test results to other areas on the lake bed with the same general soil type (sand-dominated, silt-dominated or clay-dominated) and under the same range of evaluated emissions or control efficiencies and performance standards as the test. The modeling will cover the entire test period, and will be done in accordance with the Dust ID Protocol. A DCM control map (map) will be prepared of lake bed control efficiencies (with corresponding DCM performance standards) that would be required to achieve the PM_{10} NAAQS everywhere along the historic shoreline with that DCM in the same general soil type (sand-dominated, silt dominated or clay-dominated) as the test area and under the same range of control efficiencies, emissions, and performance standards evaluated in the test.

The City will then submit this draft map to the APCO for approval. The submittal must contain all the data from the test area and the modeling that produced the map. The APCO has full and sole discretion to approve, disapprove, or modify the draft map.

If the APCO approves the map, the City may apply to the District Board for a SIP Revision to redefine that BACM for that mapped area on the Owens Lake bed. After public notice and comment and a public hearing, the District Board has full and sole discretion to determine whether to adopt the SIP Revision. If a SIP Revision identifying a redefined BACM for Owens Lake is adopted by the District Board and approved by USEPA, the redefined BACM may be implemented anywhere designated by the new DCM control map. If the City has implemented a different DCM in the mapped area, the requirements of the following section below titled "Transitioning From One BACM to Another BACM After 2010" must also be met. If any modeled or monitored exceedance of the PM_{10} NAAQS results from these adjustments to BACM, the requirements of Board Order 080128-01, Paragraphs 10 and 11, will automatically apply to increase controls on these extreme violators to restore attainment of the NAAQS.

As many of the existing and potential dust control areas on the Owens Lake bed fall under the jurisdiction of the California State Lands Commission and other responsible agencies, the City must secure the appropriate approvals, leases and permits prior to implementing adjustments to existing BACM. However, nothing in this section is intended to give any responsible agency any authority beyond their authority under law.

2. RESEARCH ON POTENTIAL NEW BACM INCLUDING MOAT ROW

The City may test new dust control measures at any time on areas of the lake bed that are emissive, except within the 43.0 square-mile 2008 Total Dust Control Area footprint where BACM (or on up to 3.5 square miles, the non-BACM dust control known as Moat & Row) must be implemented by April 1, 2010 or within any Supplemental Control Area where existing BACM has been implemented or is scheduled for implementation. This testing area exclusion does not apply to Moat & Row PM_{10} controls constructed within the 12.7 square-mile 2006 Supplemental Dust Control Area (SDCA). The City may test up to 3.5 square miles of Moat & Row within the SDCA. If the City has tested a new control measure for three years in this manner, it may apply in writing to the APCO for a SIP Revision to designate the new dust control measure as BACM. The application must meet all USEPA requirements for BACM designation and demonstrate to the APCO's satisfaction that the new control measure is sufficient to achieve the required PM_{10} emission reductions or control efficiency during the dust season and attain the NAAQS everywhere on the shoreline. The APCO has full and sole discretion to determine whether these conditions have been met.

The application shall include, but not be limited to:

1) a description of the new dust control measure

2) a description of the test site and the meteorological conditions under which it was tested
3) the measured PM_{10} emissions during the test
4) the test time frame
5) all raw data collected during the test
6) all data screening criteria and final data sets
7) data supporting the conclusion that the required control efficiency was achieved
8) a performance standard that the new dust control measure must meet in order to achieve the required emission reductions or control efficiency
9) an analysis of any environmental impacts of the dust control measure
10) the appropriate responsible agency approvals, permits and leases

The application must include modeling that demonstrates that the required PM_{10} emission reductions or control efficiency can be achieved during the dust season anywhere this control measure may be implemented on Owens Lake, and the NAAQS can be met at all times everywhere along the historic shoreline.

If the APCO determines that the application is complete and the above conditions have been met, he/she will have full discretion to select or approve a method of determining compliance of the proposed new BACM with its performance standard and include that method in the description of the proposed BACM for the SIP Revision. The District Governing Board has full and sole discretion to determine whether to adopt a SIP Revision for approval of any new BACM.

Upon adoption by the District Board, approval by CARB, and submission to USEPA of a SIP Revision that identifies a new BACM for Owens Lake, the City may implement only this one new control measure on one-half square mile of the next area to be identified as needing control under the 2003 SIP Revision Supplemental Control Requirements until EPA approves this new measure as BACM. No other new control measures may be implemented on areas identified as needing control under the 2003 SIP Revision Supplemental Control Requirements until EPA approves this new measure as BACM. The District Governing Board may limit the new BACM to specific circumstances, for example, distance of the new dust control measure from the shoreline or approval in a specific general soil type. Upon approval by USEPA, the new BACM may be implemented per the requirements described in the following section, "Transitioning From One BACM to Another BACM After 2010," or on any subsequent areas requiring control under the "2008 Owens Valley Planning Area Supplemental Control Requirements Procedure" (Board Order 080128-01, Attachment B), subject to any limitation to specific circumstances.

As many of the existing and potential dust control areas on the Owens Lake bed fall under the jurisdiction of the California State Lands Commission and other responsible agencies, the City must secure the appropriate approvals, leases and permits prior to implementing any BACM test or new BACM. However, nothing in this section is intended to give any responsible agency any authority beyond their authority under law.

3. TRANSITIONING FROM ONE BACM TO ANOTHER BACM AFTER 2010

If the City wishes to transition from one existing BACM to another existing BACM without meeting the performance standard of one or the other BACM at all times, it may submit an application to the APCO in writing for permission to do so after April 1, 2010. The APCO has full and sole discretion to accept, reject or condition the City's application. The transition may be done on no more than one and one-half (1.5) square miles lake-wide for any BACM except Managed Vegetation, or 320 acres lake-wide if the transition is to Managed Vegetation, at one time. The City shall not begin the transition in advance of the APCO's written approval.

The application shall include, but not be limited to:

1) a protocol that includes a project description
2) a site plan
3) a plan to measure PM_{10} emissions
4) a time frame for project milestones and completion
5) plans to control PM_{10} if emissions exceed any trigger value set by the APCO based upon a 140µg/m^3 modeled (including background of 20µg/m^3) or monitored PM_{10} concentration at the shoreline
6) data supporting the assumption that the transition can be completed and the BACM performance standards can be achieved within three years of the start-up of construction
7) project closure procedures if the project is discontinued for any reason or if the PM_{10} trigger value is exceeded
8) any necessary environmental documentation, responsible agency approvals, permits and leases

The protocol must include modeling in accordance with the Dust ID Protocol that predicts that the NAAQS will be met at all times everywhere on the shoreline during the transition period, and must include a method to monitor emissions continuously throughout the transition period. The transition must be complete, and the new BACM performance standard achieved, within three years of written notification from the City to the APCO that they are no longer maintaining the performance standard for the existing BACM, and are beginning the transition.

All raw data must be shared with the APCO, and all data screening criteria must be approved (or disapproved) in writing by the APCO. The APCO may terminate the transition at any time if modeling or monitoring show that emissions are increasing above any pre-set trigger level described in 5) above, or if the City is not following the APCO-approved protocol. The APCO has full and sole discretion to determine whether these conditions have been met.

If the data show to the APCO's satisfaction that the transition has been accomplished while attaining the NAAQS everywhere at the shoreline, the City may submit an application to the APCO to allow another area to be transitioned. The APCO has full and sole discretion to accept, reject or condition the City's application. The same procedures outlined above will apply.

As many of the existing and potential dust control areas on the Owens Lake bed fall under the jurisdiction of the California State Lands Commission and other responsible agencies, the City must secure the appropriate approvals, leases and permits prior to BACM transitions. However, nothing in this section is intended to give any responsible agency any authority beyond their authority under law.

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GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 3

DISTRICT HEARING BOARD ORDER

GB09-06

EXHIBIT 3

BEFORE THE HEARING BOARD

OF THE

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

VARIANCE REQUEST

Petitioner:
City of Los Angeles
Department of Water & Power
111 North Hope Street, Suite 340
Los Angeles, California 90012-2607

Request Received: August 21, 2009

Facility Location:
Owens Lake Dust Mitigation Project
111 Sulfate Road, Keeler, CA 93530

Docket Number: GB09-06

FINDINGS AND ORDER GRANTING REGULAR VARIANCE FROM REQUIREMENTS SET FORTH IN GOVERNING BOARD ORDER 080128-01

Hearing Date: September 25, 2009

BACKGROUND

The City of Los Angeles Department of Water and Power (Petitioner) submitted a variance petition to the Great Basin Unified Air Pollution Control District (District) Hearing Board on August 21, 2009 pursuant to California Health and Safety Code Section 42350 and District Regulation VI (Rules 600 *et seq.)* Petitioner requested consideration of a variance to temporarily relieve it from the obligation to comply with District Board Order 080128-01, paragraphs 3, 7 and 10 and for one year of regulatory relief from October 1, 2009 deadline set forth in said order to complete 3.5 square miles of alternative experimental dust control measure (DCM) known as "Moat & Row" on the dried bed of Owens Lake, California.

As described in the variance petition, Petitioner contended that delays in securing approvals for their Moat & Row project from State Lands Commission and California Department of Fish and Game will cause the 3.5 square-mile project to be completed one year late, by October 1, 2010. Petitioner contended that the delays were beyond its reasonable control. However in order to offset the excess air pollution emissions caused by the one year delay, Petitioner agreed to two additional dust control projects.

PROCEEDINGS

Pursuant to District Rule 617, upon receipt of the petition, the Air Pollution Control Officer (APCO) transmitted the Petition together with the APCO's recommendation to grant the regular variance to the Hearing Board. The recommendations were set forth in the Staff Report for this matter, which is on file with the Hearing Board.

Pursuant to Government Code 42359.5 and District Rule 16, with notice and hearing, the Hearing Board considered the Petitioner's Regular Variance petition and the District's recommendations on September 25, 2009 in the Town of Mammoth Lakes Council Chambers, 437 Old Mammoth Road, Suite Z, Mammoth Lakes, California 93546, with participation and sworn testimony from Ted Schade, GBUAPCD APCO; Grace McCarley Holder , GBUAPCD Playa Geologist; William VanWagoner, Milad Taghavi, Brian Tillemans and Gene Coufal, City of Los Angeles Department of Water and Power. Tori Jenkins, Clerk of the Board; Julie Conboy Riley and David Hodgekiss, Counsel for the City of Los Angeles Department of Water and Power; George Poppic of the California Air Resources Board, Representing Counsel for the Hearing Board; and Mel Joseph of the Lone Pine Paiute Shoshone Reservation were in attendance. After hearing all testimony and considering all evidence, the Hearing

Board made the Findings and granted the issuance of a Regular Variance subject to certain conditions as set forth below.

FINDINGS

The Hearing Board makes the following findings as required by Sections 42352 and 42353 of the California Health and Safety Code:

1. Petitioner will be in violation of District Board Order 080128-01, Paragraph 3, which requires Petitioner to have any Phase 7 Moat & Row DCM operational by October 1, 2009.
2. Due to conditions beyond the reasonable control of the Petitioner, it has been prevented it from completing the Moat & Row DCM by the October 1, 2009 deadline specified in the Board Order. There is no practical method to achieve compliance with the Board Order sooner than through a time extension to complete the Dust Mitigation Project, Moat & Row. Closing the Los Angeles Aqueduct would not alleviate the PM10 emission problem. Immediate compliance would impose unreasonable burden upon an essential public service.
3. There would be no corresponding benefit to the closing or taking of the Los Angeles Aqueduct. Closing the aqueduct would not be an expeditious means of controlling emissions from the 3.5 square-mile Moat & Row project area. The 3.5 square-mile Moat & Row project area is made up of seven small sub-areas, none of which have existing water-delivery infrastructure. Controlling the emissions from these widely dispersed areas by closing the Aqueduct and redirecting its waters onto the Owens Lake bed via the Owens River would take the full flow of the Aqueduct for 5 to 20 years.
4. Applicant has considered curtailing operations, however, such action would not lead to compliance with the Board Order, nor would it provide any immediate control of the emissions

associated with the 3.5 square-mile Moat and Row area. Closing the aqueduct would cause considerable hardship to the City of Los Angeles.

5. Petitioner has committed to control excess emissions from the Owens Lake bed to the maximum extent feasible during the period the variance is in effect. Petitioner proposes two methods during two periods.

The first period is the six months from October 1, 2009 until April 1, 2010. Petitioner will be continuing construction of the 9.7 square-mile of Phase 7 Shallow Flooding DCMs during this period. The Board Order requires the additional 9.7 square-miles of Shallow Flooding control to be operational by April 1, 2010. Petitioner is committed to providing at least 3.5 square-miles of temporary dust control within the 9.7 square-mile Phase 7 project by area by October 1, 2009. The temporary control will be provided by tilling 3.5 square-miles of clay soils up into very large clods that will increase the surface roughness of the lake bed and temporarily prevent emissions. Based on various studies conducted, Petitioner believes tilling will provide at least six months of sufficient control. As the Petitioner completes the Shallow Flooding construction in the tilled areas, water will cover the tilled surfaces and permanent control will be established. Petitioner is expediting control via tilling method in areas already scheduled for control by April 2010.

The second period for required emission reduction is the six-month period between April 1, 2010 and October 1, 2010. Petitioner is unable to provide direct on-lake bed offsets of the emissions from the 3.5 square-mile of Moat & Row are during this six month period because required DCMs will occupy all lake bed areas (39.5 square miles) for which Petitioner has permits and approvals.

However, the District's air quality monitoring indicates that there are additional areas on the lake bed, beyond the 43 square miles currently ordered (39.5 square-miles with permits and

3.5 square-miles of Moat and Row), that require controls. District and Petitioner staffs have preliminarily identified two square miles that were emissive during the 2007 through 2009 period. However, the 2008 SIP and Board Order prevent the District from ordering controls on much of these areas until possibly well after May 1, 2010.

Petitioner has agreed that, as an offset to the emissions that will occur from the 3.5 square-mile Moat & Row area, it will immediately begin the regulatory approval process required to construct two additional square miles of BACM dust controls on the lake bed and will complete those controls six months earlier than would ordinarily be required by the 2008 SIP. Because Petitioner is starting the process seven months earlier than the earliest it would normally start under an order from the District and it will complete the DCMs six months earlier than provided in the 2008 SIP, necessary dust controls will be in place on the lake bed more than a year earlier than under the normal procedures. The additional two square miles of expedited dust controls offsets the six months of excess emissions from the 3.5 square-mile Moat & Row area.

6. The District has an extensive air and emissions monitoring program at Owens Lake and will continue to operate the program and quantify dust emissions from the lake bed, including areas subject to this variance request. Petitioner provides annual funding through assessments levied by the Governing Board to conduct this monitoring.

7. Petitioner will continue to operate between 29.8 and 39.5 square-miles of DCMs on the lake bed during the one-year variance period. The existing controls have reduced historic PM10 levels about 90 percent and additional reductions are expected by April 1, 2010, when the current 9.7 square-mile Phase 7 Shallow Flooding project areas are completed. The delay in implementing DCMs on 3.5 square-miles of Owens Lake is not expected to result in discharge of "air contaminants or other material which may cause injury, detriment, nuisance or annoyance to any

considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property."

ORDER

1. Now therefore, the Hearing Board orders that the Petitioner, the City of Los Angeles Department of Water and Power, is granted a Regular Variance, subject to the conditions set forth in Paragraphs 3, 4 and 5, below, for a one-year extension of the deadline for the completion of Moat & Row dust control measures on the bed of Owens Lake. The existing deadline of October 1, 2009 is required in Paragraph 3 of District Governing Board Order Number 080128-01, which is contained in the "2008 Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan." The Petitioner is granted regulatory relief from this requirement until October 1, 2010.
2. Further, the Hearing Board finds that, subject to the conditions set forth in Paragraphs 3, 4 and 5, below, that by granting one year of regulatory relief from the existing October 1, 2009 deadline for the completion of the Moat & Row dust controls contained in Paragraph 3 of Board Order 080128-01, the Petitioner does not trigger the provisions in Paragraphs 7 and 10 of said Order, which provide for supplemental control determinations to resume prior to May 1, 2010, due to the non-completion of Moat & Row dust controls.
3. In order to reduce excess emissions to the maximum extent feasible, the Hearing Board conditions the variance to require the Petitioner to:
   a. Temporarily control at least 3.5 square-miles of Owens Lake within the Shallow Flood portion of the current Phase 7 dust control construction project through surface tillage to

increase surface roughness by October 1, 2009. A map showing the locations of the tilled areas and the tilling specifications are attached as Order Exhibit 3.

b. Construct and operate a new dust control project on at least two square-miles of Owens Lake in the areas shown in Order Exhibit 4. This new dust control project shall be known as "Phase 8" of the Owens Lake Dust Mitigation Program. The Phase 8 project shall be implemented by the Petitioner in lieu of any other areas that would be required for control by the District under the supplemental control determination provisions in Paragraphs 7 and 10 of Board Order 080128-01 for the period from July 1, 2006 through April 1. 2010. Thus, other than the determination that the Phase 8 areas require the implementation of DCMs, no supplemental control determination should be issued the Air Pollution Control Officer in 2010. A set of geographic coordinates defining the boundaries of the Phase 8 dust control areas shall be developed by the District and provided to the Petitioner by January 1, 2010. The size and location of the Phase 8 areas may be modified upon mutual agreement of the District Governing Board and the Los Angeles Department of Water and Power Board of Commissioners. The type of dust control measures used in the Phase 8 areas will be selected at the Petitioner's sole discretion from the list of Best Available Control Measures approved by the District as of the date construction begins on the Phase 8 project. The Petitioner shall conduct all required site investigations and environmental impact analyses and secure all required regulatory approvals and permits. The Petitioner shall start the regulatory approval and design processes for the Phase 8 project immediately upon receipt of this variance from the Hearing Board. The Petitioner shall complete construction and begin operation of the Phase 8 dust control measures six months earlier than it would have been required to do so under the provisions of Board Order 080128-01. These modified times are set forth in the attached Order Exhibit 2.

4. The Hearing Board requires, as a condition of the variance, that the Petitioner agree to a stipulated order from the District Governing Board under the provisions of California Health and Safety Code Section 42316 ordering the Phase 8 project as set forth in Paragraph 3.b, above. This order will be issued by the District Governing Board within 90 days of the certification of the environmental impact analysis by the Petitioner but no later than October 1, 2010, whichever date is later.

5. The Hearing Board requires, as a condition of the variance, that the Petitioner meet the increments of progress schedule attached as Order Exhibit 1 and submit quarterly progress reports to the Hearing Board.

Dated the 25th day of September 2009

Brad Mettam
Hearing Board Chairman

Attest:

Tori Jenkins

Tori Jenkins, Board Clerk

Order Exhibit List:

Exhibit 1 –Increments of Progress Schedule
Exhibit 2 – Modified Times for Completion of Phase 8 Dust Controls
Exhibit 3 – Map and Specifications for 3.5 square-mile Temporary Tilling Dust Controls
Exhibit 4 – Map of Phase 8 Dust Control Project

ORDER EXHIBIT 1

INCREMENTS OF PROGRESS SCHEDULE

FOR VARIANCE GB09-06

LOS ANGELES DEPARTMENT OF WATER AND POWER

MOAT & ROW DUST CONTROL MEASURE DEADLINE EXTENSION

By:	Milestone
October 1, 2009	Petitioner shall complete 3.5 square miles of temporary tilling dust control within the Phase 7 dust control area as shown on Order Exhibit 3.
October 1, 2009	Start clock for completion of 2 square-mile Phase 8 dust control project (project times shown in Order Exhibit 2).
October 1, 2009	Petitioner shall begin preparation of required CEQA documentation for the 2 square-mile Phase 8 dust control project.
January 1, 2010	Petitioner shall commence construction of the Moat & Row dust controls.
April 1, 2010	Petitioner shall convert 3.5 square miles of temporary tilling dust controls to 3.5 square miles of Shallow Flooding dust controls.
October 1, 2010	Petitioner shall select and notify the District of the BACM to be used on the 2 square-mile Phase 8 project.
October 1, 2010	District Governing Board shall issue stipulated order under H&S Sec. 42316 requiring the 2 square-mile Phase 8 dust control project (subject to certification of Phase 8 CEQA document by Petitioner).
October 1, 2010	Petitioner shall complete 3.5 square miles of Moat & Row dust controls.
To be determined	Depending on which BACM Petitioner selects, Petitioner shall complete 2 square-mile Phase 8 dust control project (times for completion are set forth in Order Exhibit 2).

DISTRICT EXHIBIT 2

MODIFIED TIMES FOR COMPLETION OF PHASE 8 DUST CONTROLS FOR VARIANCE GB09-06

LOS ANGELES DEPARTMENT OF WATER AND POWER

MOAT & ROW DUST CONTROL MEASURE DEADLINE EXTENSION

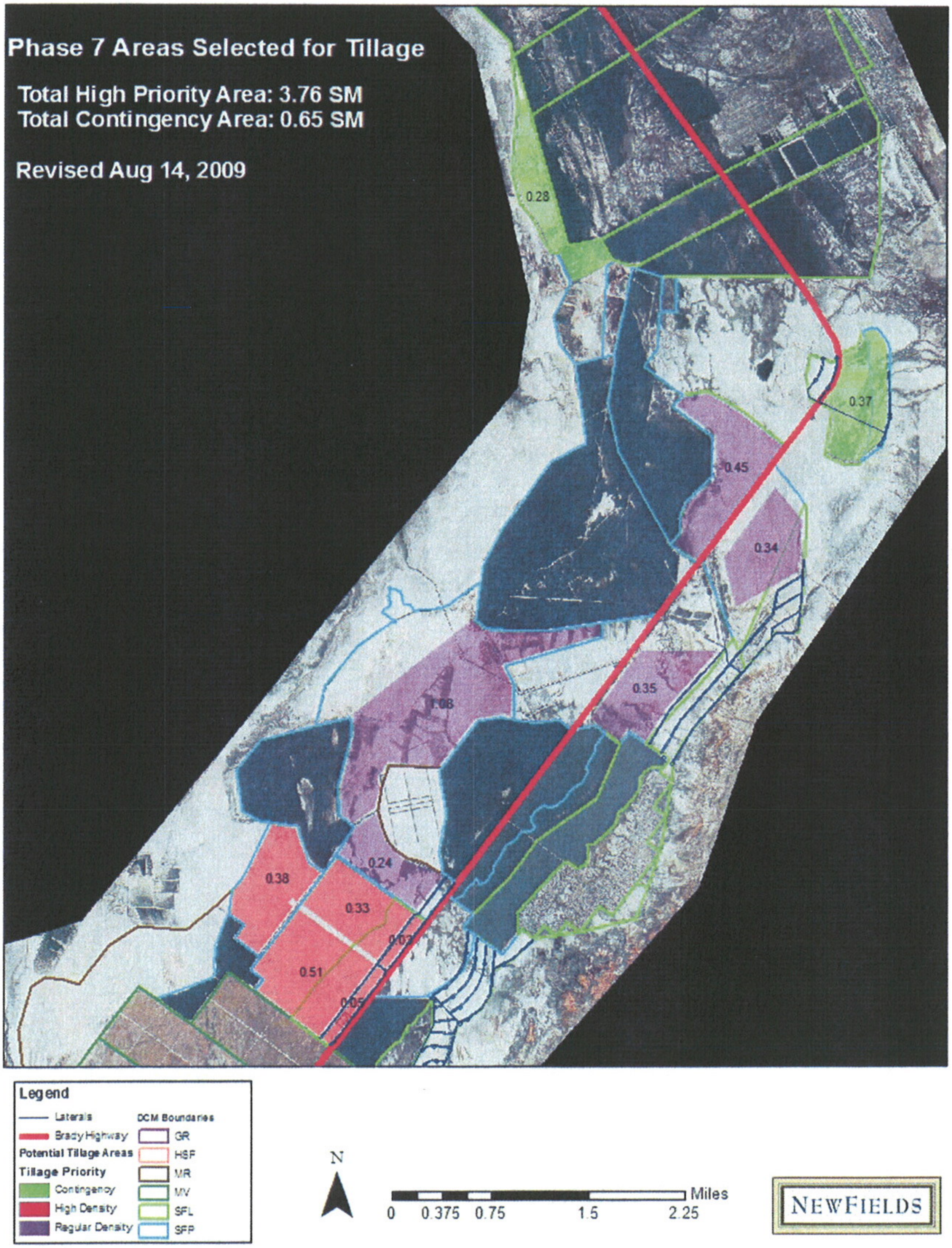
Activity	Duration (years)
New area of Shallow Flooding DCM	2.4*
New area of Managed Vegetation DCM	5.6*
New area of Gravel Cover DCM	1.7*
Other approved BACM	Determined by District**
Additions to above times:***	
Mainline capacity increase	2.1
New aqueduct turnout	1.4
New power feed	1.0
Expanded CEQA triggered	1.4

* The durations shown for the three existing BACMs are 0.5 years shorter than the times provided in Attachment B, Exhibit 3 of District Board Order 080128-01.

** If the District approves any new BACM prior to the start of the Phase 8 project, implementation durations will be included in the new BACM description. The Phase 8 durations will be 0.5 years shorter than non-Phase 8 durations.

*** Multiple additions to the BACM completion durations are not additive.

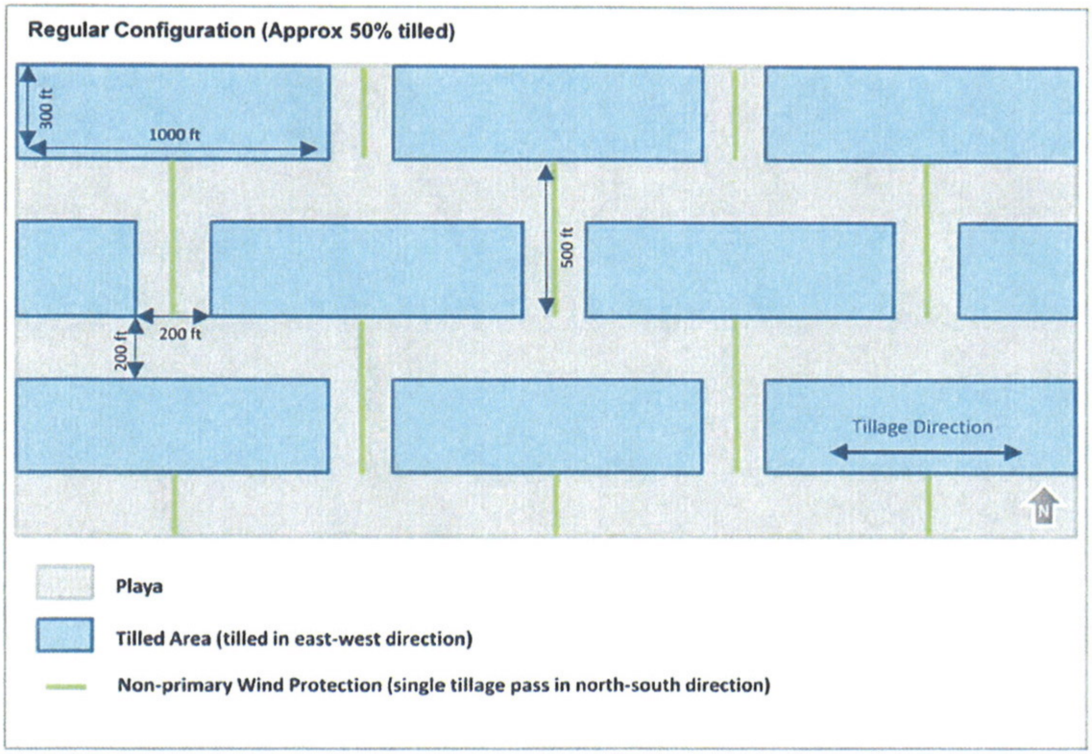
Order Exhibit 3

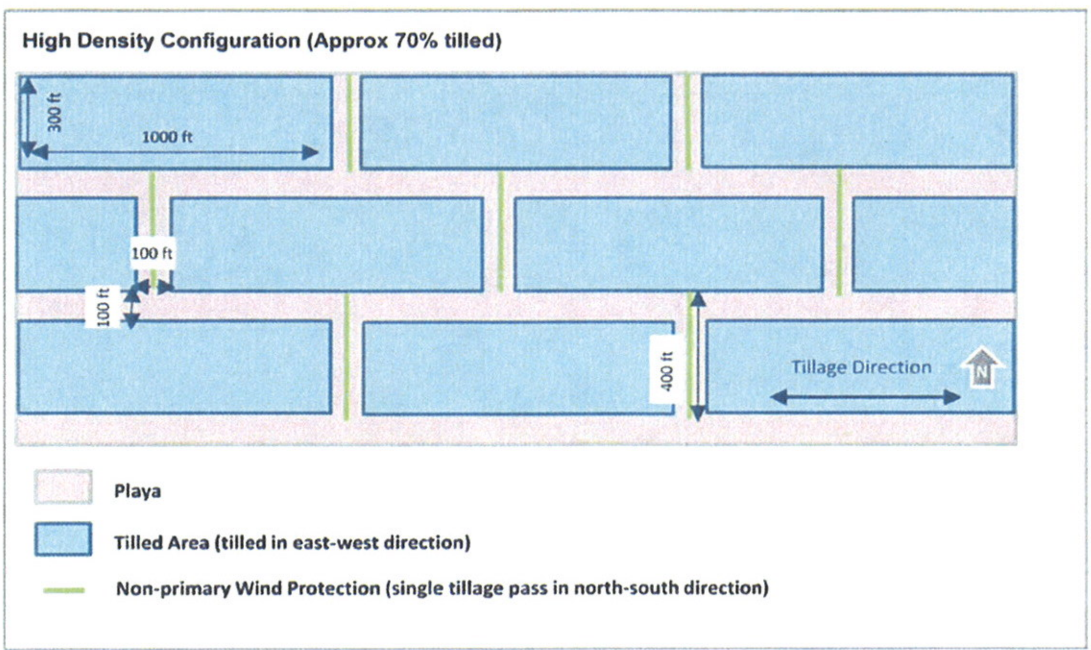


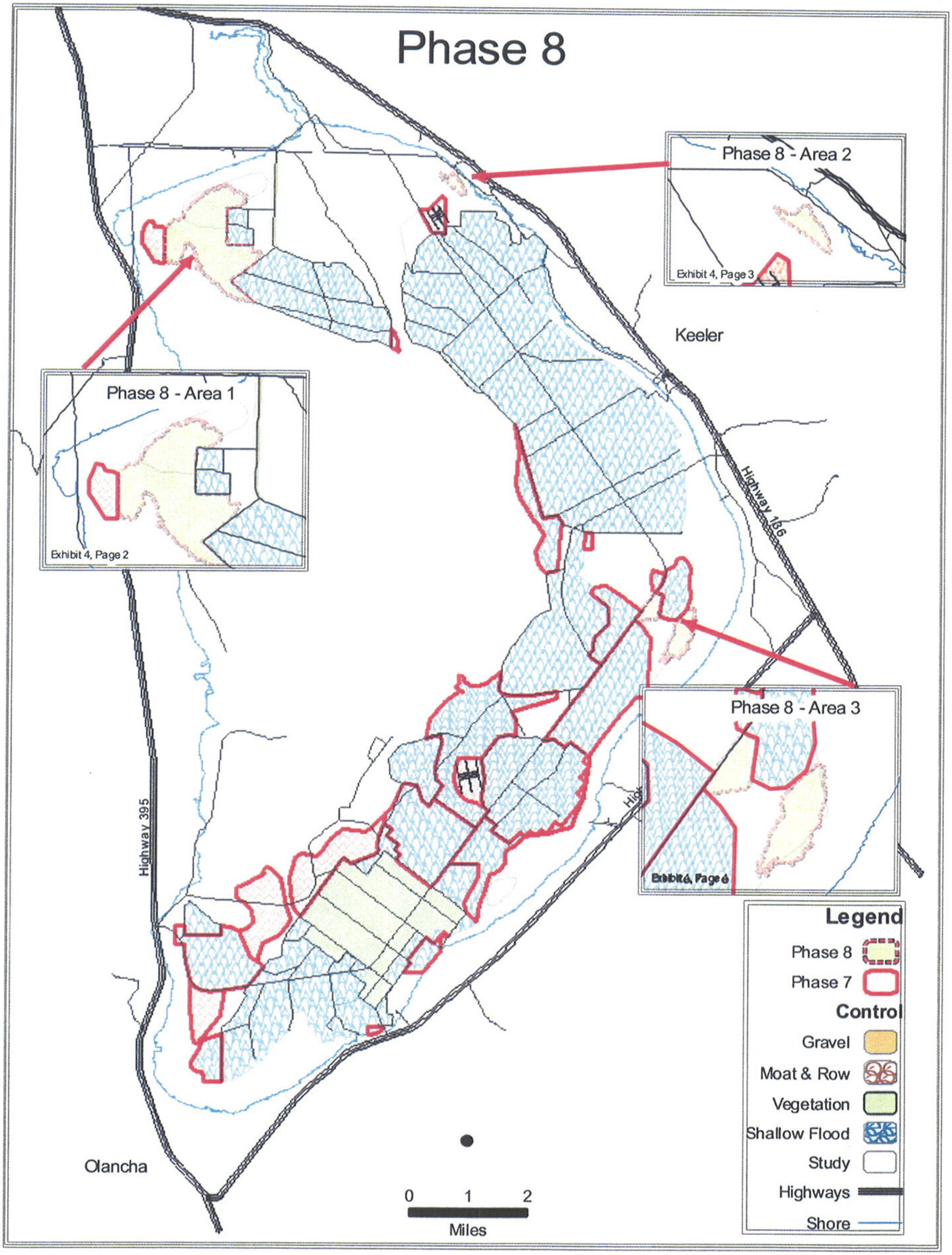
Variance GB09-06 District Exhibit 3 Page 1 of 2

Order Exhibit 3

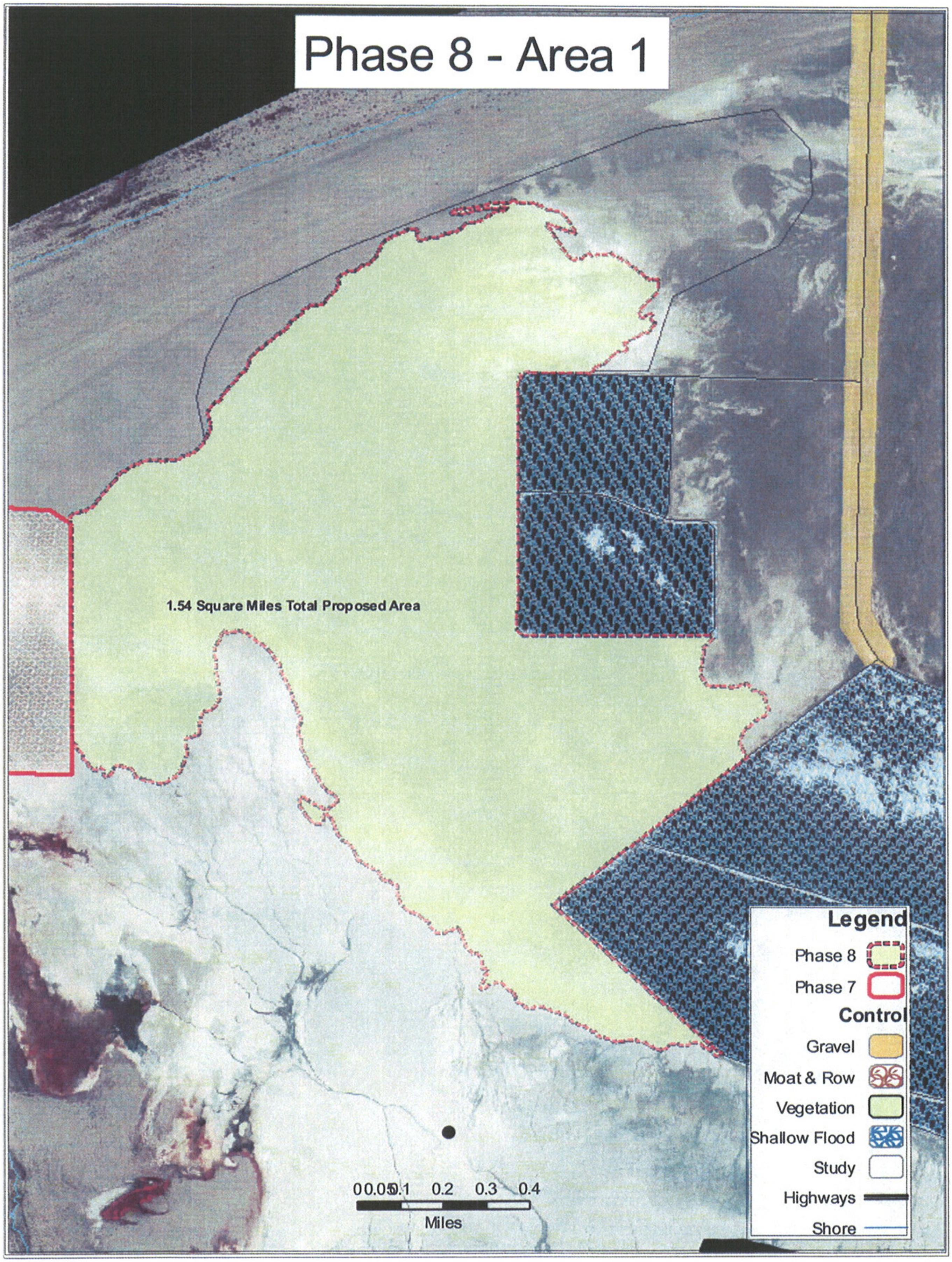
Phase 7 Tillage Configurations

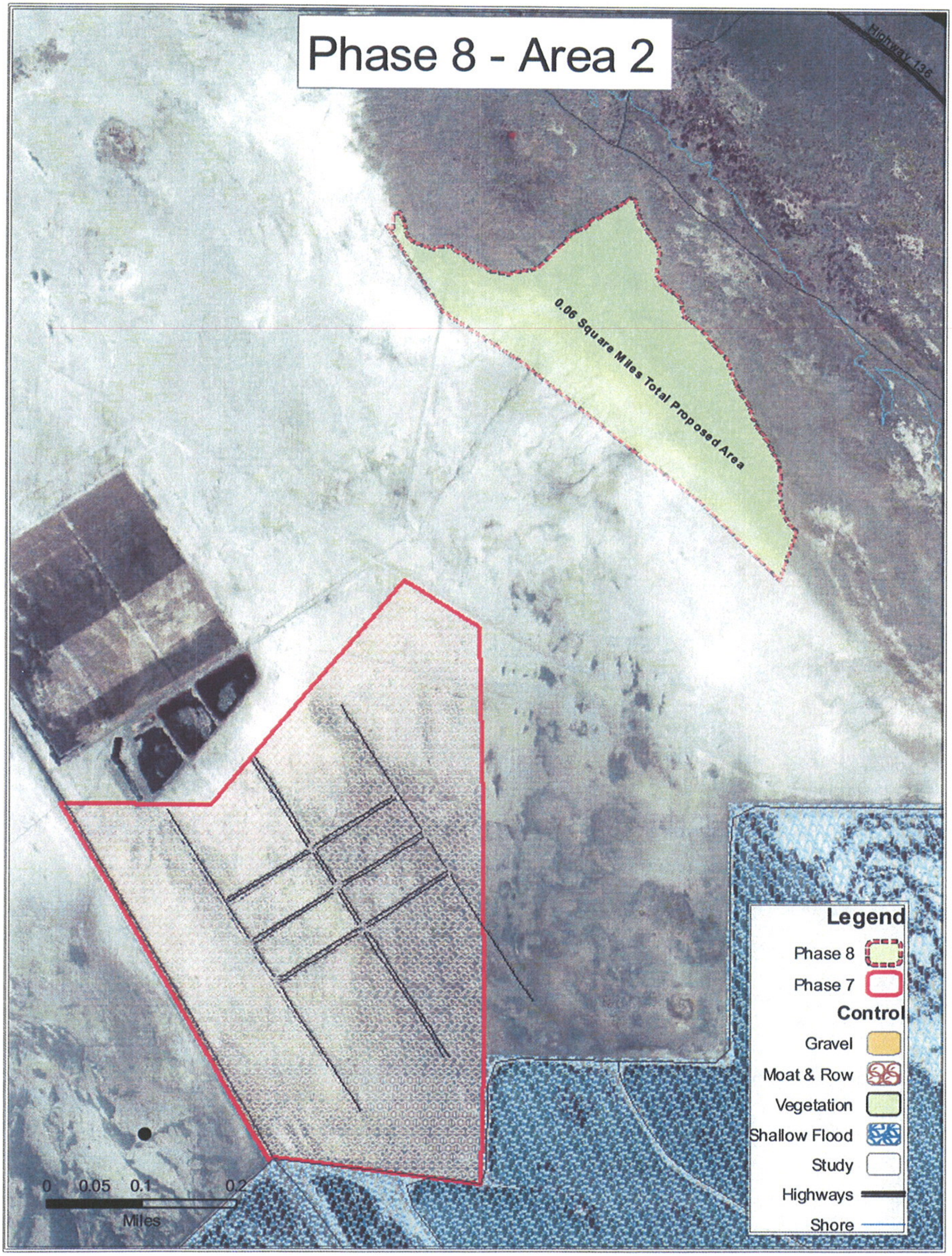




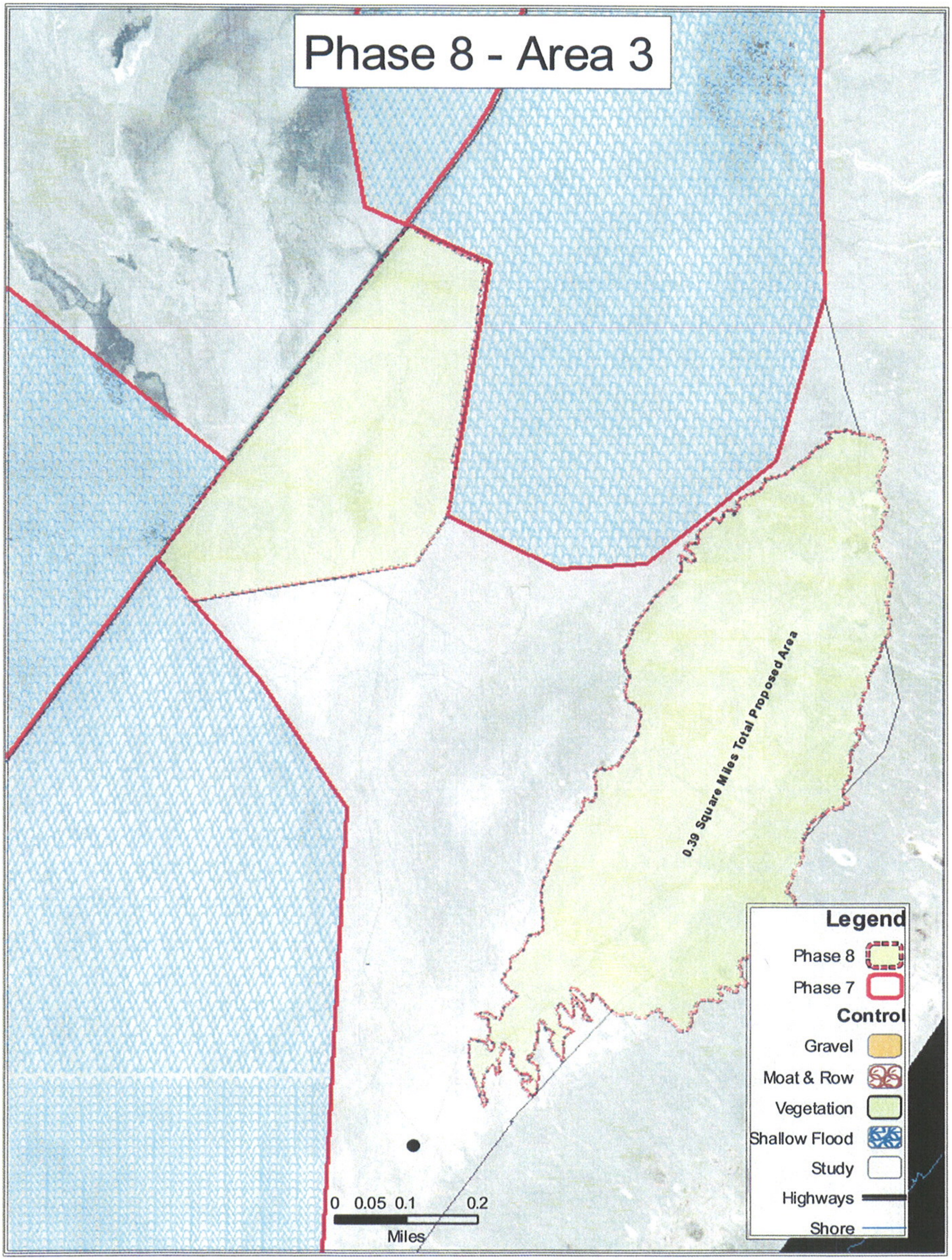

Phase 8
Phase 8 - Area 2
Exhibit 4, Page 3
Keeler
Phase 8 - Area 1
Exhibit 4, Page 2
Highway 136
Phase 8 - Area 3
Exhibit 4, Page 4
Highway 395
Legend
Phase 8
Phase 7
Control
Gravel
Moat & Row
Vegetation
Shallow Flood
Study
Highways
Shore
Olancha
0 1 2
Miles

Order Exhibit 4




Phase 8 - Area 2
Highway 136
0.06 Square Miles Total Proposed Area
Legend
Phase 8
Phase 7
Control
Gravel
Moat & Row
Vegetation
Shallow Flood
Study
Highways
Shore
0 0.05 0.1 0.2
Miles

Order Exhibit 4



GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 4

PHASE 7A AND TRANSITION AREAS – MAP AND COORDINATE DESCRIPTION

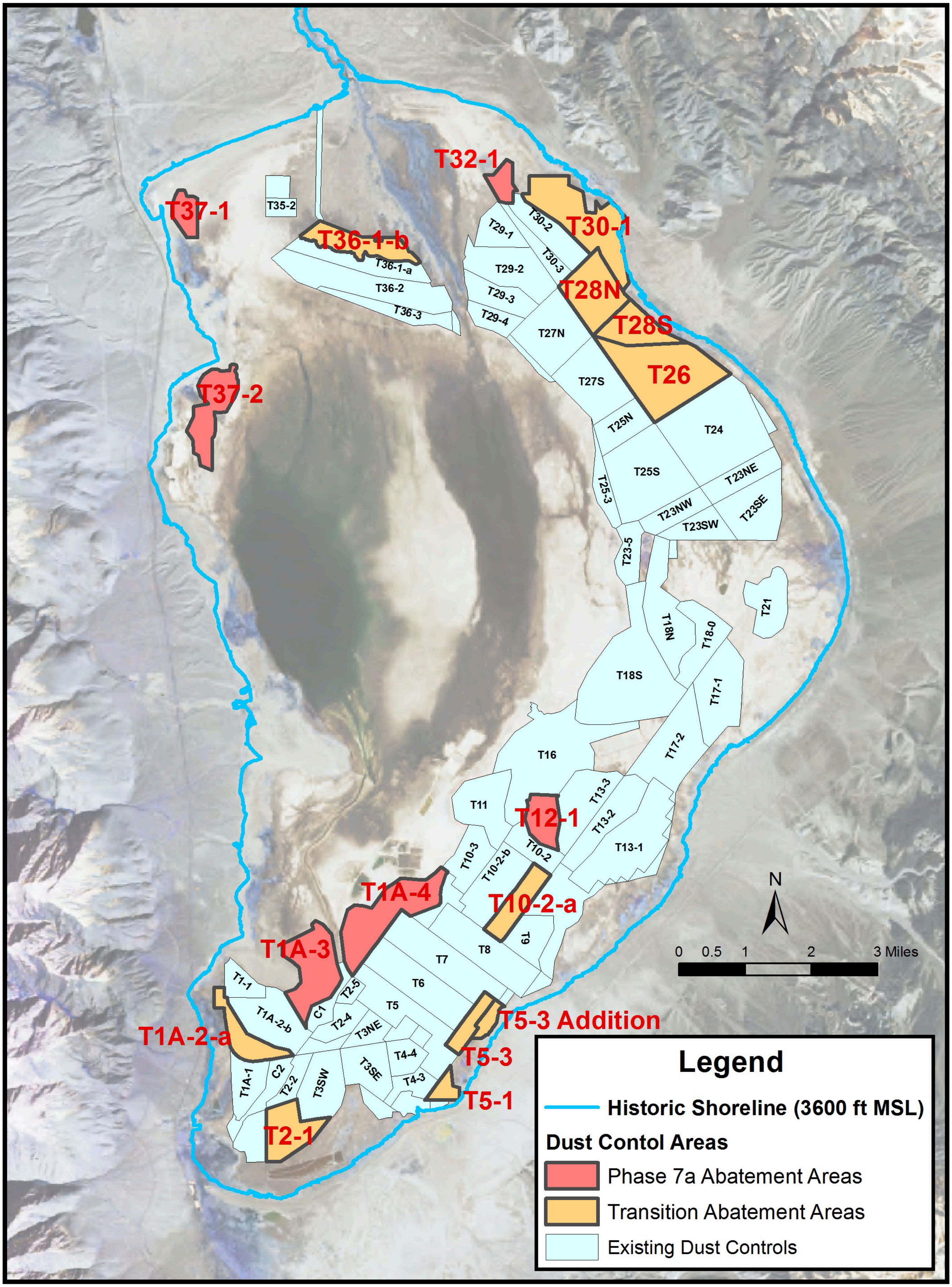

T32-1
T37-1
T35-2
T36-1-b
T36-1-a
T36-2
T36-3
T30-2
T30-1
T30-3
T29-1
T29-2
T29-3
T29-4
T28N
T28S
T27N
T27S
T26
T37-2
T25N
T24
T25S
T23NE
T25-3
T23NW
T23SW
T23SE
T23-5
T21
T18N
T18-0
T18S
T17-1
T16
T17-2
T13-3
T11
T12-1
T13-2
T13-1
T10-3
T10-2-b
T10-2
T1A-4
T10-2-a
T9
T8
T7
T1A-3
T6
T1-1
T2-5
T5
C1
T1A-2-b
T2-4
T3NE
T5-3 Addition
T1A-2-a
T4-4
T5-3
T1A-1
C2
T2-2
T3SW
T3SE
T4-3
T5-1
T2-1
N
0 0.5 1 2 3 Miles
Legend
Historic Shoreline (3600 ft MSL)
Dust Contol Areas
Phase 7a Abatement Areas
Transition Abatement Areas
Existing Dust Controls

Exhibit 4 - Transition Area coordinates

Area / ID	Area (miles²)	Coordinates(UTM Zone 11 meters NAD83) X-coordinates	Y_coordinates
T36-1-b	0.5	413,764.1054	4,040,897.1473
		413,669.6636	4,040,839.8789
		413,582.2166	4,040,888.1255
		413,502.8107	4,040,927.3259
		413,419.3842	4,040,936.3722
		413,341.9886	4,040,931.3465
		413,234.4388	4,040,920.2900
		413,135.9352	4,040,916.2694
		413,027.3803	4,040,929.3362
		412,940.9385	4,040,953.4595
		412,838.4144	4,040,996.6804
		412,764.0342	4,041,034.8757
		412,708.7516	4,041,060.0041
		412,662.5152	4,041,047.9425
		412,598.1864	4,041,042.9168
		412,528.8318	4,041,051.9630
		412,485.6109	4,041,074.0761
		412,453.4465	4,041,140.4152
		412,429.3232	4,041,154.4871
		412,394.1433	4,041,099.2045
		412,374.0406	4,041,062.0144
		412,382.0817	4,041,023.8192
		412,381.0765	4,040,991.6548
		412,349.9173	4,040,944.4133
		412,297.6501	4,040,937.3773
		412,255.4343	4,040,955.4698
		412,234.3264	4,040,987.6342
		412,213.2185	4,041,022.8140
		412,177.0335	4,041,044.9271
		412,166.9821	4,041,080.1069
		412,152.9102	4,041,111.2662
		412,125.7715	4,041,111.2662
		412,099.6379	4,041,117.2970
		412,083.5557	4,041,160.5180
		412,061.4426	4,041,145.4409
		412,038.3244	4,041,133.3792
		412,003.1446	4,041,136.3946
		411,963.9442	4,041,145.4409
		411,895.5948	4,041,147.4512
		411,845.3379	4,041,153.4820
		411,796.0862	4,041,157.5025
		411,747.8395	4,041,157.5025
		411,713.6648	4,041,170.5693
		411,693.5621	4,041,179.6156
		411,666.4234	4,041,191.6772
		411,639.2846	4,041,198.7132
		411,626.2178	4,041,216.8057
		411,597.0688	4,041,249.9752
		411,569.9301	4,041,253.9958
		411,529.7246	4,041,270.0780
		411,512.6372	4,041,282.1397
		411,492.5345	4,041,271.0831
		411,487.5088	4,041,289.1756
		411,464.3906	4,041,298.2219
		411,453.3341	4,041,291.1859
		411,422.1748	4,041,290.1808
		411,403.0772	4,041,309.2784
		411,394.0309	4,041,298.2219
		411,375.9384	4,041,288.1705
		411,343.7740	4,041,261.0318
		411,308.5942	4,041,273.0934
		411,269.3938	4,041,309.2784
		411,237.2294	4,041,342.4480
		411,228.1831	4,041,369.5867
		411,229.1883	4,041,404.7665
		411,217.1266	4,041,423.8641
		411,187.9776	4,041,424.8693
		411,167.8749	4,041,436.9309
		411,147.7721	4,041,429.8950
		411,134.7053	4,041,409.7922
		411,085.4535	4,041,420.8487
		411,068.3662	4,041,421.8539
		411,050.2737	4,041,439.9463
		411,028.1607	4,041,444.9720
		410,992.9808	4,041,446.9823
		410,963.8318	4,041,474.1210
		410,934.6828	4,041,478.1416
		410,902.5184	4,041,478.1416
T36-1-b *continued*	0.5	410,863.3180	4,041,486.1827
		410,840.9723	4,041,536.7786
		411,307.5628	4,041,894.7186
		411,328.7980	4,041,911.0091
		411,404.1637	4,041,882.1942
		412,344.1688	4,041,513.1631
		412,682.1021	4,041,508.1389
		412,652.1923	4,041,436.0645
		412,690.1314	4,041,406.0416
		412,833.6710	4,041,412.9149
		412,841.4082	4,041,505.7657
		413,191.4978	4,041,500.2871
		413,241.1227	4,041,488.5169
		413,443.2128	4,041,269.5238
		413,478.6456	4,041,158.2255
		413,561.2523	4,041,141.5984
		413,723.0869	4,040,965.9151
		413,764.1054	4,040,897.1473
T30-1	1.08	418,687.1386	4,040,203.3590
		418,155.9146	4,041,076.4185
		418,093.9730	4,041,254.0466
		417,921.3802	4,041,084.8832
		417,171.9137	4,041,828.3044
		416,322.8671	4,042,382.8026
		416,237.8729	4,042,517.5607
		416,238.8166	4,042,563.7458
		416,413.8960	4,042,560.2618
		416,415.9268	4,043,001.9282
		417,384.3152	4,042,993.4517
		417,370.6762	4,042,778.5344
		417,719.8507	4,042,619.4658
		417,792.5767	4,042,117.6796
		418,026.3192	4,042,090.2555
		418,032.4649	4,042,385.2584
		418,154.9595	4,042,206.3723
		418,410.5623	4,042,382.5975
		418,608.9968	4,042,170.9490
		418,642.6771	4,042,098.0531
		418,743.9293	4,042,022.1567
		418,637.1570	4,041,594.2678
		418,746.9274	4,040,943.5424
		418,839.1598	4,040,396.7884
		418,687.1386	4,040,203.3590
T28N	0.71	418,155.9146	4,041,076.4185
		418,687.1386	4,040,203.3590
		418,733.7251	4,040,126.7522
		418,872.7825	4,039,997.9387
		417,959.0480	4,039,116.3619
		417,255.4209	4,040,111.6752
		417,121.6189	4,040,304.5343
		417,473.8189	4,040,647.9564
		417,921.3802	4,041,084.8832
		418,093.9730	4,041,254.0466
		418,155.9146	4,041,076.4185
T28S	0.47	420,260.2740	4,038,939.6141
		418,789.3715	4,038,860.6801
		417,959.0480	4,039,116.3619
		418,872.7825	4,039,997.9387
		419,760.8752	4,039,175.2704
		420,260.2740	4,038,939.6141
T26	1.33	420,260.2740	4,038,939.6141
		420,448.8516	4,038,850.6281
		421,317.9300	4,038,183.2674
		419,459.5560	4,036,993.8362
		419,017.0594	4,037,619.7626
		417,959.0480	4,039,116.3619
		418,789.3715	4,038,860.6801
		420,260.2740	4,038,939.6141
T10-2-a	0.4	415,311.0176	4,024,665.3822
		415,423.1292	4,024,804.7239
		415,609.6721	4,025,037.9025
		415,772.8972	4,025,265.8994
		415,933.5314	4,025,483.5329

Exhibit 4 - Transition Area coordinates

Area / ID	Area (miles²)	Coordinates(UTM Zone 11 meters NAD83) X-coordinates	Y_coordinates
T10-2-a	0.4	416,086.3929	4,025,659.7123
continued		416,226.3001	4,025,838.4826
		416,368.7982	4,026,053.5251
		416,524.5004	4,026,281.6892
		416,940.2572	4,025,981.7598
		416,222.2418	4,025,004.5422
		415,795.7936	4,024,428.4142
		415,752.1670	4,024,382.2273
		415,721.8772	4,024,363.7439
		415,402.7156	4,024,597.6328
		415,311.0176	4,024,665.3822
T5-3	0.22	415,580.7123	4,022,964.7690
		415,520.5385	4,022,883.3346
		415,380.8866	4,022,694.3156
		415,192.7623	4,022,439.6891
		415,127.4250	4,022,351.2549
		415,106.6479	4,022,323.0048
		415,148.1754	4,022,285.3898
		415,178.1077	4,022,263.0525
		415,146.6854	4,022,220.5223
		414,989.6965	4,022,007.9919
		414,750.3341	4,021,684.0582
		414,700.1075	4,021,616.0524
		414,376.5555	4,021,855.0570
		414,426.4783	4,021,922.6108
		414,615.6262	4,022,178.5720
		414,854.5912	4,022,502.0156
		415,093.6715	4,022,825.5607
		415,332.6768	4,023,149.0322
		415,453.5288	4,023,059.7725
		415,580.7123	4,022,964.7690
T5-3 Addition	0.12	415,815.3044	4,022,792.4623
		415,748.1977	4,022,764.6488
		415,699.5372	4,022,723.3612
		415,670.0461	4,022,679.1244
		415,672.9952	4,022,639.3114
		415,650.8768	4,022,577.3799
		415,643.2259	4,022,531.0919
		415,621.3856	4,022,398.9584
		415,574.1998	4,022,322.2813
		415,529.9630	4,022,266.2481
		415,496.0482	4,022,202.8421
		415,434.1167	4,022,145.3343
		415,404.6256	4,022,093.7248
		415,361.8634	4,022,096.6739
		415,302.8811	4,022,046.5389
		415,242.8901	4,022,005.1797
		414,989.6965	4,022,007.9919
		415,146.6854	4,022,220.5223
		415,178.1077	4,022,263.0525
		415,148.1754	4,022,285.3898
		415,106.6479	4,022,323.0048
		415,127.4250	4,022,351.2549
		415,192.7623	4,022,439.6891
		415,380.8866	4,022,694.3156
		415,520.5385	4,022,883.3346
		415,580.7123	4,022,964.7690
		415,622.4090	4,022,934.9994
		415,656.1628	4,022,910.0892
		415,704.1714	4,022,874.5914
		415,815.3044	4,022,792.4623
T5-1	0.14	414,429.2165	4,020,500.8382
		414,232.1268	4,020,501.5982
		414,001.4695	4,020,502.4758
		413,877.7052	4,020,502.9468
		413,893.6355	4,020,524.5934
		413,982.9758	4,020,645.4436
		414,160.6092	4,020,885.8261
		414,222.0726	4,020,969.0150
		414,461.0480	4,021,292.4897

Area / ID	Area (miles²)	Coordinates(UTM Zone 11 meters NAD83) X-coordinates	Y_coordinates
T5-1	0.14	414,505.9987	4,021,353.3100
continued		414,557.3614	4,020,853.0235
		414,632.3454	4,020,832.6501
		414,717.5371	4,020,809.5032
		414,704.8599	4,020,499.7994
		414,429.2165	4,020,500.8382
T2-1	0.52	410,856.3054	4,019,986.9089
		411,246.3282	4,020,045.5553
		411,579.3994	4,020,095.6486
		411,149.7636	4,019,542.1549
		410,360.7181	4,019,008.5005
		410,025.1591	4,019,002.0354
		410,021.5195	4,020,289.5251
		410,764.8535	4,020,543.1808
		410,856.3054	4,019,986.9089
T1A-2-a	0.38	409,073.6678	4,023,000.0598
		409,093.8737	4,022,865.3802
		409,543.4247	4,022,121.7619
		410,232.9617	4,021,797.2739
		410,570.9701	4,021,719.5320
		410,673.5282	4,021,587.2606
		410,350.3675	4,021,535.4504
		410,110.0532	4,021,493.3823
		410,079.1896	4,021,494.7189
		409,975.4401	4,021,479.1354
		409,886.0723	4,021,465.7122
		409,835.6679	4,021,458.1413
		409,774.5213	4,021,449.4157
		409,734.0450	4,021,446.0422
		409,702.2970	4,021,445.4495
		409,667.1756	4,021,446.5232
		409,628.6050	4,021,450.2633
		409,587.0138	4,021,456.9762
		409,541.7453	4,021,467.7021
		409,509.3814	4,021,477.5621
		409,469.1538	4,021,492.9143
		409,430.4700	4,021,510.7705
		409,394.2697	4,021,530.5798
		409,359.8403	4,021,552.6623
		409,323.3516	4,021,579.8075
		409,294.6311	4,021,604.2271
		409,273.6568	4,021,624.1573
		409,252.5708	4,021,646.4477
		409,225.4173	4,021,678.7661
		409,209.7590	4,021,699.6128
		409,194.6701	4,021,721.5470
		409,179.6823	4,021,745.9744
		409,163.9608	4,021,774.2356
		409,149.2804	4,021,803.3442
		409,108.8160	4,021,989.7821
		409,094.0513	4,022,070.0886
		409,085.6763	4,022,117.5963
		409,078.4606	4,022,146.7713
		409,062.7226	4,022,238.2376
		409,046.0396	4,022,310.3637
		409,031.2722	4,022,390.1936
		409,011.1297	4,022,508.5332
		409,005.5373	4,022,622.1243
		409,000.7984	4,022,749.8012
		408,748.7645	4,022,752.2163
		408,748.6344	4,022,994.9303
		408,752.0708	4,023,250.6832
		409,002.0721	4,023,249.9209
		408,999.6293	4,023,000.2258
		409,073.6678	4,023,000.0598

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 5

PHASE 7A AND TRANSITION AREAS PROJECT DESCRIPTION

OWENS LAKE PHASE 7A AND TRANSITION AREAS DUST CONTROL MEASURES

PROJECT DESCRIPTION

February 2011

The Phase 7a Project consists of a total of 3.1 square miles of new dust control measures (DCMs) and 3 square miles of transitioned dust controls for a total area of 6.1 square miles. The 3.1 square miles of new DCMs consist of 6 separate subareas. Within five of these subareas totaling 2.77 square miles, the Los Angeles Department of Water and Power (LADWP) will implement current Best Available Control Measures (BACM) including Gravel Cover, Shallow Flooding, and Managed Vegetation. The remaining sixth area with an area of 0.33 square miles is currently planned for a tillage BACM test. (**Figure 1**). The Phase 7a project components are:

- Shallow Flooding in T1A-4 and a portion of T37-2
- Managed Vegetation in T32-1 and a portion of T37-2
- Gravel Cover in T37-1 and T1A-3
- A Tillage BACM test in T12-1

Water demand related to implementation of BACM on the new Phase 7a dust control areas (DCAs) will be balanced with water conservation measures at existing DCAs, including:

- Conversion of approximately 3 square miles of existing Shallow Flooding to a hybrid of BACM including Managed Vegetation, Gravel Cover and Shallow Flooding (Transition Areas). The 3 square miles of Transition Areas will be selected from the following 6 square miles of existing Shallow Flooding areas: T1A-2_a, T10-2_a, T2-1, T5-1, T5-3, T5-3 Addition_a, T5-3 Addition_b, T26, T28N, T28S, T30-1_a, T30-1_b, and T36-1_b

- Optional Additional Component - Conversion of existing Shallow Flooding areas T35-1 and T35-2 to Gravel Cover, potentially including installation of a water supply pipeline (and access roadway) to the western and northern perimeter of T37-1 to enhance vegetation growth

1.1 SHALLOW FLOODING

1.1.1 Shallow Flooding Description

This dust control measure (DCM) consists of releasing water into a bermed DCA and allowing it to spread, wet the surface, and thereby suppress windborne dust. In order to meet the requirements for dust control in the 2008 SIP for Shallow Flooding, at least 75% of the surface must be wet or have saturated soil. There are two general methods of Shallow Flooding: 1) Ponding and 2) Lateral Shallow Flooding. The Shallow Flooding planned in the Phase 7a project consists of Lateral Shallow Flooding. The performance requirements for Shallow Flood BACM are set forth in detail in the 2008 SIP. Nothing in this document is intended to supersede SIP requirements.

Lateral Shallow Flooding is proposed for subarea T1A-4 and a portion of subarea T37-2 (the portion where vegetation cannot be established). Located in the southern portion of the dry lake adjacent to the existing Managed Vegetation areas (T5 through T8), Subarea T1A-4 occupies approximately 0.97 square miles. Area T37-2 is located on the western edge of the lake, west of the brine pool and occupies approximately 0.59 square miles. It is estimated that the Shallow Flood portion of T37-2 will comprise approximately two-thirds of T37-2.

A lateral Shallow Flooding network for T1A-4 will include two 18- to 24-inch diameter buried pipelines (mainlines) that will supply water to the lateral submains (4- to 12-inch diameter buried pipelines), which will be spaced up to 1,400 feet apart. The network includes a modified whipline array (diameter to be determined by available equipment and cost), spaced up to 120 feet apart and with a length of up to 700 feet. The whipline array includes sprinkler heads spaced up to 70 feet apart or bubblers. Laterals up to 4,000 feet in length will have risers with drains at the end. Lateral valves will be placed at each intersection with the mainline. Flush lines will be incorporated for sprinkler drainage and to reduce plugging. A small pump station (capacity determined by infrastructure installed) will be located at the lowest point to drain the system. Drain water will most likely be recycled within T1A-4. A second supply alternative to TA1-4 will also be evaluated during project design that consists of a single 24-inch mainline connected to the zonal mainline near the T1A-1 turnout.

The components of the lateral Shallow Flooding network for T37-2 are similar to the Shallow Flooding design for T1A-4, with the exception of spacing. The lateral submains will be spaced up to 1,000 feet apart. The whiplines in T37-2 will be up to 500 feet long and spacing will be up to 60 feet. Approximately the western third of this area will be designed, constructed, and operated as Managed Vegetation.

Turnout Facilities. Water to the lateral Shallow Flooding will be distributed to the lake bed DCAs via area turnouts. Turnouts consist of above grade piping, pressure reducing valves (PRV), control valves (CV), magnetic flow meters (or flow elements, FE), isolation valves, combination air-vacuum release valves (CARV), pressure indicating transmitters (PIT), filtering system control valve filters, electric equipment, and monitoring and automatic control instrumentation. The turnouts are typically constructed on raised earthen pads adjacent to the DCAs. The turnouts include mechanical equipment and electrical equipment on concrete pads; **Figure 2** is an existing turnout located on the lakebed. It is anticipated that four turnouts will be constructed under the Phase 7a project.

The turnouts will be connected to the zonal mainline that is a continuous loop connecting to the Los Angeles Aqueduct at the north and south ends of the Owens Lake Dust Mitigation Program (OLDMP) area. T1A-4 and T32-1 will require new connections to the zonal mainline. T37-1 will be connected to an existing submain near the end of Corridor 1 Road. The Corridor 1 Road submain is connected to the zonal mainline.

Water enters a Shallow Flood area through PRVs, located at the turnouts. The turnouts distribute freshwater to the DCAs via area Shallow Flood submains. The PRVs at the turnouts function to lower the zonal mainline pressure to the submain operating pressure for the shallow pond submains. The PRVs at the laterals function to control and further lower the Shallow Flood submain pressure to the lateral operating maximum pressure.

Figure 2
Existing Turnout on Owens Dry Lake

Source: LADWP, November 2010 (T1A-2)

The PRVs at the turnouts are hydraulically controlled valves. These valves operate by using pilot water (supplied by the freshwater from the submains) to control the valves. The freshwater from the submains contain large quantities of sediments which will clog up the PRVs. To prevent the PRVs from clogging, the pilot water is diverted through a separate pilot water filtration system. Tailwater and Drainwater pump stations collect and recirculate flow within a given DCA and submain to optimize use of water within the irrigated zone and minimize loss of water offsite.

New Supply Pipeline. A new supply pipeline will be required to deliver water from T36-2 to T37-2. An up to 30-inch high density polyethylene (HDPE) pipeline will be installed underneath a new roadway to be built between these two DCAs. The approximately 1.7 mile roadway is required to enable year-round accessibility for maintenance of the up to 30-inch HEPE pipeline and the T37-2 irrigation system (**Figure 1**). The roadbed will be raised approximately 3 feet, with culverts installed to prevent stormwater from being impounded. Additionally, a vehicle bridge (approximately 16 feet wide, 1 to 2 feet high prefabricated or possibly portable bridge) may be installed between the northern and southern portions of T37-2 for maintenance access.

1.1.2 Shallow Flooding Construction

Construction of Shallow Flood DCAs for Phase 7a is estimated to occur over 14 months at T1A-4 and at T37-2 with the heaviest levels of construction activity occurring during the dry season. Anticipated sequential activities are:

- Installation of new turnouts
- Land leveling
- Installation of berms
- Pipe and electrical cable excavation
- Placement of irrigation pipes and sprinklers

To the maximum extent feasible, earthwork in each area will be balanced onsite. As suitable, onsite material will be used to build berms and turnout earthen pads. In some cases, suitable material may be disked and spread to reduce moisture content before placement. Sand bedding, base course, and riprap will be imported to the DCAs. It is anticipated that this material will be obtained from a local gravel production operations such as the LADWP Shale borrow pit and the Federal White Aggregate (F.W. Aggregate) Dolomite mine.

Land leveling will be performed based on existing topography and final design to achieve required 75% surface cover of water and consideration of excavation of suitable material for berm and turnout pad construction. It is anticipated that berm heights will vary from 3 to 5 feet and the turnout earthen pads may range up to 5 to 8 feet in height to protect facilities from localized flooding. Over excavation will be done underneath proposed earthen berm alignments to remove any unsuitable material. Geotextile fabric will then be placed directly on the existing surface to create a firm base. The earthen berm will be constructed over the geotextile fabric. Earthen berm side slopes facing water will be armored with riprap. Earthen berm slopes not directly in contact with water and travel surfaces will be covered with road base.

1.2 MANAGED VEGETATION

1.2.1 Managed Vegetation Description

Vegetation on the playa reduces sand motion and soil erosion. Aboveground cover acts as a wind break, lowering the velocity at the playa surface. Under Phase 7a, Managed Vegetation is proposed for the 0.16-square-mile area in T32-1, which is located in the northeast portion of the dry lake, and for a portion of the western half of T37-2; the specific acreage of Managed Vegetation will be determined based on soil conditions at the time of construction.

Currently, only saltgrass (*Distichilis spicata*) is approved as a vegetation dust control measure on Owens Lake; existing Managed Vegetation areas T5 through T8, located in the southeastern portion of the dry lake, are planted with saltgrass. A revised plant species list for Owens Lake BACM was recently developed and has been approved by the Great Basin Unified Air Pollution Control District (District), but awaits approval by the California State Lands Commission. The plant species on this list meet the locally-adapted native criterion specified by the 2008 State Implementation Plan (SIP) adopted by the District. In addition to saltgrass, 39 species have been proposed to increase the habitat diversity of the Managed Vegetation areas, reduce fertilizer need, and increase the diversity and amount of seed produced on the playa for use in future projects (**Table 1**). The final species mix in T32-1 and T37-2 will depend on the availability of planting material, and suitability of species to soil and hydrologic conditions. The T32-1 area is relatively well drained and will probably be reclaimed (i.e., decline in salinity) fairly rapidly. T37-2 is less well drained and may require additional time for reclamation. The initial cover may be achieved by fast-growing species, but after some time, the stand will probably change and diversify, partly from planted material, and partly from volunteer plants establishing from windblown seed.

An existing supply of 600 pounds of saltgrass seed is stored by S&S Seeds (in Carpinteria, California), and is available for use. Although seed of most species other than saltgrass will need to be collected, some additional seed may be available commercially. If the full complement of desired species is not available initially, the area may be over-seeded or interplanted with additional species in the future.

Seed supply for T32-1, T37-2 and the Transition Areas will be collected by hand, and by targeted mowing of existing vegetated DCAs. Seed of some herbaceous species may be multiplied by planting in managed areas and then harvesting. Once collected and cleaned, seed will be tested for germination, dried, and stored. Before planting, some seed may require special treatment to break dormancy. While seeding is preferred, some species may also be transplanted to accelerate establishment of vegetative cover. The finished landscape will consist of a variety of plants native to the Owens Valley area.

The goal for these areas will be to establish a compliant vegetative cover (per cover requirements in the SIP) as quickly as possible. Vegetative cover is assessed each fall, and compliance is determined by comparing cover levels with criteria contained in the BACM definition. The criteria contained in the 2008 SIP are currently in effect, but a modification providing for the compliance methodology on existing Managed Vegetation area to be applied to new managed Vegetation areas is pending before the District's Board, having already gained a staff recommendation for approval. These new criteria accommodate levels of soil and drainage variability that occur on the playa, while maintaining needed levels of dust control. They are likely to be the basis for evaluating new Managed Vegetation on Owens Lake. The criteria have been applied to the existing

Managed Vegetation site during the 2009 and 2010 seasons under a Managed Vegetation Operations and Management Plan with good agronomic and dust control results.

With fall seeding, a fast-growing early-cover species mix, and potentially some spring transplants, compliance in these areas may be achieved during the first growing season. In the event that this does not occur, areas with the most limited growth would be assessed for drainage limitations. Drainage would be improved by constructing surface, French, or subsurface drains, and the area might be replanted. The site would continue to be managed to comply and/or control dust as swiftly as possible.

Table 1
Species Proposed for Managed Vegetation DCAs

Scientific Name	**Common Name**
Alkali Marsh Species	
Amphiscirpus nevadensis	Nevada bulrush
Anemopsis californica	Yerba mansa
Schoenoplectus maritimus	Saltmarsh bulrush
Cordylanthus maritimus	Bird’s beak
Distichlis spicata	Saltgrass
Eleocharis parishii	Spikerush
Frankenia salina	Alkali heath
Helianthus annuus	Sunflower
Heliotropium curassavicum	Heliotrope
Juncus arcticus var. balticus	Wire rush
Juncus arcticus var. mexicanus	Mexican rush
Nitrophila occidentalis	Alkali pink
Poa secunda	Blue grass
Schoenoplectus americanus	Bulrush
Sporobolus airoides	Alkali sacaton
Sesuvium verrucosum	Verrucose seapurslane
Playa Scrub Species	
Atriplex confertifolia	Shadscale
Atriplex lentiformis ssp. torreyi	Torrey's saltbush
Atriplex parryi	Parry's saltbush
Atriplex phyllostegia	Leafcover saltweed
Cleome sparsifolia	Fewleaf bee plant
Cleome lutea	Yellow bee plant
Cressa truxillensis	Alkali weed
Kochia californica	Mojave red sage
Poa secunda	Blue grass
Sarcobatus vermiculatus	Greasewood
Suaeda moquinii	Bush seepweed
Chrysothamnus nauseosus	Rubber rabbitbrush
Machaeranthera carnosa	Shrubby alkaliaster

Marsh and Riparian Species	
Paspalum distichum	Knotgrass
Populus fremontii	Fremont cottonwood
Salix lasiolepis	Arroyo willow
Schoenoplectus californicus	Bulrush
Typha domingensis	Southern cattail
Typha latifolia	Broad-leaved cattail
Cyperus laevigatus	Smooth flatsedge
Juncus torreyi	Torrey's rush
Triglochin concinna	Slender arrowgrass
Muhlenbergia asperifolia	Scratchgrass
Phragmites australis	Common reed

1.2.2 Managed Vegetation Construction

During installation and establishment, several steps will be required to create an environment where plants can thrive on the otherwise dry and hypersaline playa:

- Irrigation systems will be installed and may include sprinklers, bubblers or drip irrigation. For areas with sprinklers or bubblers, irrigation piping will be buried to avoid damage from traffic, animals, temperature fluctuations, and UV radiation. Sprinkler heads or bubblers in these areas will rise from the buried laterals to allow water to be dispersed across the planted area during irrigation. Some irrigation systems (i.e., drip irrigation) require filtration of water; filters would be located at the turnout, and at times in the field. Liquid fertilizer will periodically be blended into irrigation water at relatively low rates that have been shown to accelerate growth and increase salinity tolerance (and therefore plant growth and survival) of several native species that have been studied on Owens Lake. Fertilizer tanks with associated injection pumps and containment will be needed in close proximity to Managed Vegetation areas.

- Broad, raised ridges will be formed to provide a reclaimed drained area within which plants can grow. Without this feature, saline shallow groundwater can easily invade the root zone, especially during and after storms, and kill plants. The ridges will be laid out such that they traverse topographic contours, allowing surface water to drain downhill along the low areas. Closed depressions that would otherwise prevent surface drainage will be opened by grading. Starter fertilizer needed to promote early growth and expansion will be applied and incorporated into the soil. The amounts of fertilizer applied to native plant stands are typically very low relative to what is used for agricultural production, but the ability of plants to tolerate drought and salinity, and to rapidly expand to protect the soil, is greatly enhanced.

- Initial reclamation (reduction of salt concentration in the surface soil by irrigation) will be completed before planting. This will likely require several irrigation events that may occur over up to 30 or 40 days. Once monitored soil salinity levels have declined to acceptable levels, the land will be allowed to dry sufficiently until it can again bear equipment traffic.

- Seeding will be done with a brillion seeder (wheeled seed bin that tows behind a tractor) and an air disc/drill. Seed is dispensed from the bottom of the box and buried by pulverizing discs that also break up surface soil, providing good seed-soil contact needed for germination and emergence.

1.3 GRAVEL COVER

1.3.1 Gravel Cover Description

Under the Phase 7a project, LADWP will install a 4-inch layer of coarse gravel to T37-1 and T1A-3, and potentially T35-1 and T35-2, to reduce PM_{10} emissions by: (a) preventing the formation of efflorescent evaporite salt crusts at the surface, because the large pore spaces between the gravel particles disrupt the capillary movement of saline water to the surface where it can evaporate and deposit salts; and (b) creating a surface that has a high threshold wind velocity so that direct movement of the large gravel particles is prevented and the finer particles of the underlying lake bed soils are protected.

The term “gravel” includes clasts from both fluvial and alluvial sources and crushed stone. The gravel will be screened to greater than ½-inch in diameter, pursuant to the specifications issued by the District (District, 2008). Gravel application will include approximately 122,000 tons distributed over 0.21 square miles of T37-1, 447,000 tons distributed over 0.79 square miles of T1A-3, 67,000 tons distributed over 0.11 square miles of T35-1, and 92,000 tons over 0.15 square miles of T35-2. A total of 728,000 tons of gravel is proposed to be spread over the four areas.

Gravel Sources. It is anticipated that gravel will be obtained from local gravel production operations such as the F.W. Aggregate Dolomite mine or the LADWP State Route 136 Shale borrow pit (LADWP Shale borrow pit). The LADWP Shale borrow pit is located just west of the Keeler Fan gravel site – a site previously considered as a gravel source and referenced in the Memorandum of Agreement between LADWP and the District (1998 MOA). The LADWP Shale borrow pit is located east of SR 136, approximately 1.5 miles southeast of Keeler, and less than 2 miles from the lakebed. The LADWP Shale borrow pit is located on public lands managed by the U.S. Bureau of Land Management (BLM) and operated per the requirements of the Surface Mining and Reclamation Act (SMARA). Shale is a fine-grained sedimentary rock consisting of compacted and hardened clay, silt or mud. The LADWP Shale borrow pit is currently permitted for 40 acres of development.

The F.W. Aggregate Dolomite mine is a privately owned commercial aggregate facility located in Dolomite, California, approximately 0.75 miles southeast of Swansea. The access point for the mine is directly off SR 136, between Swansea and Keeler. The Dolomite mine is situated on both privately owned lands and public lands managed by the BLM. Three subareas of the mine (Durability, North Pole, and Translucent) total approximately 480 acres and are able to produce up to 50 million tons; the site is permitted up to the year 2057 (T. Lopez, pers. comm., June 25, 2010). Rock at the F.W. Aggregate site is obtained from a dolomitic limestone source (mountain face), which is blasted and crushed to supply primarily white decorative rock. The existing 0.14 square miles of Gravel Cover DCM area (Corridor 1 which separates Phase 8 Areas A and B) was covered with limestone from the Dolomite mine. This source has also supplied other areas on the lakebed where gravel and rip-rap were necessary for road construction and for armoring of berms.

Gravel Coloration. Per the terms of the 1998 MOA, gravel used for dust control on Owens Dry Lake shall be comparable in coloration to the lake bed soils.

Gravel Effectiveness. The effectiveness of Gravel Cover is summarized from the 2008 SIP (District, 2008). According to the District, gravel blankets (also known as Gravel Cover) are effective at controlling dust emissions on essentially any type of soil surface. A gravel layer forms a non-erodible surface when the size of the gravel is large enough that the wind cannot move the surface. If the gravel surface does not move, it protects finer particles from being emitted from the surface. Gravel and rock coverings have been used successfully to prevent wind erosion from mine tailings in Arizona (Chow and Ono, 1992).

The District estimated the potential PM_{10} emissions from a gravel layer using the U.S. Environmental Protection Agency (USEPA) emission calculation method for industrial wind erosion for wind speeds above the threshold for the surface (District, 2008). PM_{10} will not be emitted if the wind speed is below the threshold speed. With a minimum particle size of ½ inch, a gravel layer will have a threshold wind speed of more than 90 miles per hour measured at 10 meters (USEPA, 1992; Ono and Keisler, 1996). The District predicted that PM_{10} emissions would be virtually zero for a gravel layer since the threshold wind speed to entrain gravel, and thus PM_{10}, is above the highest wind speeds expected for the area. A 100 percent reduction of PM_{10} from areas that are covered by gravel was predicted.

The proposed 4-inch thick gravel layer is intended to prevent capillary movement of salts to the surface. Were fine sands and silts to fill in void spaces in the gravel, capillary rise of salts might ensue and reduce the dust control effectiveness of a gravel layer. In addition, finer particles would lower the average particle size and lower the threshold wind speed for the surface. The District performed small-scale gravel test plots at two sites on Owens Lake starting in June 1986. These tests showed that 4-inch thick gravel blankets composed of ½- to 1½-inch and larger rocks prevented capillary rise of salts to the surface. Observations of un-graveled test plots in the same area, one with no surface covering and another with local unscreened alluvial soil, showed that salts would otherwise rise to the surface (Cox, 1996).

Permeable Geotextile Fabric. Gravel Cover will be placed over a nonwoven geotextile fabric (anticipated to be approximately 2.3 millimeter (90 mils) thick) to prevent gravel from settling into lakebed sediments and thereby losing effectiveness in controlling dust emissions. The permanent geotextile will be permeable to allow draining. Geotextile membranes are artificial fabrics that have a variety of uses including: filtration/drainage, ground stabilization, structural waterproofing, land containment, as well as weed and root control. The geotextile is chemically inert and generally not affected by acids and alkalis that may be present in the soils.

Access Roadways for Gravel Areas. The boundaries surrounding T37-1 and T1A-3 will have raised roadbeds for vehicle access and for wind protection to limit sand inundation of the gravel. The roadbeds will be earthen, approximately 3 feet high, 16 feet wide and armored with gravel. Vehicle bypass pads (turnoff or turnaround pads) (approximately 20 ft by 40 ft in area) will facilitate vehicle travel in two directions. Geotextile fabric may be placed directly on the existing surface to create a firm base. The earthen raised roadway will be constructed over the geotextile fabric. Earthen side slopes facing water or adjacent to potential runoff flows will be armored with rip rap. Earthern slopes not directly in contact with water and travel surfaces will be covered with road base. Installation of access roadways on the boundaries of T37-1 and T1A-3 will include earthwork inside of the boundary of the DCAs; suitable earth material will be scraped, used to construct the raised roadway, and then the area will be smoothed to an even slope. Base course (crushed rock less than ¾ inch) from a local gravel source would then be placed on the travel surface. To the extent feasible, Gravel Cover for the access roadways shall be consistent with the type, size, and color of the Gravel Cover placed on the adjoining lakebed areas.

1.3.2 Gravel Cover Construction

Gravel installation at T1A-3 and T37-1 for Phase 7a is estimated to occur over an approximately 12 month period. Construction activities are:

- Development of gravel stockpile area
- Installation of access roadways
- Gravel conveyance
- Geotextile and Gravel installation

Gravel Stockpile. Gravel stockpile areas will be developed within the boundaries of both T1A-3 and T37-1. These areas will be covered with aggregate to prepare the sites for gravel deliveries during the initial months of construction. Dump trucks will deposit gravel and a dozer will be used to pile the aggregate. Assuming 25 tons per truck, approximately 3,000 tons per day will be transported to each staging area location. Gravel transport will continue throughout the construction period concurrent with geotextile fabric and gravel installation. From the stockpile location, low ground pressure (LGP) vehicles will be used for travel directly on the playa.

Gravel Conveyance. If gravel is obtained from the LADWP Shale borrow pit, trucks will cross SR 136 to Sulfate Road to Main Line Road and then to the stockpile locations (at T37-1 or T1A-3). Although a conveyor is not currently installed at the borrow pit, if one was constructed in the future it could be used to convey gravel across SR 136 to the

LADWP Sulfate Facility and then trucks would be used to transport gravel to the stockpile locations.

If gravel is obtained from F.W. Aggregate Dolomite mine, trucks will cross SR 136 to the T30 road to Main Line Road and then to the stockpile locations (at T37-1 or T1A-3).

Geotextile Installation. Before installation of the geotextile membrane, minor land leveling may be required in areas where obstructions will damage the fabric. A pipe dragged behind a tractor will remove localized high and low spots and prepare the surface; there will be no import or export of soils related to this minor site preparation. It is assumed that the fabric will be delivered to the site on spools carried by flatbed trucks. Small areas of fabric will be rolled out and staked to secure them before gravel installation.

The two vehicle and equipment staging areas previously used (for Phases 7 and 8) will be used for Phase 7a. These previously disturbed sites are located near the intersection of Main Line Road and Corridor 1 at the north end of the lake (20 acre site) and at the southern end of the lake adjacent to Dirty Socks Access Road (3.75 acre site). In addition to office trailers and equipment and vehicle storage, these areas will have fueling stations for gas and diesel. Fuel trucks will be used to refuel construction equipment (including the low ground pressure gravel trucks) and the long haul gravel trucks; no vehicle fuels or oils will be stored in the gravel stockpile areas. Additionally, refueling may occur at the existing LADWP Sulfate facility. Once the geotextile is staked, dozers and ground crews will spread gravel to the required 4-inch thickness. Depending on site conditions, conveyors may be used internally within the DCM boundaries to move gravel from the stockpile locations to other areas of the DCM site.

The onsite construction workforce will consist of laborers, supervisory personnel, support personnel, and construction management personnel. The onsite workforce is expected to reach a maximum of approximately 140 workers during the gravel and geotextile installation.

1.4 TILLAGE

Tillage is commonly used to control wind erosion in agricultural and arid regions around the world. It works by clodding and roughening the soil surface, rendering it more resistant to wind erosion. Surface roughness reduces the wind velocity at the surface, so that windblown soil particles like sand are trapped. The creation of soil clods through appropriate tillage methods forms a stable surface resistant to wind erosion by binding of the available fine-grained loose soil particles.

Tillage was previously applied on the playa of Owens Lake for temporary dust control in some Shallow Flooding construction areas (T21-A, T21-B, T18-O, T17-1_a, T17-2_a, T16, T10-2_b, and T10-3) between October 1, 2009 and April 1, 2010. This tillage may have reduced the frequency and intensity of observed emissions within these areas, even when wind erosion occurred within untilled areas immediately adjacent.

Under Phase 7a, a tillage management plan would be implemented as part of a new BACM test on 0.32 square miles of T12-1, an area with relatively heavy (rich in clay and silt) soils. The BACM test plan (in draft) states that the area will be initially tilled and then once it begins to deteriorate such that it does not meet required control dust efficiency it will be sprinkler irrigated to increase soil moisture. Irrigation will be followed by re-tilling to re-establish needed dust control efficiencies. Irrigation piping (submains and whiplines, flush lines connected to flush mains) would be buried more than 2 feet below the soil (such that they are below the reach of the tillage equipment) with sprinkler risers positioned throughout the DCA; the layout will be similar to the Shallow Flooding areas.

Tractors pulling plows or harrows will roughen the surface of T12-1 creating swaths of tilled ridges with spacing between swaths allowing for irrigation installation and maintenance, as well as monitoring access. The goal of the BACM testing will be to establish dust control efficiency relationships over a wide range of climatic conditions upon which to base performance specifications in a new BACM description. Over time, the surface roughness achieved by Tillage will begin to be altered by weathering and dust control efficiency may decline. The amount of fine material (sand and smaller particles) on the surface may change due to 1) disaggregation of soil, 2) crusting and re-aggregation of fine material, 3) deposition of transported fine material, and 4) erosion and export of material. When monitoring indicates that these processes have reduced the dust control efficiency achieved by Tillage to levels that threaten to violate air quality standards, the area will normally be re-tilled. The goal of re-tilling will be to restore erosion-resistant levels of roughness and aggregation. When Tillage control efficiency declines, the area will be irrigated to restore optimum soil moisture, and then re-tilled. Monitoring will include visual observations of surface conditions and other actions as outlined in the draft Tillage BACM Test Monitoring Plan (Air Sciences, 2010).

A complete tillage BACM test project plan must be submitted and approved by the District before any work in the T12-1 area can proceed. Tillage may be implemented in T12-1 before installation of the irrigation network. This tillage was considered in the Addendum to the Supplemental EIR for the Owens Lake Dust Control Measures (LADWP, 2010) for the Phase 7 project.

To minimize dust emissions during construction, areas will be tilled during low wind periods. To the extent feasible, installation will occur in the summer season when winds are relatively lower and when the playa tends to be less erodible. Tilling will be conducted in daylight hours without use of artificial lighting.

1.5 TRANSITION AREAS FROM SHALLOW FLOODING TO BACM HYBRID

New Shallow Flooding in subareas T1A-4 and T37-2, and new Managed Vegetation in T32-1 and T37-2, are estimated to require approximately 3,700 acre-feet per year (afy) of water. To provide water to these areas, approximately 6 square miles of 13 existing DCAs (T1A-2_a, T10-2_a, T2-1, T5-1, T5-3, T5-3 Addition_a, T5-3 Addition_b, T26, T28N, T28S, T30-1_a, T30-1_b, and T36-1_b) will be evaluated for transition from Shallow Flood to a hybrid mix of approved BACMs. Approximately 3 square miles will be converted under the Phase 7a project. Note that some areas identified for conversion are already partially vegetated. For example, T30-1 (_a and _b) is currently designated as Shallow Flooding by the LADWP and evaluated as Shallow Flooding by the District, despite significant vegetative cover. As of the end of 2010, vegetative cover in this area is being evaluated relative to proposed Managed Vegetation criteria. Areas that pass will be proposed to the District for evaluation as Managed Vegetation for compliance purposes. Area T36-1_b is also currently partially vegetated.

While 3 square miles of existing Shallow Flooding DCAs are proposed for transition to BACM Hybrid, approximately 6 square miles will be evaluated. Consideration of this larger area is proposed since soil and drainage data are limited; it is anticipated that some areas may prove too difficult to vegetate. Owens Lake soils present significant challenges (mainly a combination of very high salinity, extremely poor drainage, and low bearing capacity) for the establishment of compliant stands of vegetation. Ultimately, 3 square miles will be chosen from the 6 square miles studied for transition as part of the Phase 7a project.

The proposed Transition Areas will be developed as BACM Hybrid. Each portion of these areas would be evaluated as an existing (per the SIP definition) dust control measure for compliance purposes. Under the Hybrid concept, approximately two-thirds of the area will be a mix of Shallow Flooding and Managed Vegetation and up to one third will be Gravel Cover (**Figures 3** and **4**). With a gravel layer 4 inches thick, approximately 500,000 tons of gravel will be applied. Irrigation systems similar to those previously described will be installed in non-gravel areas.

Construction, reclamation, planting, establishment, and compliance in the Transition Areas will proceed as previously described for the new Managed Vegetation areas. However, due to potentially more challenging soil and drainage conditions in the Transition Areas, multi-year efforts for establishment may be necessary. Minor reconfiguration of the eastern berms for areas T30-1_b, T28N, T28S, T26, T5-1, and T5-3 may be required. Additional berm modifications may be necessary for access.

A reasonable Transition Areas Dust Control Plan will be developed and implemented during construction for all construction areas, including the Transition Areas. The plan will particularly address measures to be taken when removing existing DCAs from service. The following best management practices (BMPs) will be implemented:

- Use of water trucks to spray roadway travel surfaces on existing and temporary roads used for construction
- Installation of temporary sand fences strategically placed within the DCA being constructed
- Placement of a gravel surface on interim staging areas within the DCA used by the contractor
- Termination of work activities during high wind events

Figure 3
Rendering 1 of BACM Hybrid Area

Figure 4
Rendering 2 of BACM Hybrid Area

1.6 OTHER FEATURES FOR PHASE 7A DCAs

1.6.1 Drainage System

For new non-gravel DCAs included in Phase 7a (T32-1, T12-1, T37-2, T1A-4), drainage systems will be installed beneath Managed Vegetation fields and on the margins of Shallow Flooding areas. New drainage laterals to be installed in Phase 7a will be perforated plastic pipes in covered trenches placed 5 to 9 feet below the ground surface. The drainage system will control soil saturation to:

- maintain drained root zone under irrigated vegetation
- maintain drained pipe zone (prevent pipe floatation)
- capture water along the DCA perimeters to reduce seepage off-site

Drainage return flows can be recirculated into Shallow Flooding areas. The existing drainwater system functions in this manner. A drainwater mainline (brineline) runs parallel to the water supply mainline throughout the dust mitigation area from T2 to T25. The drainwater mainline also delivers water to the Shallow Flooding areas.

1.6.2 Power Supply and Controls

Power for pumps for water conveyance to and from DCAs is supplied by an existing underground 3-phase, 4.8 KV grid. The 4.8 KV grid will be connected to the new turnouts with directed buried cables. The turnouts have their own distribution system for power and controls. Transformers at the turnouts convert the power to lower voltages to supply various equipment, lighting, and control instrumentation. The 3-phase 480 volts alternating current (VAC) is typically used for pump stations. Directed buried cables will be used to supply power from the turnouts to the pump stations. T1A-4, T32-1 and T37-2 will have small pump stations. For Phase 7a, a new high voltage cable will be installed to power pumps associated with T37-2.

1.7 OVERALL 7A CONSTRUCTION SEQUENCE

After design of the proposed facilities is complete, it is anticipated that the construction sequence would proceed as follows:

- Tillage
- Turnout construction
- Earthwork, berm re-enforcement and water distribution systems for Shallow Flooding Areas
- Sprinkler system installation in Transition Areas
- Gravel installation
- Earthwork, berm re-enforcement and sprinkler system installation for BACM Hybrid Areas
- Planting and seeding in Managed Vegetation Areas

1.8 WATER REQUIREMENTS

The total water demand for new DCAs (T1A-4, T32-1 and T37-2) for Phase 7a is estimated at approximately 3,700 afy. To enable these additional water commitments, existing areas of Shallow Flooding will be transitioned to BACM Hybrid, and potentially Gravel Cover (T35-1 and T35-2). The approximately 3 square miles of Transition Areas selected for the Phase 7a project will be designed to provide approximately 3,700 afy to ensure adequate water supply for the new Phase 7a areas.

1.9 OPERATIONS AND MAINTENANCE

1.9.1 Gravel Cover

Once the Gravel Cover has been applied to the playa, limited maintenance will be required to preserve the gravel blanket. The gravel will be visually monitored for sand and dust accumulation, evidence of washouts, or inundation. If any of these conditions are observed over a substantial area, additional gravel will be transported to the playa. It is assumed that no maintenance will be needed in the initial years of operation. Subsequently, small areas may require replenishment and later, larger areas may require replacement. It is anticipated that the total volume of gravel on the Phase 7a areas may be replaced at most once every 50 years.

1.9.2 Shallow Flooding

To attain the required PM_{10} control efficiency, generally at least 75 percent of each square mile of the control area must be wetted to produce standing water or surface-saturated soil, between October 1 and June 30 of each year. Actual Shallow Flooding BACM requirements are set forth in the 2008 SIP. Surface saturation will continue to be monitored via satellite images (as is currently the practice). Maintenance activities will occur as needed throughout the year. However, when feasible, extended facility maintenance (repair of pumps, berms, laterals, and submains) will be completed during the period when dust storms generally do not occur (mid/late summer to early fall). Inflows, outflows and water quality in Shallow Flooding areas will also be monitored. Drains and valves will be inspected periodically and maintained as necessary.

1.9.3 Berms and Roadways

Berms and roadways will be continually maintained to prevent erosion and washout, and to maintain safe driving conditions. Maintenance activity will include minor earthwork and gravel replenishment.

1.9.4 Managed Vegetation

Vegetation will be monitored in the field to determine reclamation progress (declines in soil salinity), soil moisture, irrigation system function (including leak identification and repair), germination success, transplant mortality, and plant vigor. Once established, soil fertility and plant tissue will be monitored at least annually, and vegetative cover will be assessed with satellite imagery. At present, imagery is ground-truthed with specialized, near-surface digital images of vegetative cover. Operations activities will include maintenance of irrigation systems and replanting/reseeded as necessary.

1.9.5 Tillage

Tillage in DCA T12-1 is proposed as BACM Testing. Periodic wetting, re-tilling, and/or alterations in the configuration of the tilling will occur throughout the testing period. Operations activities will include maintenance of irrigation systems as necessary, as well as monitoring of surface conditions, meteorological parameters, and biological resources as part of the BACM test.

2.1 PHASE 7A SCHEDULE MILESTONES

Milestone	Anticipated Completion Date
Award engineering & design contract	April 2011
Design Completion	October/November 2011
LADWP Board approval of CEQA document	December 2011
California Department of Fish and Game issues Streambed Alteration Agreement	No later than March 2012
Lahontan Regional Water Quality Control Board issues Section 401 permit	No later than March 2012
US Army Corps of Engineers issues Section 404 permit	No later than April 2012
California State Lands Commission issues lease	No later than April 2012
Award construction contract	May 2012
Notice to Proceed for Construction	June 2012
Construction Completion	December 2013

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 6

MARCH 2010 MANAGED VEGETATION BACM PROPOSAL

Report

Managed Vegetation BACM Proposal

Prepared for

Los Angeles Department of Water and Power

March 2010

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ACRONYMS AND ABBREVIATIONS

Adj	adjusted
AFB	Absolute Fractional Bias
APCO	Air Pollution Control Officer
BACM	best available control measure
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
DCM	Dust control measure
DPF	digital point frame
GBUAPCD	Great Basin Unified Air Pollution Control District
LADWP	Los Angeles Department of Water and Power
MVPU	Managed Vegetation Performance Update
NAAQS	National Ambient Air Quality Standards
Plan	Managed Vegetation Operations and Management Plan
Playa	Owens Lake playa
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
Proposal	Managed Vegetation BACM Proposal
SIP	State Implementation Plan
USEPA	U.S. Environmental Protection Agency

PREFACE

Great Basin Air Pollution Control District (GBUAPCD) prepared the *2008 Owens Valley PM10 Planning Area Demonstration of Attainment, State Implementation Plan* (GBUAPCD, 2008a), referred to in this document as "the SIP". Among other things, the SIP provided for the development of new best available control measures (BACM), which are applied to stabilize the surface of the Owens Lake playa (Playa), referencing GBUAPCD's method for identifying dust sources on the Playa, the Dust ID Protocol. The SIP states the following on Pages 8 and 9 of Chapter 8, Appendix D, in the section "Research on Potential New BACM – Including Moat & Row":

> *The application must meet all USEPA requirements for BACM designation and demonstrate to the APCO's satisfaction that the new control measure is sufficient to achieve the required PM_{10} emission reductions or control efficiency during the dust season and attain the NAAQS everywhere on the shoreline. The APCO has full and sole discretion to determine whether these conditions have been met.*
>
> *The application shall include, but not be limited to:*
>
> 1) *a description of the new dust control measure*
> 2) *a description of the test site and the meteorological conditions under which it was tested*
> 3) *the measured PM_{10} emissions during the test*
> 4) *the test time frame*
> 5) *all raw data collected during the test*
> 6) *all data screening criteria and final data sets*
> 7) *data supporting the conclusion that the required control efficiency was achieved*
> 8) *a performance standard that the new dust control measure must meet in order to achieve the required emission reductions or control efficiency*
> 9) *an analysis of any environmental impacts of the dust control measure*
> 10) *the appropriate responsible agency approvals, permits and leases*
>
> *The application must include modeling that demonstrates that the required PM_{10} emission reductions or control efficiency can be achieved during the dust season anywhere this control measure may be implemented on Owens Lake, and the NAAQS can be met at all times everywhere along the historic shoreline.*
>
> *If the APCO determines that the application is complete and the above conditions have been met, he/she will have full discretion to select or approve a method of determining compliance of the proposed new BACM with its performance standard and include that method in the description of the proposed BACM for the SIP Revision. The District Governing Board has full and sole discretion to determine whether to adopt a SIP Revision for approval of any new BACM.*
>
> *Upon adoption by the District Board, approval by CARB, and submission to USEPA of a SIP Revision that identifies a new BACM for Owens Lake, the City may implement only this one new control measure on one-half square mile of the next area to be identified as needing control under the 2003 SIP Revision Supplemental Control Requirements until EPA approves this new measure as BACM. No other new control measures may be implemented on areas identified as needing control under the 2003 SIP Revision Supplemental Control Requirements until EPA approves this new measure as BACM. The District Governing Board may limit the new BACM to specific circumstances, for example, distance of the new dust control measure from the shoreline or approval in a specific general soil type. Upon approval by USEPA, the new BACM may be implemented per the requirements described in the following section, "Transitioning From One BACM to Another BACM After 2010," or on any subsequent areas requiring control under the "2008 Owens Valley Planning Area Supplemental Control Requirements Procedure" (Board Order 080128-01, Attachment B), subject to any limitation to specific circumstances.*

This *Managed Vegetation BACM Proposal* (Proposal) is submitted by the City of Los Angeles Department of Water & Power (LADWP) to satisfy the requirements of this section of the SIP. In the sections that follow and attachments, the relationship between measurable conditions and control efficiency is presented, and performance standards are proposed. In the future, the Proposal may be updated and re-submitted based on new knowledge or changed conditions.

The Managed Vegetation Operation and Management Plan and attachments (Plan; NewFields et al., 2008) was submitted by LADWP in June 2008 and approved by GBUAPCD in a letter dated July 7, 2008. In the process of developing this Plan, LADWP and GBUAPCD invested substantial effort in developing, deliberating, and finalizing a sound scientific basis and set of performance specifications for dust control with vegetative cover. In discussions with the APCO, we have determined that to the maximum practicable extent, applicable technical content from this document will be referenced to satisfy requirements of this Proposal. The main body of this Proposal accordingly contains references to supporting documents (mostly provided previously with the Plan) as needed. These documents are appended. Since the entirety of the Plan has been reviewed by and is familiar to LADWP and GBUAPCD, it is hoped that this approach will minimize duplication of previous effort and allow the parties to focus on questions that are unique to this Proposal.

In addition to these and other cited documents, several sets of environmental documentation and management plans that touch on managed vegetation have been developed for Owens Lake (GBUAPCD 1998, 2003, and 2008b; LADWP 2001 and 2009). These documents are relevant context and useful references when considering both existing managed vegetation and future sites.

BACKGROUND AND PURPOSE

Performance criteria for Managed Vegetation are explained in the SIP as follows (GBUAPCD, 2008a, pp. 5-11):

> *Tests by the District and others have shown that vegetation covers ranging from 11 to 54 percent provide the surface protection necessary for the 99 percent PM_{10} control needed at Owens Lake in order to meet the NAAQS. In order to provide the margin of safety necessary to prevent PM_{10} emissions in all conditions, the District has determined that 50 percent total cover averaged over every acre is an appropriate, conservative prescription for the Managed Vegetation PM_{10} control measure. Total cover includes living plants and any dead plant materials, as both function to prevent PM_{10} emissions.*

The SIP also acknowledges the following (GBUAPCD, 2008a, pp. 5-11):

> *The City currently has about 3.5 square miles of Managed Vegetation PM_{10} controls on the lake bed. The Managed Vegetation area is in one contiguous block near the south end of the lake bed. Initial site planting occurred in the summer of 2002 and the City has worked since that time to improve vegetation cover. Although there are portions of the existing Managed Vegetation area that meet the 50 percent cover requirement, the overall site vegetation cover averages about 24 percent. This is well below the SIP requirement of 50 percent vegetation cover on every acre. However, the 3.5 square mile site, as a whole, has achieved a high level of PM_{10} control (Air Sciences, Inc., 2006).*

So, Managed Vegetation performance criteria in the SIP were based on a combination of information from control efficiency results from other sites (documented in scientific literature), from wind-tunnel studies designed to reflect Owens Lake conditions, and observations of plant growth on Owens Lake. With the implementation and monitoring of a full-scale (2,100-acre) Managed Vegetation facility, we now have the opportunity to review and refine performance criteria based on several years of performance relationships observed on Owens Lake. A further advantage is that the large scale of the monitored facility is comparable to potential future installations. These Owens Lake observations, therefore, are the basis for this Proposal.

The purpose of this Proposal is to present and provide technical support for compliance requirements for the Managed Vegetation dust control measure (DCM). Detailed requirements pertaining to levels of control efficiency below 99%, as well as regulatory requirements unrelated to air quality, are not provided in this document.

BACM PROPOSAL TECHNICAL ELEMENTS

As described in the Preface, many of the technical elements of this Proposal have been addressed previously in NewFields et al. (2008). A summary of the technical elements of the proposal is contained in Table 1. Table 1 provides a quick reference to the location of documentation for each element listed in the SIP.

Table 1. Required Elements of BACM Proposal

Required Element (per the SIP)		Location of Documentation
1	Description of the new dust control measure	Appendix 1
2	Description of the test site and the meteorological conditions under which it was tested	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
3	Measured PM10 emissions during the test	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
4	Test time frame	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
5	All raw data collected during the test	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
6	All data screening criteria and final data sets	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
7	Data supporting the conclusion that the required control efficiency was achieved	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.

Table 1. Required Elements of BACM Proposal

Required Element (per the SIP)		Location of Documentation
8	Performance standard that the new dust control measure must meet in order to achieve the required emission reductions or control efficiency	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
9	Analysis of any environmental impacts of the dust control measure	Main body of BACM Proposal
10	Appropriate responsible agency approvals, permits and leases	Main body of BACM Proposal
	Modeling that demonstrates that the required PM_{10} emission reductions or control efficiency can be achieved during the dust season anywhere this control measure may be implemented on Owens Lake, and the NAAQS can be met at all times everywhere along the historical shoreline	Appendix 3, Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006. Also Appendix 4, Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007.
	Documentation of compliance measurement methodology	Appendix 2

In Appendices 3 and 4, it was shown that 99% control efficiency was achieved at between 11 and 20 percent vegetative cover based on digital point frame (DPF) images assessed by the spectral method. Subsequently, vegetative cover monitoring methods transitioned to visual interpretation of DPF images, which was found to result in about 9% greater vegetative cover (site-wide average). This is equivalent to finding that 99% control efficiency was achieved at between 20 and 29 percent vegetative cover based on visual interpretation of the DPF images. The average vegetative cover on the existing Managed Vegetation site in November 2004 (according to a calibrated vegetation map based on visually interpreted DPF) was about 42%. Therefore, the average vegetative cover on the site at the reference date exceeds the vegetative cover level demonstrated in Appendices 3 and 4 to produce 99% control efficiency. Part of this margin accounts for wintertime reductions in vegetative cover levels due to leaf senescence. The remainder is a margin of conservatism that is protective of public health.

Details of the nature of Managed Vegetation and associated performance specifications are described in Appendix 1. The general approach to the Managed Vegetation DCM management is described in Appendix 5, relating DCM conditions to actions by LADWP.

Analysis of any environmental impacts of the dust control measure

The changes to performance specifications contained in this proposal are not of a nature that would significantly alter the environmental impacts of Managed Vegetation relative to research and full-scale facilities that have been constructed and operated previously on Owens Lake.

None of the previous environmental analyses, or any aspect of operation of the full-scale, existing Managed Vegetation site since planting in summer 2002, has brought to light a significant environmental impact. On the contrary, as originally envisioned, Managed Vegetation successfully mimics existing plant communities in the Owens Lake area while controlling dust. Some of the existing area serves as mitigation for predicted project impacts to dry alkaline meadow habitat, and the remainder incidentally provides many of these same environmental benefits.

Appropriate responsible agency approvals, permits and leases

Managed Vegetation BACM was analyzed in each approved California Environmental Quality Act (CEQA) analysis for the 1997, 1998, 2003, and the 2008 SIPs (all by GBUAPCD), and for Phase 2 South (existing Managed Vegetation) dust control (by LADWP). It has been successfully permitted and leases obtained for construction and operation of Phase 2 South on Owens Lake. In addition, GBUAPCD operated pilot Managed Vegetation research facilities at 6 locations on the playa, one of which continues under LADWP operation (the Vegetation on Sand, or VOS, site north of T32-1).

New Managed Vegetation facilities would likely have regulatory requirements similar to the existing site including the existing Waste Discharge Requirements and other existing permits, and leases. Where new facilities are to be built or existing facilities are to be modified, pertinent aspects of new facilities would be described in project-specific CEQA analyses, lease applications, permit updates, and the like.

CONCLUSION

As documented, this Proposal contains the following assurances that DCM effectiveness will be adequate in the future:

1. DCM management is an active program to promote development and maintenance of adequate vegetative cover and to minimize and restrict areas of sparse vegetative coverage. Benefits of improved management and greater maturity to vegetative cover levels and DCM effectiveness for any particular site are cumulative.
2. The Proposal commits LADWP to actively manage potential problem areas (see Appendices 1 and 5).

3. Vegetative cover thresholds are based on the end of the second season during which no significant sand motion was measured on the existing Managed Vegetation site, and future vegetative cover levels must meet or exceed these thresholds. Further, vegetative cover levels lower than those specified in this BACM application were shown to provide 99% control efficiency (Appendix 4).
4. The existing Managed Vegetation site was effective even when surrounded by uncontrolled playa. New Managed Vegetation areas will in many cases border on controlled areas, reducing sand mass moving into margins of Managed Vegetation areas. These areas would thereby be subjected to less intense erosive forces than was the existing Managed Vegetation site upon which the proposed performance specifications are based.
5. This Proposal is based on six years of DCM management experience, the firmest foundation yet for a set of DCM performance specifications.

By all of these means, this Proposal provides amply for robust DCM performance and the protection of public health.

ACKNOWLEDGEMENTS

During development of the ideas in this Proposal, GBUAPCD and their consultants provided valuable comments and suggestions. The contributions of all team members are appreciated by the authors and LADWP, and were essential to the successful completion of this work.

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APPENDIX 1.
DESCRIPTION OF MANAGED VEGETATION FOR PM_{10} CONTROL (SIP SECTION 5.3.1, PROPOSED)

Vegetated surfaces are resistant to soil movement and thus provide protection from PM_{10} emissions. Vegetative cover that is sufficiently dense and uniform (particularly avoiding large, contiguous expanses of barren playa) provides a very effective barrier that traps sand and sand-sized soil particles and keeps wind speeds from reaching the threshold friction velocity required to generate emissions at the playa surface. Vegetation has naturally become established where sufficient water quantity and quality is available on or near the playa surface to leach the salty playa soils and sustain plant growth. Natural saltgrass meadows around the playa margins and the scattered spring mounds found on the playa are examples of such areas (Figure 5.13). Observation of these naturally vegetated areas has shown that very little dust emissions are generated from them. The Managed Vegetation strategy is modeled on these naturally protective saltgrass vegetated areas. Dust control using Managed Vegetation is a mosaic of fields with soil conditions suitable for plant growth. These conditions may (usually are) created by minimal irrigation and, where necessary, artificial subsurface drainage. Aerial and ground-level views of existing Managed Vegetation PM_{10} controls constructed by the City are shown in Figures 5.14, 5.15a and 5.15b.

To date, the Managed Vegetation control measure has been implemented by constructing and operating farm-like facilities to transform the naturally barren playa. The saline soil is first reclaimed with the application of relatively fresh water, and then planted with salt-tolerant plants that are native to the Owens Valley. Thereafter, soil fertility and moisture inputs are managed to encourage plant development first to rapidly achieve, and then to maintain, required levels and patterns of vegetative cover. Existing Managed Vegetation controls on the lake bed are irrigated with buried drip irrigation tubing and drained during wet weather by surface overland flow and a network of buried tile drains that capture excess water for reuse on the Managed Vegetation area or in Shallow Flooding areas.

Future Managed Vegetation facilities may also include habitat enhancement and/or recreation features unrelated to dust control, such as watering points to promote wildlife reproductive success in a manner that does not compromise components required for plant establishment and maintenance.

The root zone is the soil volume in which active rooting, and uptake of water and nutrients, occurs. Managed Vegetation is sustainable at Owens Lake only if salts present in unreclaimed lake bed soils and the naturally occurring shallow groundwater are prevented from reaching critically high concentrations in the root zone. Leaching with rainfall and irrigation water applied to Managed Vegetation serves to generally move salts down and away from the root zone of the planted vegetation. The subsurface drainage system facilitates this process, and may be essential in some areas. Water must be applied to satisfy the plants' uptake needs and the soil reclamation requirements. Excess applied water may exceed that which can practically be moved downward through the soil. When that occurs, the soil can become waterlogged, and salinity may accumulate at concentrations that can damage plants. The two main approaches to avoiding this circumstance are (a) minimizing the volume of applied water and (b) providing artificial subsurface drainage. Approach (a) involves promoting good surface drainage (to avoid surface flow of stormwater and applied water to low points within the control area) and by monitoring of site conditions and scheduling irrigation to avoid exceeding drainage capacity of the soil. Approach (b) involves constructing subsurface drainage facilities of various designs, each of which collect subsurface water into perforated pipes or gravel channels, and removal of collected water for recycling, usually with pumps.

Water is pumped from the subsurface drain system and placed into brine storage ponds where it can be recycled and used for Shallow Flooding, or mixed with fresh irrigation water for re-application to Managed Vegetation. However, depending on local site conditions and compliance requirements, alternative irrigation and drainage configurations, water supply quality, irrigation scheduling regimes, and plant communities may be employed, so long as the dust-controlling vegetative cover requirements are achieved. Drains installed near naturally occurring wetlands are operated so as not to cause significant groundwater drawdown or loss of surface water extent in the adjacent wetland areas. Drainage systems are to be operated with the goal of not decreasing the amount and or changing the type of existing natural wetlands.

In some cases, it is possible to reduce root-zone salinity to levels that are too low. In clay dominated soils, irrigation with low-salinity or fresh water may cause soil structure to collapse, altering future water infiltration and salt leaching. The City's existing Managed Vegetation site has a target applied water salinity of approximately 9 deciSiemens per meter (a measure of electrical conductivity—seawater has a salinity of about 35 deciSiemens per meter). Needed salt is collected in drain water. Prolonged irrigation of clay soils on Owens Lake with freshwater, where attempted, has not been observed to cause dramatic immediate effects. Over time, however, there does appear to be a consolidation of very large soil prisms, limiting most water flow, aeration, and rooting to the surfaces of those prisms. Therefore, where this is considered a risk on Owens Lake, irrigation water salinity may be controlled to avoid creating this undesirable condition.

Operational experience indicates that applied water of approximately 1.2 feet per year (net of recycled drainage water) is required to maintain sufficient protective vegetative cover. A somewhat greater depth of applied water is required for land reclamation and establishment (primarily before and during the first growing season). Thereafter, the appropriate applied water depth varies widely around this average depending on local soil and drainage conditions.

At the end of 2009, the City had about 3.5 square miles of Managed Vegetation PM_{10} controls on the lake bed. This 2009 Managed Vegetation area is in one contiguous block near the south end of the lake bed. Initial site planting occurred in the summer of 2002 and the City has worked since that time to improve and maintain vegetative cover.

Once 3.5 square miles of Managed Vegetation was established, the District and City engaged in relatively intense monitoring and analysis of control efficiency. This collaborative effort has formed the basis for refinement of the initial performance specifications for Managed Vegetation. The required control efficiency for the site has been 99%, and new performance specifications are for that level of control. However, other vegetative cover levels could be similarly determined where lower control efficiency levels are required. The refined specifications and their basis are described next.

Tests by LADWP have shown that the 3.5-square-mile site, as a whole, has achieved a high level of PM_{10} control. Air quality modeling conducted in conjunction with the 2008 SIP revision confirmed that the site achieved its required level of PM_{10} control. In addition, two studies were produced based on a control efficiency study on the existing Managed Vegetation facility on Owens Lake:

- Air Sciences Inc. 2006. Managed Vegetation Control Efficiency Study, Owens Dry Lake, California. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. July, 2006 (Appendix 3 of this BACM Proposal).
- Air Sciences Inc. 2007a. Demonstration of 99% Control Efficiency for the Managed Vegetation Dust Control Measure. Prepared for the Los Angeles Department of Water & Power, Los Angeles, California. June, 2007 (Appendix 4 of this BACM Proposal).

The 2006 study determined that 99% control was achieved on the existing Managed Vegetation site with between 11 and 20% vegetative cover (as measured by methods in use at the time. This is equivalent to 20 to 29% vegetative cover measured with the updated remote sensing approach).

The 2007 study verified, on the basis of the Dust ID model and sand motion data collected by the GBUAPCD and LADWP, that the entire Managed Vegetation site did not cause or contribute to an exceedance of the federal 24-hour PM_{10} standard at the shoreline. Vegetative cover performance specifications (average vegetative cover and spatial distribution requirements) for Managed Vegetation at Owens Lake have been developed based on effectiveness monitoring results from the existing Managed Vegetation facility. An appropriate margin of safety has been incorporated into these specifications and is reinforced by selection of a 99% PM10 emissions control efficiency for many areas; lower vegetative cover levels would be acceptable where lower control efficiencies are required, and where evidence indicates that the lower target vegetative cover levels could achieve that lower control efficiency.

Pursuant to the 2006 Settlement Agreement between the District and the City (Chapter 8, Attachment A, 2006 Settlement Agreement, Paragraph 6) the City prepared, and the APCO approved a Managed Vegetation Operation and Management Plan that ensured the 3.5 square-mile site continued to achieve control sufficient to prevent emissions that caused or contributed to NAAQS violations. With respect to determination of compliance, that Plan will be superseded by this BACM Proposal upon APCO approval, except where it is cited herein.

Vegetative cover requirements cannot be met until vegetation has had time to develop. Initial development may take at least two growing seasons, after which substantial control efficiency should be achieved. Resolution of site-specific drainage challenges and compliant levels of vegetative cover may require another several seasons for resolution. Vegetation of some of these areas may or may not be required for compliance, but their improvement will in any case render the facility more robust, and is therefore desirable where practicable. Some areas of the playa, however, may prove extremely hard to vegetate and must either be controlled in the context of an otherwise vegetated site, or by some other means.

Any Managed Vegetation area will be considered compliant when the vegetative cover requirements in Table 1.1 are maintained on the area by the City. Vegetative cover compliance is to be determined on a **fall satellite image of the area and ground-truthed, calibrated, and validated by reference to** measurements made by point frame or by equivalent methods (including digital point frame [measurement of vegetative cover on downward-looking, high-resolution digital images of vegetative cover taken a few meters from the land surface]). Vegetative cover provided by any locally adapted native plant species will count toward compliance in any Managed Vegetation area.

TABLE 1.1
Managed Vegetation DCM Vegetative Cover Criteria without Adjustments Based on Absolute Fractional Bias of the Cover Measurement
Managed Vegetation BACM

Grid Scale	**Average**	**5 cover**	**10 cover**	**20 cover**
(acres)	(minimum % cover)	(minimum % of DCM area)		
0.1	37	92	83	65
1	37	94	87	68
10	37	95	89	74
100	37	95	90	77

[a]Note that in the measured reference condition, no whole, 1- to 100-acre grid cells had <5 percent vegetative cover. The associated criteria are not intended to imply or to allow whole 10-acre or 100-acre grid cells to have < 5 percent vegetative cover. Rather, they are intended to allow for smaller grid cell fragments (e.g., at the DCM's edges) with this level of vegetative cover.

DCM areas will be subdivided by grids imposed at four scales, beginning at 0.1 acre, and increasing tenfold in area for the three subsequent grids (to 1, 10, and 100 acres). Vegetative cover distributions among these grid cells (average vegetative cover in each cell, and the distribution of those average values for each grid scale) will be characterized. Average cover thresholds in Table 1.1 will be adjusted for uncertainty of the vegetation map for that particular date, based on the vegetative cover map validation results. Adjustment of each of these thresholds will be made as follows:

$$Threshold_{adj} = Threshold*(1-(AFB/2.5)) \quad (1)$$

where AFB = half of the Absolute Fractional Bias (ranging from 0 to 2, with 0 indicating no error in the calibrated model prediction of vegetative cover at independent validation points), *Threshold* = any average % cover threshold from Table 1.1, and $Threshold_{adj}$ is the adjusted criterion against which an average cover measurement for the date and parameter in question would be evaluated.

Table 1.2 contains a summary of responses in the event that one or more of the following occur in a Managed Vegetation area:

- Vegetation shows signs of decline over significant areas that could result in future failures to meet vegetative cover requirements
- Vegetative cover levels are shown to be less than those required in Table 1.1

TABLE 1.2

Tabular Summary of Managed Vegetation Operation and Management

Site condition	Management requirement	Regulatory requirement	Range of site management responses
1. Vegetation and soil conditions	No 10-acre grids with predominantly orange or brown aboveground saltgrass and insignificant new growth during an entire growing season (as determined by ground observations and subsurface investigation).	See item 2.	a) Site-specific evaluation of plant health and determining factors, and surrounding conditions, b) develop and implement steps to address determining factors identified in Step a, c) if actions were required under Step b, then monitor and verify that these actions achieve their stated goals.
2. Vegetative cover	No 10-acre grids with <5% cover; 1-acre grids with <5% cover (subject to site-specific review).	Cover levels > threshold shown in Table 1.1.	a) Site-specific evaluation of plant health and determining factors, and surrounding conditions, b) develop and implement steps to address determining factors identified in Step a, c) if actions were required under Step b, then monitor and verify that these actions achieve their stated goals.
	Assess green cover annually during the August-September period. Identify and evaluate areas with low rates of green cover generation.	Process and results documented, and reviewed annually with GBUAPCD.	Employ primarily as “early warning”. Consider green vegetative cover in the context of total vegetative cover, in relation to the size and surroundings of the area being considered. Develop management responses to remedy low levels of green vegetative cover replacement when and where this evaluation indicates that such action is needed.

The following portions of the areas designated for control with Managed Vegetation are exempted from the vegetative cover requirements:

1. portions of the site that are consistently inundated with water, such as reservoirs, ponds and canals,
2. roadways and equipment pads necessary to access, operate and maintain the control measure which are otherwise controlled and maintained to render them substantially non-emissive, and
3. portions of the site that are used as floodwater diversion channels or desilting/retention basins.

“Substantially non-emissive” shall be defined to mean that the surface is protected with gravel, durable pavement or other APCO-approved surface protections sufficient to meet the requirements of District Rules 400 and 401 (visible emissions and fugitive dust).

APPENDIX 2.
VEGETATIVE COVER MEASUREMENT

Final Report

Methods Used for Verification of Vegetative Cover on the Managed Vegetation Dust Mitigation Site

Prepared for

The Los Angeles Department of Water and Power

August 2007

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Co-authored by:
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ACRONYMS AND ABBREVIATIONS

AGL	*above the ground level*
CT	*calibration target*
DCM	*dust control measure*
DN	*digital number*
DOS	*Dark object subtraction*
DPF	*digital point framing*
GBUAPCD	*Great Basin Unified Air Pollution Control District*
GC	*Geometric correction*
HB	*HydroBio*
DPF	*Hi-Pod digital point frame*
LADWP	*Los Angeles Department of Water and Power*
MV	*managed vegetation*
MVL	*Managed Vegetation Land*
NDVI	*Normalized Difference Vegetative Index*
Plan	*Managed Vegetation Operation and Management Plan*
PMP	*performance and monitoring plan*
SAVI	*Soil Adjusted Vegetative Index*
TOA	*top-of-atmosphere*

SECTION 1.0
INTRODUCTION

1.1 Background

Contained within the November 2006 Settlement Agreement between Great Basin Unified Air Pollution Control District (GBUAPCD) and the Los Angeles Department of Water and Power (LADWP) is a provision requiring the development of a *Managed Vegetation Operation and Management Plan* (Plan)*.* Essential to the Plan is accurate verification of current and historic vegetative cover levels across the managed vegetation (MV). A *performance and monitoring plan* (PMP) submitted on an annual basis will be used to compare specific criteria related to historic conditions that achieved 99 percent control efficiency at the site. The most appropriate methodologies to quantitatively verify vegetative cover are, therefore, essential to both the Plan and annual PMP.

Following the establishment of the MV dust control measure (DCM) in 2003, both GBUAPCD and LADWP independently developed remote sensing techniques to quantitatively verify vegetative cover. Detailed evaluation of the two methods revealed that the basic foundations from which both methods are derived contain several similarities; each uses independent ground truthed data (in the form of measured vegetative cover) to calibrate remotely sensed imagery, resulting in a quantitative assessment of cover. Although several similarities exist, slight differences between the two methods are apparent and stem from the methods involved in ground truthing vegetative cover and remotely sensed image calibration/validation. Differences between the two methods are noteworthy and warrant a closer examination to quantify the strengths and weakness of each respective method.

1.2 Purpose

The purpose of this memorandum is to provide a detailed description of both remote sensing vegetative monitoring methods, identify areas of agreement and disagreement between the two methods, outline a study methodology to collaboratively address areas of disagreement, and use the results from the collaborative study to determine methodology for future vegetative compliance monitoring. This report is organized as follows:

- Section 1.0 - Introduction
- Section 2.0 - LADWP's Monitoring Methodology
- Section 3.0 - GBUAPCD's Monitoring Methodology
- Section 4.0 - Proposed Plan of Action and Future Vegetative Compliance Methodology
- Section 5.0 - Conclusions
- Section 6.0 - Work Cited

SECTION 2.0
LADWP MONITORING METHODOLOGY

With any intensive remote sensing analysis effort, concurrent collection of representative ground truth data and remotely sensed imagery is necessary to ensure proper image calibration. It is essential that ground truth data be gathered at a scale that is appropriate for the desired image calibration and validation. Several methods for estimating vegetative cover for ground truth sites have been developed by plant ecologists, agronomists, and remote sensing experts. Contemporary methods of assessing vegetative cover for ground truth sites; such as a reference frame, quadrant siting frame, and point-frame transects, can be considered subjective in nature and do not facilitate recreation or checking after the initial field evaluation. These methods can also be time consuming, and results are drawn from a few points located systematically in relatively small unit areas. To overcome the restricted sampling area of these methods, measurements located at random in larger areas of interest must be repeated many times over.

These methods are, however, well established, and cover measurements by point frame in particular are the method by which vegetative cover in the MV at Owens Lake was previously defined. It is therefore desirable that vegetation cover ground truthing be easily related to this method. To achieve this, LADWP developed a new method that is somewhat more rapid, readily reproduced (checked), that takes in more points in a relatively large quadrant, and that can be readily analyzed for site-specific trends and accuracy through time.

2.1 Ground Truthing Tool

Digital photos of the ground surface provide a means of quantitatively estimating vegetative cover. LADWP's method for capturing digital photos to quantify vegetative cover evolved as digital photo technology (especially resolution and automatic exposure control) improved. The original method, termed digital point framing (DPF), consisted of photos taken with a digital camera held at eye-level, approximately 5 feet above the ground level (AGL). This height was chosen based on a maximum camera resolution at that time, which was 3.1 mega pixels or 2560 x 1920 lines. This 5-foot AGL height captured an image such that between the resolution of the camera and the AGL height, the pixel resolution was such that lessened the quantity of grass blade and soil mixed pixels, though these mixed pixels certainly still exist. This lessened the mixed pixel effect, thus improving spectral discrimination results. To get a representative vegetative cover estimate in a quadrat extending from inter-row to inter-row, sets of four slightly (~20 percent) overlapping photos were taken to cover a combined area of 1.5 feet by 5 feet. The four photos were then mosaicked (digitally stitched together) into a single, panoramic digital image (Figure 2-1).

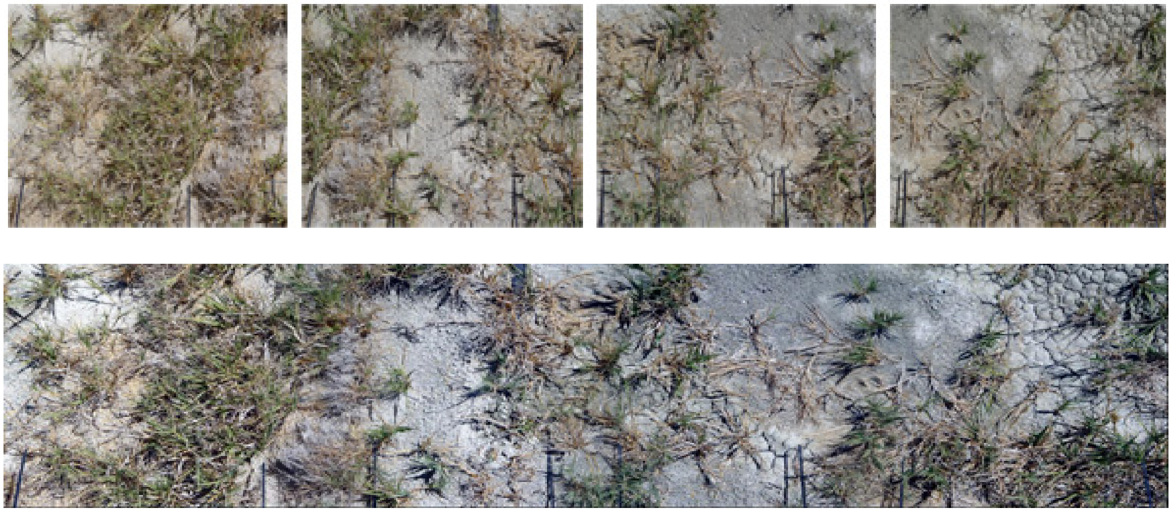

FIGURE 2-1
Figure 2-1A: Four DPF Photos
Figure 2-1B: Final DPF Mosaic

In an effort to maximize the area characterized per DPF and minimize the time associated with ground truthing, a more powerful digital camera mounted on a 15-foot Hi-Pod monopod system (Figure 2-2), was purchased in October 2006. This new devices improved the efficiency of the DPF methodology. The new DPF characterized a larger ground surface area than the original DPF methodology (Table 2-1), increasing the ground surface area characterized from 2.25 ft^2 per photo (four photos then mosaicked together for a total area of 7.5 ft^2) to one photo characterizing a total of 16.7 ft^2. The single frame capture of a larger array area also eliminated the need for the mosaic process previously used on four DPF frames. Elimination of that process was significant because mosaicing of photos taken at a 5-foot AGL was never fully capable of modeling out the effects introduced by the (4) individual points of perspective. It also resulted in a significant reduction in field work associated with photo capture.

The new DPF approach had a substantial field effort savings in that (1) technician can spend 2-3 days (16-24 hrs) collecting all DPF photos, rather than the 2-3 days of (4) staff necessary for the point-frame field effort.

FIGURE 2-2
DPF Field Equipment Setup
The new DPF equipment included the use of a high resolution camera mounted on a 15' Hi-Pod monopod.

TABLE 2-1
DPF and DPF Specifications

Item	Original DPF Specification	New DPF Specification
Camera Brand	Sony Cyber-shot DSC-F717	Sony Cyber-shot DSC-R1
Camera Resolution	2560 x 1920	3888 x 2560 pixels
Photo height	5’ above ground surface	14.5’ above ground surface
Photo Dimensions	1.5’ x 1.5’; Four photos per location	5’ x 3.3’; One photo per location
Surface Area Characterized	7.5 ft^2	16.7 ft^2

2.1.1 DPF Grass Classification

Two methods for classifying the amount of vegetation within each DPF have been developed by LADWP. The first method spectrally classifies each pixel within the DPF into one of three classes (green grass, brown grass, or no grass) (Figure 2-3). At one time this was done using an ISODATA unsupervised classification approach, segmenting the image into 100 spectral classes, which were then assigned to one of the three cover classes based on visual analysis. The current spectral approach, which has been found to be more successful at separating the cover classes, was adopted in late 2005. This method involves modeling of two ratios of the photo’s bands to separate the cover classes (blue/red and green/red). New thresholds must be selected for each DPF event due to seasonal variation of the vegetation and illumination characteristics on the day of capture. Thresholds are selected to separate green grass, brown grass, and bare ground. The model performs the following logic:

1. (blue/red < threshold1 AND green/red > threshold2) = green grass

2. (blue/red < threshold) – green grass from above = brown grass

3. Other pixels = bare ground

This process resulted in a vegetation cover map for each photo. Each pixel is designated as one of the cover categories.

While the spectral analysis worked relatively well, selection of the thresholds (done subjectively by the analyst) is time consuming. Further, the added “silver” classification category introduces challenges due to similar spectral characteristics with the substrate. Because of the visible-range spectrum similarity between bare ground surfaces and brown/silver grass, there is also some balancing done in the threshold selection process, such that the amounts of bare ground erroneously classified brown grass roughly balances with the amount of brown grass that is classified bare ground. This threshold is also subjectively identified by the analyst. These processes are to a large extent due to the sensor’s limited spectral range, rendering more automated classification techniques unusable.

From this vegetation cover map, areas within the DPF that are covered by vegetation can be readily determined by software that counts pixels in each class. Quadrats defined by DPF can be used to characterize larger areas of vegetated land (equivalent to the mean DPF results in the area). Cover levels for these areas can in turn be employed to calibrate index or ratio results in satellite imagery.

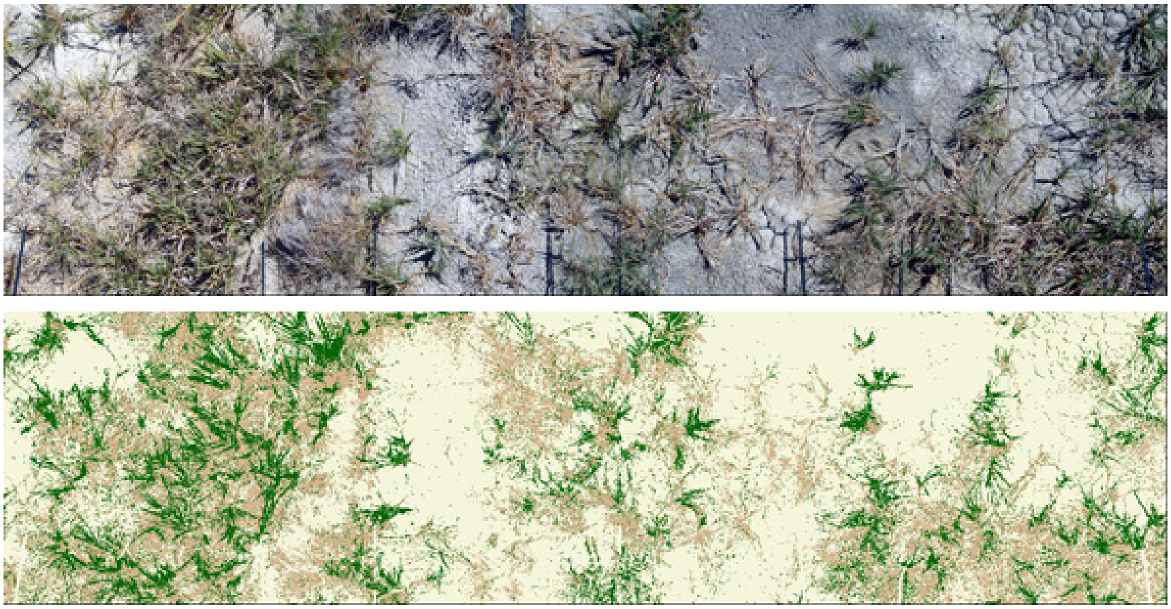

FIGURE 2-3
Figure 2-3A: Example DPF
Figure 2-3B: Example Spectral Grass Classification of a DPF
Spectral classification divides vegetation into three classes: (1) green = green grass, (2) brown = brown grass, (3) white = bare ground surface

In October 2006, a second non-spectrally-based method of estimating percent cover within each DPF was developed to assess the accuracy and precision of the spectral classification method. Termed digital pin classification, it visually assessed vegetative cover with computer grid points overlain on the DPF photo at regular intervals (Figure 2-4). An ESRI shapefile grid of 50 points (crosshairs) per photo was overlain on each photo. The center of each crosshair, not any other part of the crosshair, was used in the determination of vegetative cover. Each of the 50 crosshair points (per DPF) was characterized as either green grass, brown grass, or no grass (silver grass is easily added in as a category in that the visual discrimination is clearly made in the DPF image). This classification was then entered into the attribute table for the shapefile, which was then copied to an Excel spreadsheet where mean percent cover percentages were calculated for each site. Both methods will be used in future vegetative monitoring events to compare the difference between the results of the two methods. The digital pin classification method time requirements puts the level of effort into the same general amount as the conventional point-frame, once accounting for the 1-technician field data collection and subsequent DPF analysis, as compared to the 4-technician field data collection effort necessary for conventional point frame. Again, the advantage of the DPF approach is for historical record of a data collection event.

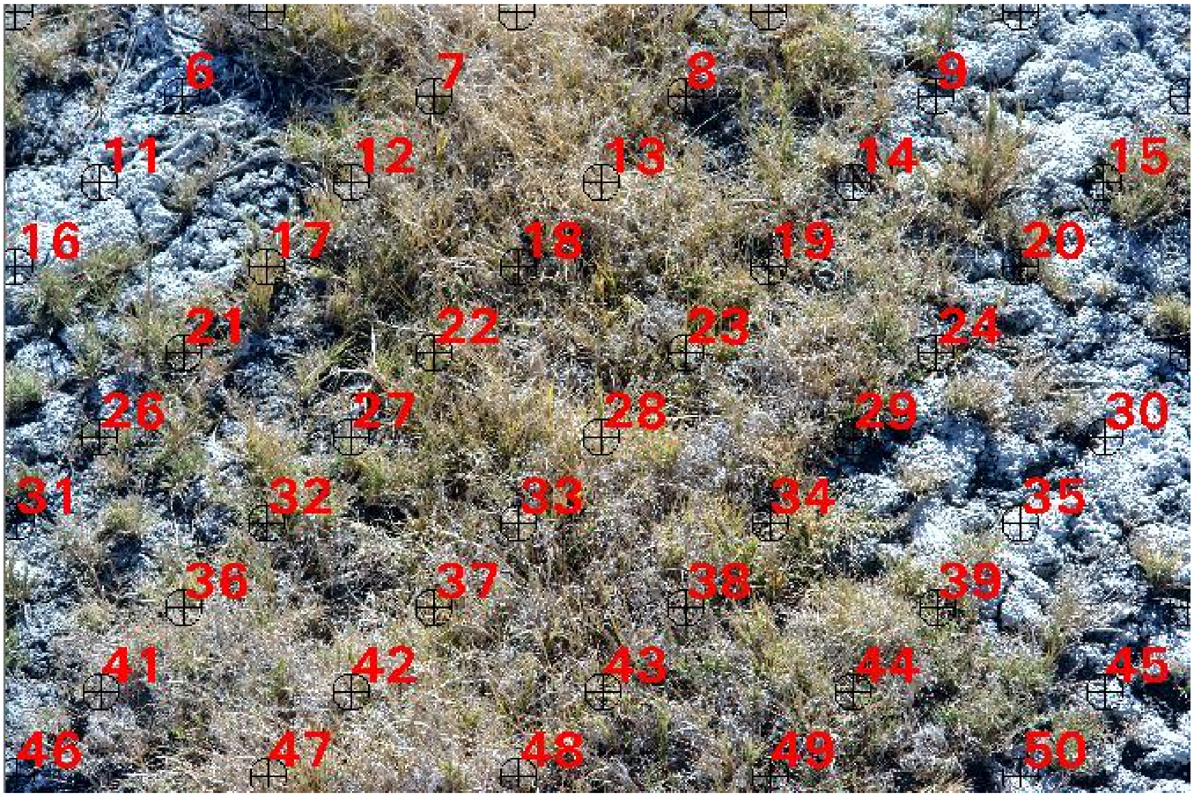

FIGURE 2-4
DPF "Digital Pin" Classification
DPF photo with the 50 point grid shapefile overlain

2.2 Calibration Target Characteristics

Accurate satellite image calibration is dependent on several calibration target (CT) characteristics. These include: size, shape, number, distribution, and relative homogeneity.

2.1.1 Calibration Target Size and Shape

Currently, the LADWP CT size is equivalent to a square 3x3 QB pixel area (9 QB pixels), which is approximately 52 m^2 (558 ft^2). The 9 QB pixels are averaged and compared to percent cover derived from one DPF photo. One DPF photo characterizes 1.6 m^2 (16.5 ft^2) which is approximately 3 percent of the CT area.

2.1.2 Calibration Target Quantity and Distribution

The quantity and distribution of CT sites is important to proper image calibration and validation. Currently, LADWP ground truths a total of 51 CT locations. When possible, the same locations have been used repeatedly year after year to develop a baseline of comparison. Depending on weather conditions and yearly vegetative growth patterns, some locations have been moved, removed, or added. Current CT LADWP CT locations are presented in Figure 2-5.

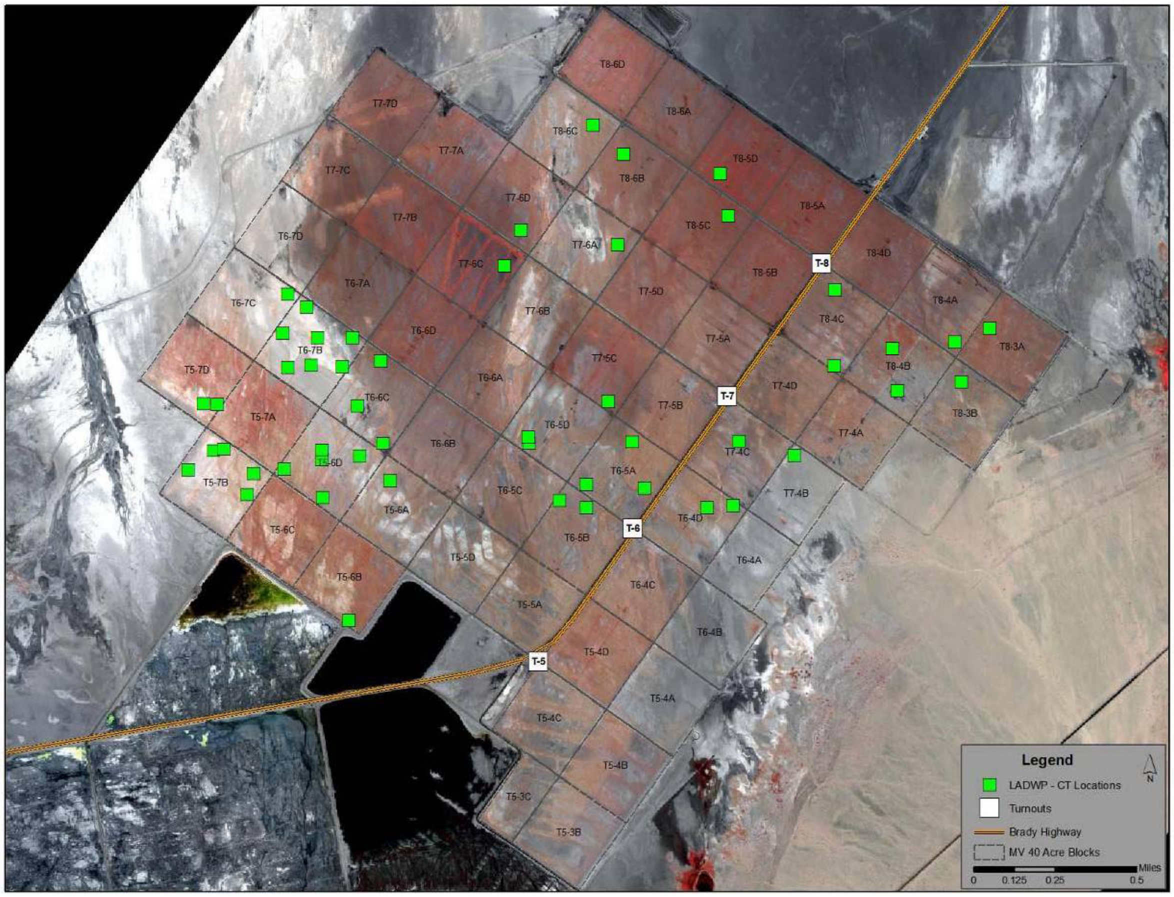

FIGURE 2-5
Current LADWP CT Locations

Equally important to proper image calibration and validation is the distribution of those sites relative to the actual vegetative cover distribution of the MV site. Current LADWP calibration site distributions relative to the estimated MV site distribution are presented graphically in Figure 2-6. LADWP has targeted areas to be used for image calibration that fall into the less-than-30 percent vegetative cover class.

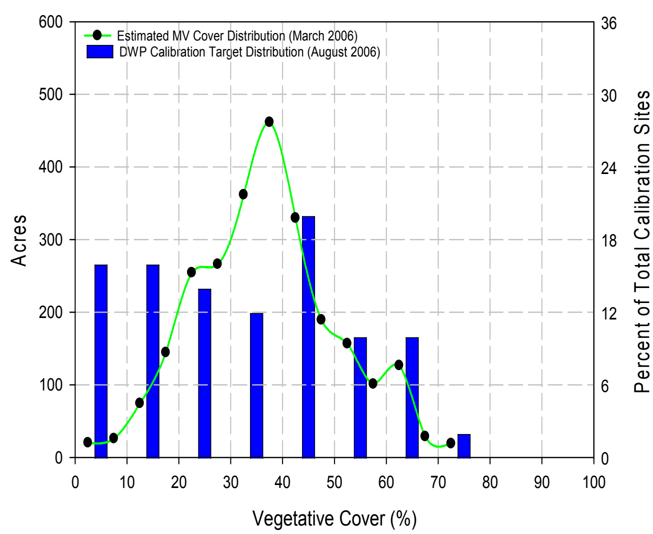

FIGURE 2-6
Current LADWP Calibration Target Distribution Relative to the MV Cover Distribution

2.3 Remote Sensing Image Analysis

The LADWP image analysis approach uses imagery from the QuickBird satellite (DigitalGlobe, Inc). QuickBird imagery is preferred because of its spatial and spectral characteristics, as well as its cost. The approach developed by LADWP requires a high-resolution image with both visible and near-infrared spectral range, a reliable geometry and band registration, and an associated cost allowing for many analyses per year at a reasonable expense. Note that cover was previously tracked by LADWP higher frequency for control effectiveness investigations. In the future, if annual assessment is sufficient, the cost of imagery is less important.

The QuickBird multispectral imagery is composed of four bands, each of which represents a specific portion of the spectrum; green, blue, red, near-infrared. The multispectral imagery is capable of a spatial resolution of 2.4m per pixel. Also included in the “standard bundle” package is the high-resolution panchromatic band. Spectrally, the high-resolution panchromatic band represents nearly all of the visible range and slightly into the near-infrared range of the spectrum. Spatially, this band is capable of 0.6m per pixel resolution.

The cost of the QuickBird imagery for the MV sites, per collection, is approximately $2,500. For comparison, an airborne (airplane-based) sensor capable of multispectral image collection appropriate for spectral post-processing may cost $10,000 or more per collection.

2.3.1 Preprocessing of the Quickbird imagery

To calculate vegetative indices or ratios to assess vegetative cover, QuickBird data must first be preprocessed or corrected to account for various environmental factors including: instrument irregularities, solar angle, distance of the sun, and atmospheric scatter. Details on the preprocessing steps used to prepare Quickbird images for mapping vegetative cover are presented in Table 2-2. An additional pre-processing step was performed when compliance assessments were being made. This included delineation of vegetated areas, which excluded roads, turnouts, irrigation equipment, and the like.

TABLE 2-2
QuickBird Image Preprocessing Steps

Preprocessing Correction Conversion	Explanation	Method Details
Geometric correction (GC)	GC is used to rectify the satellite image to known ground control points. This essentially adjusts the image to known corresponding visual features.	Ground control points visually identified in reference panchromatic (0.6m image) and newly acquired panchromatic image, geometric model calculated and applied to both 0.6m Pan and 2.4m Multispec imagery. Image projection parameters used for Geocorrection: UTM, Zone 11, GRS 1980 Spheroid; NAD83 Datum; Nearest Neighbor Resampling; 2.4 Meter Pixel Size.
Conversion of image digital number (DNs) to top-of-atmosphere (TOA) Spectral Radiance	Conversion to TOA spectral radiance normalizes the data for the incident energy of the sun. This changes with solar angle and distance, which is a factor of time of day and year.	Each band of the image is multiplied by a K-Conversion Factor and divided by the bandwidth to obtain TOA radiance values. K-Conversion Factors and Bandwidths: Band 1 = 0.0160412, 0.068; Band 2 = 0.0143847, 0.099; Band 3 = 0.0126735, 0.071; Band 4 = 0.0154242, 0.114.
Conversion of TOA radiance to refleCTnce	ReleCTnce values are used in the calculation of some vegetative indices (e.g., NDVI, SAVI, etc.).	Reflectance calculation: (image band * earth-sun distance * pi) / (irradiance * COS(90 degrees – sun elevation) The Earth – Sun Distance is estimated from the Landsat Data User's Handbook*. Sun elevation and Exoatmospheric Solar Spectral Irradiance are provided in the image metadata from the Satellite Image Vender DigitalGlobe.
Dark object subtraction (DOS)	DOS corrects for atmospheric scatter and other environmental conditions.	The histogram of each band of the reflectance image is observed and the value at the low end of the curve, which is at the point of having a significant number of pixels (~100) is recorded. That value is then subtracted from its source band to shift the low value close to what should be the actual lowest value.

* Source: Table 11.4 Earth-Sun Distance in Astronomical Units in the Landsat Data User's Handbook.

2.3.2 Producing Vegetation Indices/Ratios from Satellite Images

Several standard vegetative indices and ratios have been calculated by LADWP to correlate to vegetative cover. Until recently, focus of the LADWP vegetative monitoring effort has been to support management activities during the growing season when green grass is the dominant vegetative color at the MV Site. Although all indices and ratios were calculated for each image, special consideration was given to those known to predict green grass vegetative cover. Recently, as the focus shifted to other time periods when green grass was not the dominant color (e.g., during wintertime), other vegetative indices or ratios more appropriate for senesced grass color were utilized. A description of each index or ratio calculated is as follows:

- Normalized Difference Vegetative Index (NDVI). NDVI is a known indicator of green vegetative activity. Green vegetative growth is easily quantified because red light is absorbed by the plant chlorophyll and other wavelengths are reflected. The NDVI standard index is produced with the following equation:

  NDVI = (band 4 – band 3) / (band 4 + band 3)

- Soil Adjusted Vegetative Index (SAVI). SAVI was developed as a variation of the NDVI to remove the soil effects on index calculation. The standard SAVI index is produced with the following equation:

  *SAVI = (band 4 – band 3) / (band 4 + band 3 + 0.5) * (1 + 0.5)*

- Simple band ratios have been tested and determined to be useful for extracting green and senesced vegetation. At times, all of these ratios have shown promise as having high correlation to percent cover for the combination of green and brown grass. Image ratios are calculated by simply dividing the bands in the ratio name (i.e., 4/2 image ratio equals band 4 divided by band 2). Ratios historically used include:
  - 4/2 Ratio Image
  - 4/1 Ratio Image
  - 3/2 Ratio Image
  - 3/1 Ratio Image

2.3.3 Linear Regression and Percent Cover Calibration

Percent cover was determined from the CT locations by processing of the DPF photos as described above. The ground truthed CT values were obtained through the DPF grass classification process described previously. Procedurally, the percentages were stored as values in a spreadsheet, which were related to the unique location IDs of the ground truth sites. Percent categories assessed included percent green, percent brown, and percent bare ground. The total percent vegetated was determined based on the sum of the percent green and percent brown categories.

Mean values were then obtained from each of the processed index and ratios calculated. For each of these images, a circle (equal in area to a 3x3 pixel array) was used to extract the mean value for each CT location. The values for each location, for each index or ratio calculated, were added to the spreadsheet containing the ground truth percent cover data. The geographically common DPF percent cover values and the 3x3 mean calculation values were correlated through a linear regression calculation resulting in slope and intercept values defining the relationship of the correlation. All ratios and indices calculated were regressed with percent green grass and total percent vegetated, resulting in two sets of slopes, intercepts, and r^2 values.

Slopes and intercepts for the ratio or index were applied with a calibration model ((index x slope) + intercept) within the image analysis software. The output of this calibration model represented a percent cover continuum of values in the imagery (i.e., a percent cover map) (Figure 2-8). This model was run to produce maps for percent green grass and total percent vegetated. A total of 24 of the 51 “active” CT sites were used for this analysis.

Error analysis was performed with the remaining 27 CT sites by comparing percent cover values from those locations to the mean index/ratio calculation from the calibrated percent cover map for those same check points. A difference statistic was then calculated for each check site.

Final tabular results of mean vegetative cover statistics were presented at four different scales for comparison (0.1-acre, 1.0-acre, 10-acre, and 100-acre grids). Construction of the grids was performed in ArcGIS, producing grid cells in four separate shapefiles to cover the entire managed vegetation area. Grids were clipped to exclude non-grass areas such as road and turnouts. Table 2-3 presents mean percent cover statistics for each of the grid cells (0.1-acre, 1.0-acre, 10-acre, and 100-acre) extracted from the March 2005 QuickBird image. The March 2005 cover maps were

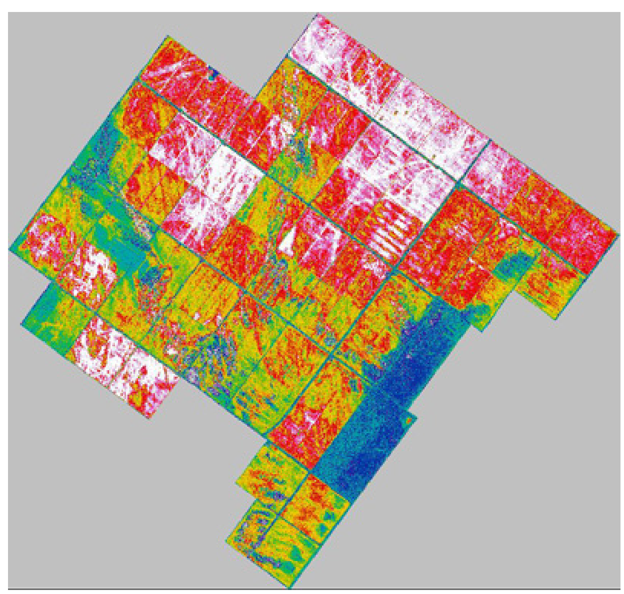

FIGURE 2-8
Example Vegetative Cover Map

created using the 4/2 image ratio, which returned the highest R^2 with the least error compared to all other indices and ratios tested.

TABLE 2-3
Tabular Vegetative Cover Statistics-March 2005
Tabular vegetative cover statistics from the March 2005 QuickBird Image. Percent cover was assessed using the 4/2 image ratio.

Grid Scale	n	*Average*	*SD*	*%>5*	*%>10*	*%>20*
Reference			(measured)			
0.1	22,954	23	12	92	83	59
1	2,419	22	11	96	88	59
10	278	22	9	99	93	60
100	38	22	8	100	97	71

SECTION 3.0

GBUAPCD VEGETATIVE COMPLIANCE MONITORING METHODOLOGY

Procedures used by the GBUAPCD to assess vegetative cover on the MV Site have been developing since the completion of the MV DCM in 2003. The following sections briefly describe past methods while focusing largely on the current methodology. The current GBUAPCD method is implied by LADWP from collaborative field efforts in December 2003 and several subsequent reports provided to LADWP by GBUAPCD on behalf of HydroBio (HB). Reports and technical memorandum used for this evaluation include the following:

- Report 2003: Owens Lake Vegetation Compliance Report
- Technical Memorandum June 2004: Managed Vegetation Evaluation
- Report 2004: Owens Lake Vegetation Compliance Report
- Report August, 2005: 3/2 Index Versus Allgrass Methods for Evaluating Managed Vegetation at Owens Lake
- Technical Memorandum March, 2007: Preliminary Products for the Managed Vegetation Land (MVL) (With HydoBio's Initial Thoughts for Remediation)
- Technical Memorandum April, 2007: Managed Vegetation Cover-2005 Growing Season

3.1 Ground Truthing

Similar to the LADWP approach for assessing vegetative cover, GBUAPCD uses concurrent collection of ground truthed data (in the form of vegetative cover measurements) to calibrate Quickbird satellite images. In December 2003, a LADWP team (composed of CH2M HILL and Earthworks staff) shadowed GBUAPCD staff in the field as ground truthed data were being collected with a PF device. At that time, the PF data were being collected with the 10-pin 18-inch-wide metal device (Figure 3-1). The PF central rod was pushed into the ground so that the 10 measurement pins barely came into contact with the ground surface. The technician then analyzed each of the (10) pins of the PF by raising each pin to the full height in the PF and then lowering each slowly. As each pin was lowered, it was recorded as hitting either live, dead, or no vegetation. The results of each PF location were recorded onto standard hard copy tally-forms that were later transcribed into an Excel spreadsheet. The ground truthing activity was completed within 2 days of the satellite imagery acquisition date.

In 2006, a new PF device was used by GBUAPCD for ground truthing vegetative cover (Figure 3-1). The new PF device was 5 feet long with 14 pins compared to the old device, which was 18 inches long and only 10 pins. The new PF device improved ground truth vegetative cover characterization by improving the ability to properly characterize the 5-foot inter-row to inter-row distance.

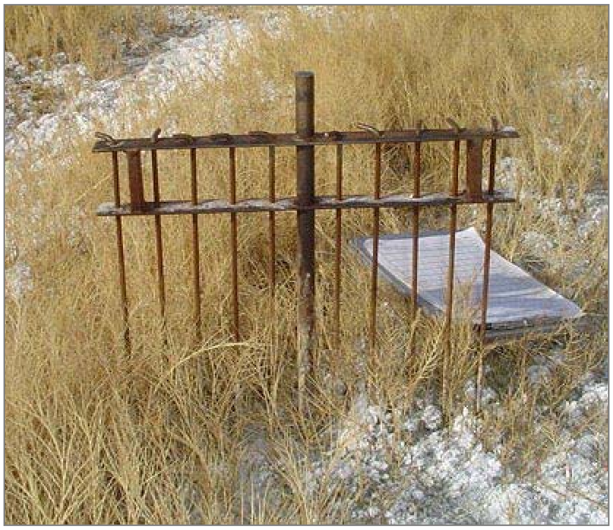

FIGURE 3-1
GBUAPCD Point Frame Device
The original PF device (left photo) was 18 inches wide with 10 pins. The new PF device (right photo) is approximately 5 feet wide with 14 pins.

3.2 Calibration Target Characteristics

3.2.1 Calibration Target Size and Shape

Currently, the GBUAPCD CT size is equivalent to a 5.5m-radius circle, which is approximately 95 m^2 (1023 ft^2). This area equates to 16 QB pixels, which are averaged and compared to percent cover derived from 30 PF measurements. One PF measurement characterizes approximately 0.05 m^2 (0.5 ft^2)[1]. The 30 PF measurements taken per CT site represent approximately 1.5 percent of the CT area.

3.2.2 Calibration Target Quantity and Distribution

The quantity and distribution of CT sites is important to proper image calibration and validation. Currently, GBUAPCD ground truths a total of 28 calibration sites. It appears that when possible, the same sites have been used repeatedly year after year. Current GBUAPCD CT locations are presented in Figure 3-2.

As stated in the previous section, the distribution of CT sites compared to the MV cover distribution is equally important to proper image calibration and validation. Current GBUAPCD calibration site distributions relative to the estimated MV Site distribution are presented graphically in Figure 3-3.

[1] Area characterized by a single PF measurement was estimated assuming a 5-foot PF, characterizing an area 5 feet long by 3 inches wide. Although PF measurements are usually not quantified in this manner, it is useful for quantification of area characterized for vegetative cover per CT.

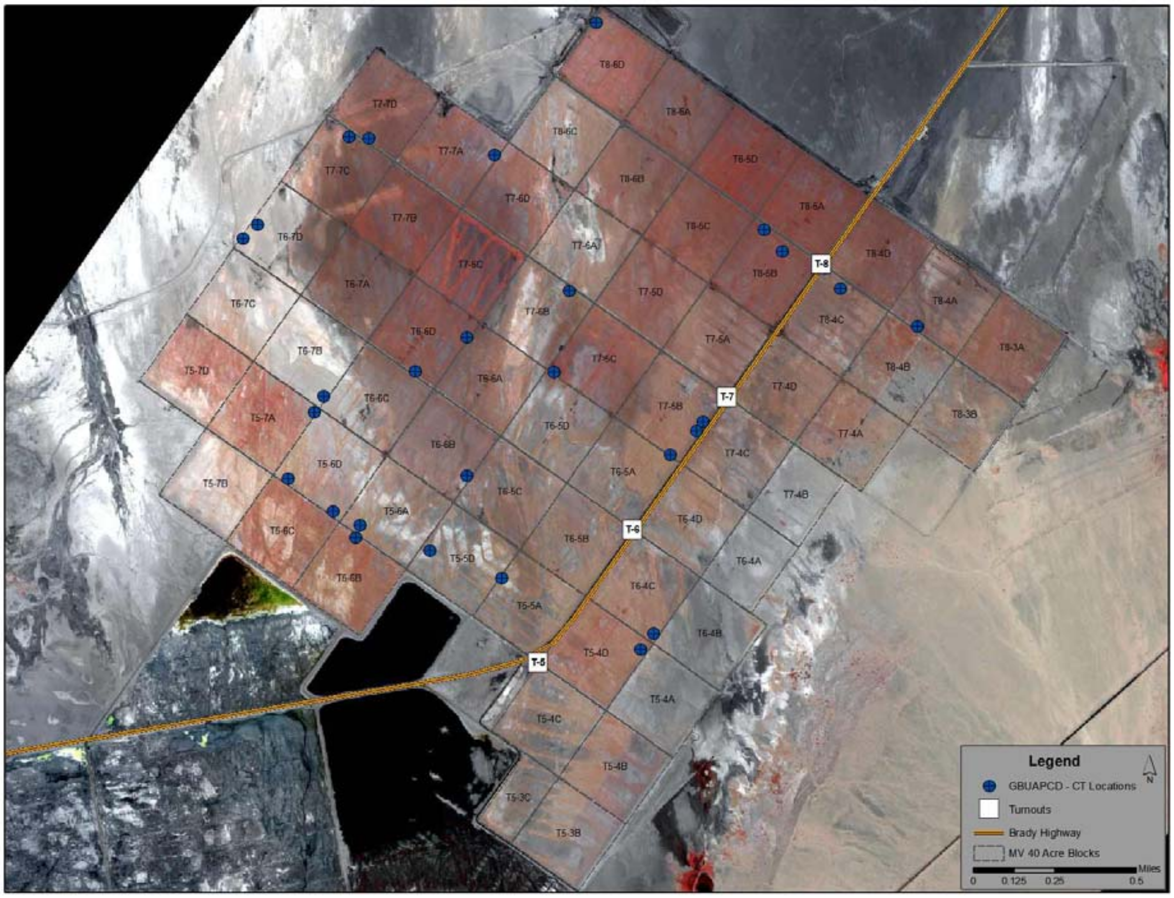

FIGURE 3-2
Current GBUAPCD CT Locations

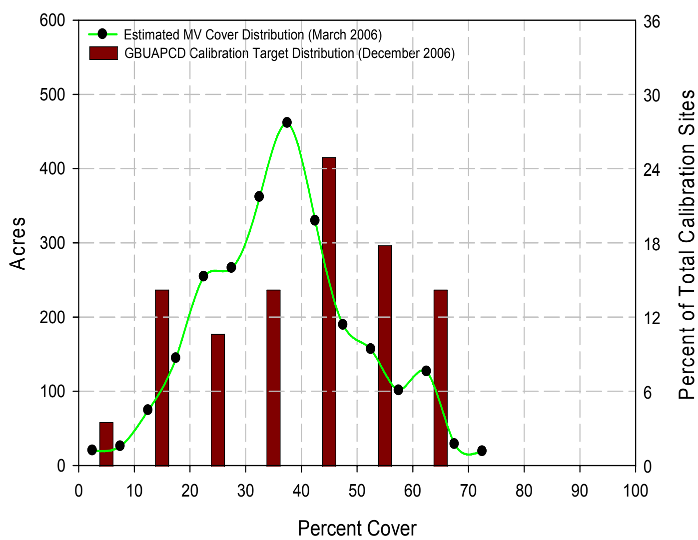

FIGURE 3-3
Current GBUAPCD Calibration Target Distribution Relative to the MV Cover Distribution

3.3 Remote Sensing Image Analysis

3.3.1 Quickbird Image Preprocessing and Vegetative Index/Ratio Calculation

Comparable to the LADWP approach, GBUAPCD image analysis uses imagery from the QuickBird satellite. Details described in several HB Reports and Memorandum (HydroBio 2003-2007) suggests that the standard remote sensing procedures (identical to LADWP methods) are used by GBUAPCD. The following procedures are understood to be identical to those used by LADWP and outlined in Section 2.3.

1. QuickBird image preprocessing
   - Geometric correction
   - Conversion to top of atmosphere radiance
   - Conversion to reflectance (for vegetative indices only)
   - Dark object subtraction
2. Vegetative indices/ratio calculation
   - NDVI
   - SAVI
   - NDVI Offset and NDVI*[2]
   - 4/2 Ratio Image
   - 4/1 Ratio Image
   - 3/2 Ratio Image
   - 3/1 Ratio Image

3.3.2 Linear Regression and Percent Cover Calibration

GBUAPCD linear regression and percent cover calibration are calculated from 28 ground control sites. The ground truth values (percent cover for each CT) are obtained from PF measurements described in the previous sections. Vegetative cover categories include percent green, percent brown, and percent bare ground. The total percent vegetated cover is determined based on the sum of the percent green and percent brown categories.

Mean values are then obtained from each of the processed index and ratio calculations. For each of these images, a 5.5m-radius circle (equal in area to a 4x4 pixel array) is used to extract the mean value for each ground truth site location. The values for each location, for each index or ratio, are added to a spreadsheet containing the ground truth percent cover data. The geographically common PF percent cover values and the 5.5m-radius circle mean calculation values are correlated through a linear regression calculation that results in a slope and intercept value defining the relationship of the correlation.

The slope and intercept from the index or ratio with the highest coefficient of determination (R^2) are applied with a calibration model ((index x slope) + intercept) back to the satellite index or ratio. The final product of the calibration model is a percent cover continuum of values in the imagery, i.e., a percent cover map.

[2] NDVI Offset and NDVI* have been mentioned by HB in several reports and memoranda, but LADWP is not currently calculating these indices for vegetative cover assessment.

SECTION 4.0
PROPOSED PLAN OF ACTION AND FUTURE COMPLIANCE MONITORING METHODOLOGY

Documented in the previous sections are the current methods used by LADWP and GBUAPCD to quantitatively verify vegetative cover on the MV Site. The basic foundations from which the two methods are constructed are quite similar. Both use ground truth data to calibrate a QuickBird image, resulting in a spatial estimate of vegetative cover. While several similarities are apparent, some minor differences in the mechanics of ground truthing and image calibration do exist. This section identifies those similarities and differences and proposes a collaborative path forward for future compliance monitoring efforts. Current similarities and differences between the two methods are outlined in Table 4-1 and detailed in the following sections.

TABLE 4-1
LADWP and GBUAPCD Managed Vegetative Compliance Monitoring Methods
Comparison of LADWP and GBUAPCD ground truthing tools, calibration target characteristics, and QB image analysis techniques.

Specification	Current LADWP Method	Current GBUAPCD Method	Proposed Future Method
Ground Truthing Tool			
Type	DPF	Traditional PF	DPF Methodology
Size	1 DPF: 1.6 m^2 (16.7 ft^2)	1 PF: 0.05 m^2 (0.5 ft^2)	
Documentation	Photo history that can be traced and recreated; electronic database of results	Electronic Database of Results	
Calibration Target Characteristics			
Shape	Square 3x3 QB Pixel Area	5.5m-radius circle	5.5m-radius circle
Size	51.8 m^2 (558 ft^2)	95 m^2 (1,023 ft^2)	95 m^2 (1,023 ft^2)
Area Ground Truthed	1 DPF equivalent to 1.6 m^2 (16.7 ft^2) or 3% of the calibration target area	30 PFs equivalent to 1.4 m^2 (15 ft^2) or 1.5% of the calibration target area	9.5 m^2 (102 ft^2) or 10% of the calibration target area
Number	51 sites	28 sites	40 sites
Distribution	See Figure 4-2A	See Figure 4-2A	See Figure 4-2B
QB Image Analysis Techniques			
Image Preprocessing	Geocorrection, Conversion to TOA, Conversion to RefleCTnce, Dark Object Subtraction	Geocorrection, Conversion to TOA, Conversion to RefleCTnce, Dark Object Subtraction	Geocorrection, Conversion to TOA, Conversion to RefleCTnce, Dark Object Subtraction
Index / Ratio Calculated	NDVI, SAVI, 3/2 ratio, 4/2 ratio, 4/1 ratio, 3/1 ratio	NDVI, SAVI, 3/2 ratio, 4/2 ratio, 4/1 ratio, 3/1 ratio	NDVI, SAVI, 3/2 ratio, 4/2 ratio, 4/1 ratio, 3/1 ratio

TABLE 4-1
LADWP and GBUAPCD Managed Vegetative Compliance Monitoring Methods
Comparison of LADWP and GBUAPCD ground truthing tools, calibration target characteristics, and QB image analysis techniques.

Specification	Current LADWP Method	Current GBUAPCD Method	Proposed Future Method
Index / Ratio Calibration	Index / ratio calibrated using linear regression on 25 of 51 calibration sites	Index / ratio calibrated using linear regression on 28 of 28 calibration sites	Index / ratio calibrated using linear regression on 25 of the 40 calibration sites
Index / Ratio Validation	Index / ratio validated using 26 of the 51 calibration sites	None	Index / ratio validated using 15 of the 40 calibration sites
Index / Ratio Selection Criteria	Strictly use NDVI	Varies based on R^2	Index / ratio selection criteria based on R2 and validation results
Data Format and Sharing	LADWP Only	GBUAPCD Only	Open book policy between the two parties

4.1 Ground Truthing Tool

Currently, LADWP and GBUAPCD are utilizing different ground truthing tools to assess vegetative cover. GBUPACD uses a traditional PF method; LADWP uses a novel DPF method. Both methods have merit in quantifying vegetative cover, but each has inherent advantages and disadvantages. The traditional PF method is field proven, yet can be considered subjective in nature. Checking of past PF results after field collection is impossible. DPF results can be traced through time, recreated from archived DPF images, and re-processed to validate previous measurements long after the related field conditions have passed. A recent study of sagebrush steppe vegetation by Seefeldt and Booth (2006) confirmed the advantages of ground truthing vegetative cover with 2m AGL digital images. They found that for the purpose of measuring plant cover, digital photos taken from 2m AGL performed as well or better than traditional visual estimation techniques for speed, standard deviation, and cost. They concluded that the acquisition of permanent digital photos taken at 2m AGL are an important advantage because vegetation can be analyzed retrospectively using improved software or to answer different questions; and changes in vegetation over time can be more accurately determined, particularly if quadrats are permanently located.

While DPF technology has proven successful at evaluating vegetative cover, direct assessment of its accuracy and reliability in producing comparable results to traditional PF methodology has not been attempted. For this reason, it is proposed that a side-by-side, quantitative comparison between the two methods be completed. The results of the evaluation are of interest to both GBUAPCD and LADWP, so it is proposed that the comparison be conducted in a collaborative manner, with GBUAPCD participation in field work, open sharing of data and results of analyses, and joint development of a single, shared interpretation and implications for future monitoring of vegetation. It is further proposed that the study be focused on evaluation of the DPF methodology as proposed by LADWP relative to traditional point framing. Finally, it is proposed that a single protocol should be drafted by LADWP for use in developing future PMPs, and that this protocol should then be reviewed and finalized with GBUAPCD[3].

[3] The collaborative study proposed in this section was completed June 2007. Final methodology utilized and subsequent results of the study are attached to this document as Addendum A.

4.1.1 Proposed Collaborative Study

Direct comparisons of percent cover estimates within each DPF for each CT will be evaluated for accuracy and repeatability. Within each CT area (CT) a systematic sampling grid will be assigned to indicate the sampling locations of the DPF photos (Figure 4-1). While the a-priori locations of the sampling points would be systematic, once applied in the field, these would yield conditions randomly distributed across the range of vegetation cover existing in each CT, and independent of the field technician's judgment. DPF images will be taken from inter-row to inter-row and analyzed in by three different techniques to obtain three comparable vegetative cover estimates. The three techniques consist of:

1. Analyzing vegetative cover over the entire image with spectral classification methodology, essentially sampling the entire 16.5 feet^2 area of the images (~17 percent of the CT).
2. Analyzing a subset of each picture by overlaying a set of grid points along several linear transects ("digital pins"). By systematically sub sampling points in the image, this methodology is the digital equivalent to the traditional PF method applied by the GBUAPCD (Section 3), except that a larger number of points are observed, and the points are in a two-dimensional grid as opposed to the PF's linear array.
3. Ground-based PF measurements will be completed within each DPF footprint. The amount and location of the ground-based PF measurements within the DPF footprint will be determined in the field by LADWP and GBUAPCD personnel. A set of random x-y locations and orientations will be available for the field team's use in locating PF observations, if desired.

The three vegetative cover estimates derived from the techniques above will be compared within and among all DPF photos per CT. Results will be used to evaluate the validity of DPF methodology to traditional PF methodology.

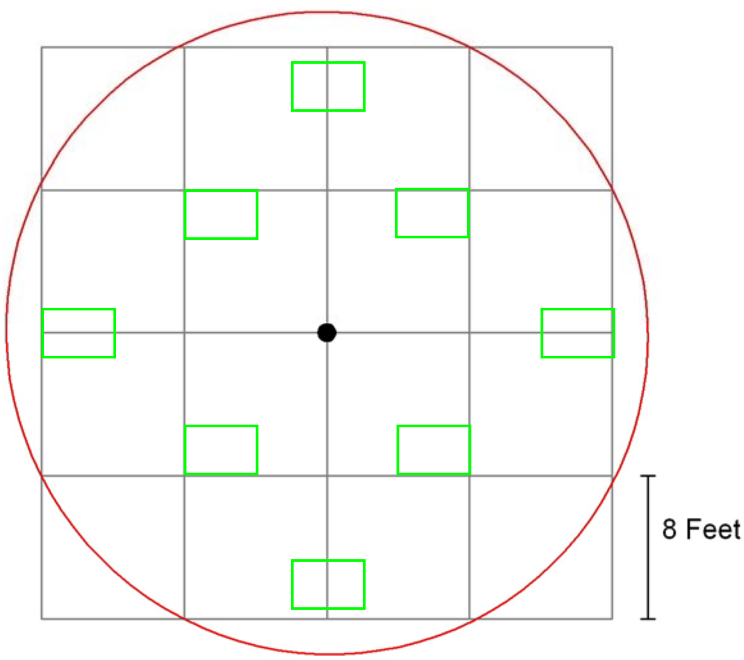

FIGURE 4-1
Conceptual Design of Calibration Target Layout
Shown is the proposed 5.5m-radius circle used for the ground truth measurements (red circle), the 2.4m grid cells as seen by the QuickBird satellite (gray lines), and the DPF locations (green rectangles). Ground-based PF measurements will be made within each DPF footprint (green rectangles).

4.2 Calibration Target Area Characteristics

As discussed previously, accurate satellite image calibration is dependent on several CT characteristics. These include CT size, shape, number, distribution, and internal homogeneity. Several similarities and relatively few differences existed between the GBUAPCD and LADWP methods (Table 4-1). Each characteristic is discussed below and if differences were identified, a plan to address the differences is presented.

4.2.1 Calibration Target Size and Shape

Currently, GBUAPCD CTs are sized to a 5.5m-radius circle centered on each CT site. Each CT consists of approximately 16 QB pixels and characterizes an area of 95 m^2 or 1,023 ft^2. The 16 QB pixels are averaged and compared to a percent cover value derived from approximately 30 PF measurements. Those 30 PF measurements characterize an area of approximately 15ft^2, which equates to roughly 1.5 percent of the CT area. In contrast, each LADWP CT is equivalent to a 3x3 QB pixel area (9 QB pixels), which is approximately 52 m^2 or 558 ft^2. The 9 QB pixels are averaged and compared to percent cover derived from one DPF photo. One DPF photo characterizes 16.5 ft^2 which is 3 percent of the CT area.

The differences in methods explained above are relatively minor. GBUAPCD's CT area is circular compared to LADWP's square pixel method. LADWP's CT area is roughly half the size of GB's CT area. While this may seem significant, both characterize relatively small areas. It is proposed that future CT areas be sized according to current GBUAPCD methodology, equivalent to the area of a 5.5m-radius circle (95 m^2 or 1,023 ft^2).

Both methods inadequately characterize percent cover relative to the entire area of the calibration site. GBUAPCD's method characterizes approximately 1.5 percent of the CT area with the PF device, while LADWP's method characterizes approximately 3 percent of the area using DPFs. To ensure that CT vegetative cover levels are adequately characterized, the percentage of area evaluated for vegetative cover within the each CT should be increased to minimum of 10 percent. Statistical analysis of subsampling variability can then be applied to optimize the number of subsamples, which may turn out to be different than this initial, conservative level. The optimum subsample number may change over time, so it is recommended that the 10 percent subsample be retained through several events and varying conditions, and that all of these events should be analyzed to help select an optimum long-term subsampling intensity.

4.2.2 Calibration Target Quantity and Distribution

As discussed in Sections 2.2 and 3.2, GBUAPCD and LADWP methods utilize different quantities of CT sites. GBUAPCD samples anywhere from 16 to 28 CT sites, while LADWP samples 51 CT sites. For future compliance monitoring events, it is proposed that a total of 40 CT sites, composed from historic LADWP and GBUAPCD CT locations, be utilized (Figure 4-2). Of the total 40 CT sites, 25 would be employed to build the QuickBird calibration curve, and the remaining 15 would serve as an independent dataset. The latter is necessary to assess the performance of the calibration model with statistics independent of the original calibration. This method provides a more meaningful evaluation of performance than the R^2 of the calibration itself, by assessing the success of the model in accurately mapping cover at various locations on the site. Ultimately, the coefficient of determination and the independent data set will be used together to determine which band ratio calculation is most appropriate for that particular satellite image date. This flexibility in choice of band ratio for each date is similar to the approach that has been taken by HydroBio, and differs from the consistent use of the same band ratio (despite variable performance over time) taken by LADWP.

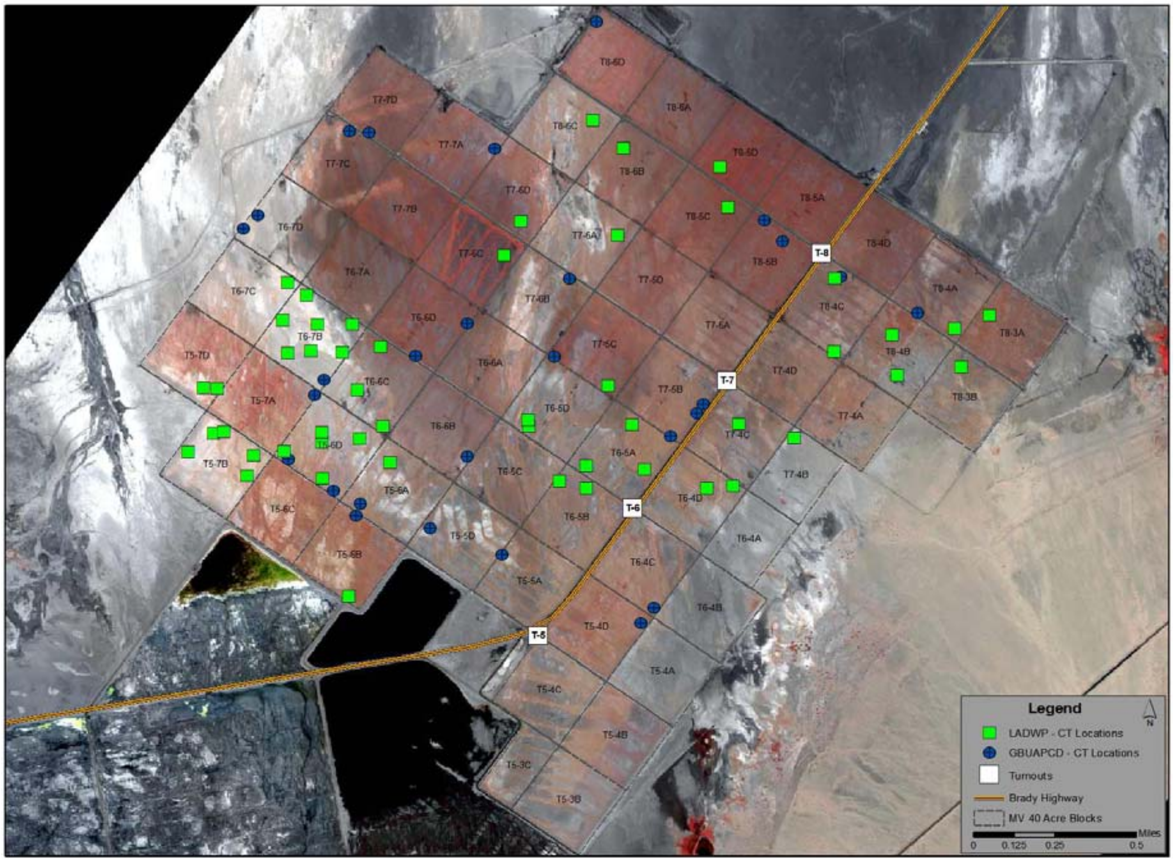

FIGURE 4-2
Current GBUAPCD and LADWP CT Locations
Future CT locations should be composed of historic GBUAPCD and LADWP CT locations where possible.

Equally important to image calibration is the distribution of CT sites relative to the distribution of vegetative cover on the MV Site. The 40 CTs will be distributed over different cover classes to: 1) Represent the full range of cover classes on the MV Site, and, 2) provide an emphasis on the cover classes of greatest interest for compliance purposes (0 to 30 percent). The cover distribution of the current GBUAPCD and LADWP sites is shown in Figure 4-3A. While the GBUAPCD CT sites overrepresent the higher cover classes, LADWP CT sites have insufficient representation in middle cover classes (20 to 40 percent cover). It is proposed that a distribution similar to that depicted in Figure 4-3B be adopted, to provide sufficient characterization in all cover classes for both calibration as well as verification purposes, and to emphasize the critical 0 to 30 percent interval.

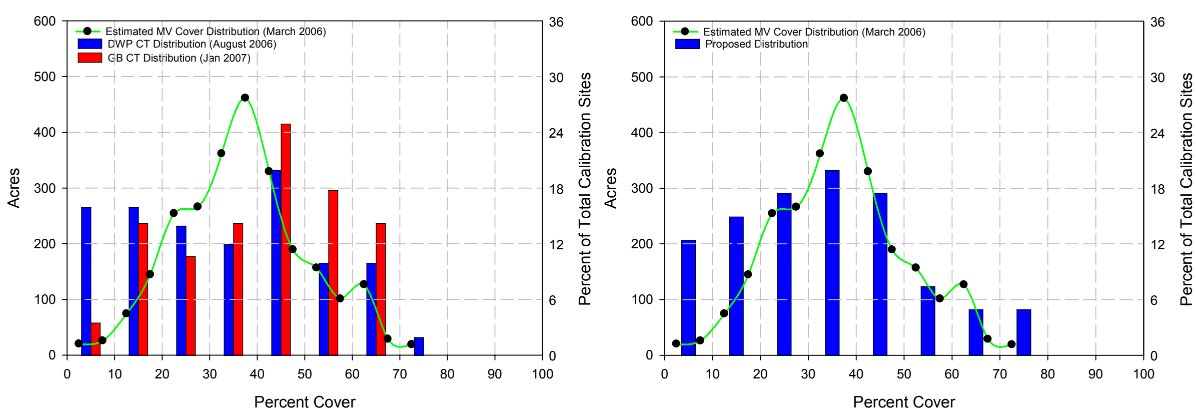

FIGURE 4-3
Figure 4-3.A: Estimated MV Cover Distribution relative to LADWP and GBUAPCD Calibration Site Distribution
Figure 4-3.B: Estimated MV Cover Distribution and Proposed Calibration Site Distribution

4.2.3 Calibration Target Homogeneity

DWP and GBUAPCD have made extensive efforts in the past to select CT sites that appear to be homogenous in cover. Subsampling results for vegetative cover within each CT will be analyzed for homogeneity. From these data, a homogeneity criterion will be statistically derived and used to identify suitable CTs for future monitoring efforts.

4.3 QuickBird Image Analysis Criteria

LADWP and GBUAPCD methods for preparation of QuickBird images for verifying vegetative cover are almost identical. Methodology for future compliance monitoring events is detailed in the following sections.

4.3.1 Preprocessing of Quickbird Satellite Images

Steps outlined in Table 4-2 (identical to current GBUAPCD and LADWP methodologies) will be followed to prepare Quickbird images for mapping vegetative cover.

TABLE 4-2
QuickBird Image Preprocessing Steps
The steps outlined in this Table will be used to preprocess QuickBird imagery.

Preprocessing Correction Conversion	Explanation	Method Details
Geometric correction (GC)	GC is used to rectify the satellite image to known ground control points. This essentially adjusts the image to known corresponding visual features.	Increase the quantity of differential GPS coordinates of known visual features used as GC points to visually identify in reference panchromatic (0.6m image) and newly acquired panchromatic image, geometric model calculated and applied to both 0.6m Pan and 2.4m Multispec imagery. Image projection parameters used for GC: UTM, Zone 11, GRS 1980 Spheroid; NAD83 Datum; Nearest Neighbor Resampling; 2.4 Meter Pixel Size
Conversion of image digital number (DNs) to top-of-atmosphere (TOA) Spectral Radiance	Conversion to TOA spectral radiance normalizes the data for the incident energy of the sun. This changes with solar angle and distance which is a factor of time of day and year.	Each band of the image is multiplied by a K-Conversion Factor and divided by the bandwidth to obtain TOA radiance values. K -Conversion Factors and Bandwidths: Band 1 = 0.0160412, 0.068; Band 2 = 0.0143847, 0.099; Band 3 = 0.0126735, 0.071; Band 4 = 0.0154242, 0.114
Conversion of TOA radiance to reflectance	Relectance values are used in the calculation of some vegetative indices (e.g., NDVI, SAVI, etc.).	Reflectance calculation: (image band x earth-sun distance x pi) / (irradiance x COS(90 degrees – sun elevation) The Earth – Sun Distance is estimated from the Landsat Data User's Handbook*. Sun elevation and Exoatmospheric Solar Spectral Irradiance are provided in the image metadata from the Satellite Image Vender DigitalGlobe.
Dark object subtraction (DOS)	DOS corrects for atmospheric scatter and other environmental conditions.	The histogram of each band of the refleCTnce image is observed and the value at the low end of the curve, which is at the point of having a significant number of pixels (~100) is recorded. That value is then subtracted from its source band to shift the low value close to what should be the actual lowest value.

TABLE 4-2
QuickBird Image Preprocessing Steps
The steps outlined in this Table will be used to preprocess QuickBird imagery.

Preprocessing Correction Conversion	Explanation	Method Details

* Source: Table 11.4 Earth-Sun Distance in Astronomical Units in the Landsat Data User's Handbook.

4.3.2 Producing Vegetation Indices/Ratios from Satellite Images

Standard vegetative indices and ratios have been calculated by LADWP and GBUAPCD. It has been documented extensively by GBUAPCD and LADWP that the ratio or index providing the best correlation with vegetative cover varies due to environmental and atmospheric conditions. For that reason, we will test all indices and ratios to identify the most appropriate candidate for each vegetative cover estimate. Not only should indices and ratios that have been used in the past be calculated for continuity and historical reference, but others that appear to hold promise should be evaluated. A number of standard indices and ratios common to remote sensing that might produce a strong relationship to observed vegetative cover are presented in Table 4-3.

TABLE 4-3

Vegetative Indices and Ratios

This table contains a list of vegetative indices and ratios that are currently used by GBUAPCD or LADWP. In addition, other documented indices and ratios are presented for potential use in future compliance monitoring efforts.

Vegetative Index or Ratio	Mathematical Formula
Normalized Difference Vegetative Index (NDVI).[a]	NDVI = (band 4 – band 3) / (band 4 + band 3)
Normalized Difference Vegetative Index Offset ($NDVI^{OFFSET}$) [a]	GBUAPCD Formula
Normalized Difference Vegetative Index* (NDVI*) [a]	GBUAPCD Formula
Soil Adjusted Vegetative Index (SAVI). [a]	SAVI = (band 4 – band 3) / (band 4 + band 3 + 0.5) * (1 + 0.5)
4/2 Ratio Image [a]	Band 4 / Band 2
4/1 Ratio Image [a]	Band 4 / Band 1
3/2 Ratio Image [a]	Band 3 / Band 2
3/1 Ratio Image [a]	Band 3 / Band 1
Ratio Vegetation Index (RVI)[b]	RVI = NIR/Red
Infrared Percentage Vegetation Index (IPVI) [b]	IPVI = NIR/NIR + Red
Difference Vegetation Index (DVI) [b]	DVI = NIR – Red
Perpendicular Vegetation Index (PVI) [b]	PVI = sin(a)NIR – cos(a)Red where a is the angle between the soil line and the NIR axis
Weighted Difference Vegetation Index (WDVI) [b]	WDVI = NIR – g * Red where g is the slope of the soil line
Transformed Soil Adjusted Vegetation Index TSAVI) [b]	TSAVI = s(NIR – s * Red – a)/(a * NIR + Red – a * s + X * (1 + s * s) where a is the soil line intercept, s is the soil line slope, and X is an adjustment factor which is set to minimize soil noise (0.08 in original papers)

TABLE 4-3

Vegetative Indices and Ratios

This table contains a list of vegetative indices and ratios that are currently used by GBUAPCD or LADWP. In addition, other documented indices and ratios are presented for potential use in future compliance monitoring efforts.

Vegetative Index or Ratio	Mathematical Formula
Modified Soil Adjusted Vegetation Index (MSAVI) [b]	MSAVI = (NIR – Red/NIR + Red + L) * (1 + L) where L = 1 - 2*s*NDVI*WDVI
second Modified Soil Adjusted Vegetation Index (MSAVI2) [b]	MSAVI2 = (1/2) * (2* (NIR + 1) – sqrt((2 * NIR + 1)2 – 8(NIR – Red))
Enhanced Vegetation Index (EVI) [b]	EVI = 2.5 * (NIR – Red) / (NIR + (6 * Red) – (7.5 * Blue) +1
Green Difference Vegetation Index (GDVI) [b]	GDVI = NIR – Green
Green Normalized Difference Vegetation Index (GNDVI) [b]	GNDVI = (NIR – Green) / (NIR + Green)
Green Optimized Soil Adjusted Vegetation Index (GOSAVI) [b]	GOSAVI = (NIR – Green) / NIR + Green + 0.16)
Green Ratio Vegetation Index (GRVI) [b]	GRVI = NIR / Green
Green Soil Adjusted Vegetation Index (GSAVI) [b]	GSAVI = ((NIR – Green) / (NIR +G + 0.5)) * 1.5
Norm NIR [b]	Norm NIR = NIR / (NIR + Red + Green)
Norm R [b]	Norm R = Red / (NIR + Red + Green)
Norm G [b]	Norm G = Green / (NIR + Red + Green)
Rel NIR [b]	Rel NIR = NIRplot / NIRreference plot
Rel Red [b]	Rel Red = Redplot / Redreference plot
Rel Green [b]	Rel Green = Greenplot / Greenreference plot
Optimized Soil Adjusted Vegetation Index (OSAVI)	OSAVI = (NIR – Red) / (NIR + Red + 0.16)
Relative Difference Vegetation Index (RDVI) [b]	
Relative Green Difference Vegetation Index (RGDVI) [b]	RGDVI = GDVIplot / GDVIreference plot
Relative Green Normalized Difference Vegetation Index (RGNDVI) [b]	RGNDVI = DVIplot / DVIreference plot
Relative Green Optimized Soil Adjusted Vegetation Index (RGOSAVI) [b]	RGOSAVI = GOSAVIplot / GOSAVIreference plot
Relative Green Ratio Vegetation Index (RGRVI) [b]	RGRVI = GRVIplot / GRVIreference plot
Relative Green Soil Adjusted Vegetation Index (RGSAVI) [b]	RGSAVI= GSAVIplot / GSAVIreference plot
Relative Normalized Difference Vegetation Index (RNDVI) [b]	
Relative Optimized Soil Adjusted Vegetation Index (ROSAVI) [b]	ROSAVI = OSAVIplot / OSAVIreference plot
Relative Ratio Vegetation Index (RRVI) [b]	PRVI = RVIplot / RVIreference plot

TABLE 4-3

Vegetative Indices and Ratios

This table contains a list of vegetative indices and ratios that are currently used by GBUAPCD or LADWP. In addition, other documented indices and ratios are presented for potential use in future compliance monitoring efforts.

Vegetative Index or Ratio	Mathematical Formula
Relative Soil Adjusted Vegetation Index (RSAVI) [b]	RSAVI = SAVIplot / SAVIreference plot
Atmospherically Resistant Vegetation Index (ARVI)[b]	ARVI = -0.18 + 1.17 * NDVI
Soil Corrected & Atmospherically Resistant Vegetation Index (SARVI) [b]	SARVI = Corrected NIR – Corrected rb / Corrected NIR + Corrected rbWhere Corrected rb = Corrected Red – γ(Corrected Blue – Corrected Red) and γ is an analyst supplied value between 0.7 and 1.3
Simple Ratio Vegetation Index (SRVI) [b]	
Modified Non-Linear Vegetation Index (MNLI) [b]	MNLI = (NIR2 – Red)(1 + L) / (NIR2 + Red + L)
Modified Simple Ratio (MSR) [b]	MSR = (NIR/Red – 1) / (NIR/Red)1/2 + 1
NDVI*SR [b]	NDVI*SR = (NIR2 – Red) / (NIR + Red2)
SAVI*SR [b]	SAVI*SR = (NIR2 – Red) / (NIR + Red + L) * Red

[a] Vegetative indices or ratios historically used by GBUAPCD or LADWP.
[b] Other documented vegetative indices or ratios that could be useful for compliance monitoring efforts.

4.3.3 Linear Regression Calibration and Selection Criteria for Indices and Ratios

Linear regression will be performed with each of the processed indices and ratios. Mean vegetative cover values within each of 25 of the 40 calibration sites will be employed. The slope and intercept for each will be applied to the source index or ratio to produce preliminary vegetation cover maps. The predicted percent cover by each method will then be checked against the mean of cover results within each of the remaining 15 validation sites. The statistical comparison of the linear regression equations with this independent dataset will then be used to determine which combination of field and remote sensing methodologies produces the most accurate result, and should be retained to generate the final vegetation cover map. Specific statistical methods and their explanation are given in Table 4-4

TABLE 4-4

Vegetative Model Statistical Performance Measures

Statistical methods used for ranking vegetative index ratio model performance

Vegetative Model Statistical Performance Measures	Definition / Explanation for Use
R^2-calibrate	Coefficient of determination based on the linear regression between the vegetative indices / ratios and the ground-based cover measurement. The corresponding linear regression curve serves as the calibration equation based on which the cover of the entire MV-area is estimated

TABLE 4-4
Vegetative Model Statistical Performance Measures
Statistical methods used for ranking vegetative index ratio model performance

Vegetative Model Statistical Performance Measures	Definition / Explanation for Use
R^2-check	Coefficient of determination based on the linear regression between actual ground-based cover measurements and the estimated cover based on the calibration equation. Since this regression is based on an independent set of field sampling points that was not applied to built the calibration curve, this can be considered an independent test of the "goodness of fit" of the calibration equation.
Mean normalized bias (MNB)	MNB is defined as the difference between the predicted and the observed cover values, of the independent data set, normalized to the observed cover value. It provides an indication of the overall error in the cover prediction model, as well as the direction of the error, specifically, over- or under prediction.
Mean normalized error (MNE)	MNE is defined as the mean of absolute values of MNB, and therefore does not distinguish between under- and over predictions. This makes it a suitable indicator of the overall magnitude of the mean error, since over- and under predictions do not cancel each other out, as is the case with the MNB.
Mean fractional bias (FB)	FB is defined as the mean of the differences between the predicted and the observed cover values, of the independent data set, normalized to the sum of the observed and predicted cover values. This normalization step reduces the influence of large outlying values, either over- or over predictions, on the mean error statistic. It provides an indication of the overall error, as well as the direction of the error, specifically, over- or under prediction.
Mean absolute fractional bias (AFB):	AFB is defined as the mean of the absolute differences between the predicted and the observed cover values, of the independent data set, normalized to the sum of the observed and predicted cover values. This normalization step reduces the influence of large outlying values on the mean error statistic. Similar to the MNE, it is an indicator of the overall magnitude of the mean error, since over- and under predictions do not cancel each other out, as is the case with the FB.

As an example, the relative performance of the each ratio / index for each statistical comparison described in Table 4-4 (six per image date) for the March 2005 QB image are presented in Table 4-5. Only ratios and indices historically used by GBUAPCD and LADWP are presented in this analysis.

In the future, when a QB image is acquired for cover estimate purposes, statistical results will be used to sum, score, and ultimately rank each of the ratio / indices from Section 4.3.2 based on the following two steps:

1. Sum each of the five independent model performance measures, essentially all of the above except the R^2-calibrate, by calibration method. The overall sum consists of the sum of each the error indices and the inverse of R^2-check (Table 4-5). Each index will then be ranked by calibration method. The calibration method with the lowest total sum (and rank) is considered to be the best performing method by this statistical comparison.

TABLE 4-5

Statistical Comparison Method Results

Statistical comparison results for March 2005 QB image.

Ratio / Index	Calibrate R^2	Check R^2	MNB	MNE	FB	AFB	Abs(FB)	Overall Sum[1]	Overall Rank[2]
NDVI	0.56	0.67	0.63	1.09	-0.16	0.49	0.16	3.9	2
SAVI	0.38	0.62	0.61	1.05	-0.11	0.49	0.11	3.9	3
3/2 Ratio	0.49	0.54	0.29	0.93	-0.29	0.62	0.29	4	4
3/1 Ratio	0.38	0.31	0.66	1.35	-0.29	0.68	0.29	6.2	6
4/2 Ratio	0.6	0.64	0.41	0.96	-0.23	0.56	0.23	3.7	1
4/1 Ratio	0.5	0.52	0.63	1.27	-0.29	0.64	0.29	4.8	5

[1] Overall sum equal the sum of individual ranks for respective ratio / indices.

[2] Overall rank determined by overall score. Lowest score = 1, highest score = 5.

2. Determine the most appropriate vegetative index / ratio to be retained by ranking each of the five independent model performance measures, individually (essentially all of Table 4-4 except the R^2 –calibrate) from best to worst, for each statistical method (Table 4-6). The best and worst performing calibration methods are assigned the lowest and highest rank, respectively 1 and 6. Next, all five ranks will be summed over each of the six calibration methods, and the sum of the ranks will be ranked by calibration method. The calibration method with the lowest total sum (and rank) is considered the best performing method.

TABLE 4-6

Statistical Ranking Scores

Ranking Scores for Statistical comparison of the March 2005 QB image. Results derived from Table X-X

Ratio / Index	Calibrate R^2	Check R^2	MNB	MNE	Abs(FB)	AFB	Overall Score[1]	Overall Rank[2]
NDVI	2	1	4	4	2	1	14	2
SAVI	6	3	3	3	1	2	18	3
3/2 Ratio	4	4	1	1	6	4	20	4
3/1 Ratio	5	6	6	6	5	6	34	6
4/2 Ratio	1	2	2	2	3	3	13	1
4/1 Ratio	3	5	5	5	4	5	27	5

[1] Overall score equal the sum of individual ranks for respective ratio / indices.

[2] Overall rank determined by overall score. Lowest score = 1, highest score = 5.

Final ratio / index selection for each image date will be determined by the quantitative results in steps 1 and 2 above. As an example, the 4/2 ratio performed the best for the March 2005 QB image (Table 4-6). It is possible that in some cases more than one method could be considered to perform equally well (i.e. overall sum and score are equal). In this case, a qualitative judgment call will be made on which index or ratio should be selected.

SECTION 5.0
CONCLUSIONS

This report outlined current GBUAPCD and LADWP vegetative compliance monitoring methodologies and proposed a methodology for future compliance monitoring efforts. Several similarities and very few differences were identified between the two methods. When minor differences were recognized, the preferred method for future compliance monitoring events was proposed. , a plan to collaboratively address the difference was proposed. Each characteristic and its associated category are summarized below.

1. Similarities between the two methods included the following:
   - Image analysis preprocessing techniques
   - Image analysis index/ratio calculation
   - Image analysis index/ration calibration techniques

2. Minor differences between the two methods included:
   - CT size and shape
   - CT number and distribution
   - Index / ratio selection criteria
   - Index / ratio validation

3. Significant differences between the two methods for which a collaborative study was proposed include the following:
   - Ground truthing tool

When finalized, the methodology presented in this report for future compliance monitoring events should provide the desired outcomes for regulatory evaluation of vegetative cover at Owens Lake.

SECTION 6.0
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ADDENDUM A

Quantitative Comparison of Digital Point Frame and Traditional Point Frame Ground Truth Data (June 2007)

1.0 Introduction and Purpose

The Los Angeles Department of Water and Power (LADWP) and Great Basin Unified Air Pollution Control District (GBUAPCD) use different ground-truthing tools to assess vegetative cover. GBUPACD uses a traditional point frame (PF) method; LADWP uses a novel digital point frame (DPF) method. Both methods have merit in quantifying vegetative cover, but each has inherent advantages and disadvantages. The traditional PF method is field proven, but it can be considered subjective in nature and verification of PF results after field collection is impossible. DPF results can be traced through time, re-created from archived DPF images, and re-processed to validate previous measurements long after the related field conditions have passed. While DPF technology has proven successful at evaluating vegetative cover in the past, direct assessment of its accuracy and reliability in producing comparable results to traditional PF methodology had not been completed. Therefore, in June 2007 representatives from GBUAPCD and LADWP initiated a collaborative comparison study (study) designed to compare the two methods to determine which method was appropriate for future compliance monitoring events. Comprehensive details on the two methods are presented in the main report to which this addendum is attached.

2.0 Methodology

This section describes the methodology used to identify and characterize vegetative cover on appropriate calibration targets for the study. Additional background information on the basis of each methodology can also be found in the main report, Section 4.0.

2.1 Calibration Target (CT) Selection

Historic GBUAPCD and LADWP CT sites formed the basis from which CT locations were selected for use in the study. Care was taken to identify CT locations that were distributed over different cover classes that: 1) represented the full range of cover classes on the MV Site, 2) provided sufficient spatial distribution across the MV site, and, 3) provided an emphasis on the cover classes of greatest interest for compliance purposes (0 to 30 percent). The actual vegetative cover distributions of the CT locations utilized in the study are shown in Figure A-1a. The spatial distribution of those same sites on the MV is shown in Figure A-1b.

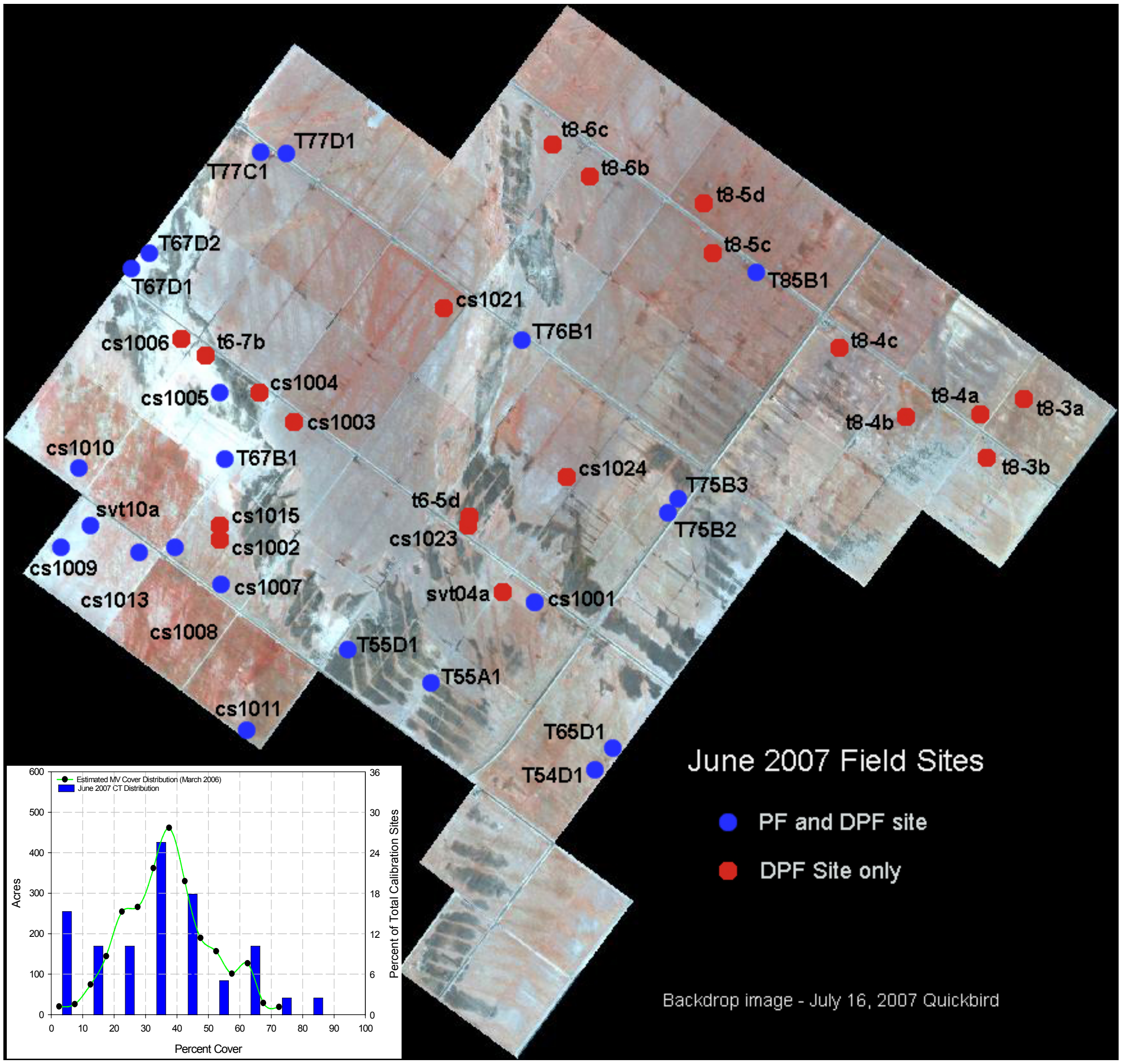


FIGURE A-1
Figure A-1a: Vegetative Cover Distribution of CTs Utilized in the Study
Figure A-1b: Spatial Distribution of CTs used

2.2 CT Vegetative Cover Characterization

As discussed in Section 4.0 of the main report, GBUAPCD and LADWP CT size was determined to be equivalent to a 5.5m-radius circle centered on the middle of the CT location. This size equated to approximately 16 QB pixels, which were averaged and compared to percent cover derived from the PF or DPF measurements discussed below.

PF Characterization Methodology

Current GBUAPCD PF methodology was used in the study. The PF consisted of a 5-foot long device with 14 individual pins used for vegetative cover assessment (Figure A-2). Each pin was raised to the full height of the PF and then individually lowered into the vegetation. As each pin was lowered, it was recorded as a green, brown, silver, or no vegetation "hit".

Consistent with GBUAPCD methodology, a total of 28 PF measurements were made within each calibration target. Care was taken to ensure that the 28 PF measurements were properly distributed to characterize the entire CT area. Results from each PF location were recorded onto standard hard copy tally-forms that were later transcribed into an Excel spreadsheet.

FIGURE A-2
GBUAPCD Point Frame Device
The GBUAPCD PF device is approximately 5 feet wide with 14 individual pins.

DPF Characterization Methodology

Current LADWP DPF methodology was utilized in the study. DPFs were captured using a Sony Cyber-shot DSC-R1 digital camera mounted on a 15-foot Hi-Pod monopod system (Figure A-3). Detailed camera settings used for DPF collection and standard DPF specifications are presented in Table A-1.

FIGURE A-3
DPF Field Equipment Setup
DPF equipment included the use of a high resolution camera mounted on a 15' Hi-Pod monopod.

A total of 8 DPFs, which characterized approximately 134 ft^2, were captured in each CT location. Within each CT area a systematic sampling grid was assigned to indicate the sampling locations of the DPF photos (Figure A-4). While the a-priori locations of the sampling points was systematic, once the points were identified in the field they were randomly distributed across the range of vegetation cover within each CT, and independent of the field technician's judgment. All DPF images were taken from inter-row to inter-row. Extreme care was taken to minimize foot traffic and subsequent stomping of vegetation at each CT location. DPFs were captured before PF measurements because significantly less foot traffic was associated with DPF capture.

TABLE A-1
Digital Camera and DPF Specifications

Item	DPF Specification
Camera Brand	Sony Cyber-shot DSC-R1
Camera Resolution	3888 x 2560 pixels
Exposure Value (E.V.)	0.0
F. Stop	Auto adjust
ISO	160
Shutter Speed	500
Photo height	14.5’ above ground surface
Photo Dimensions	5’ x 3.3’
Surface Area Characterized	16.7 ft^2

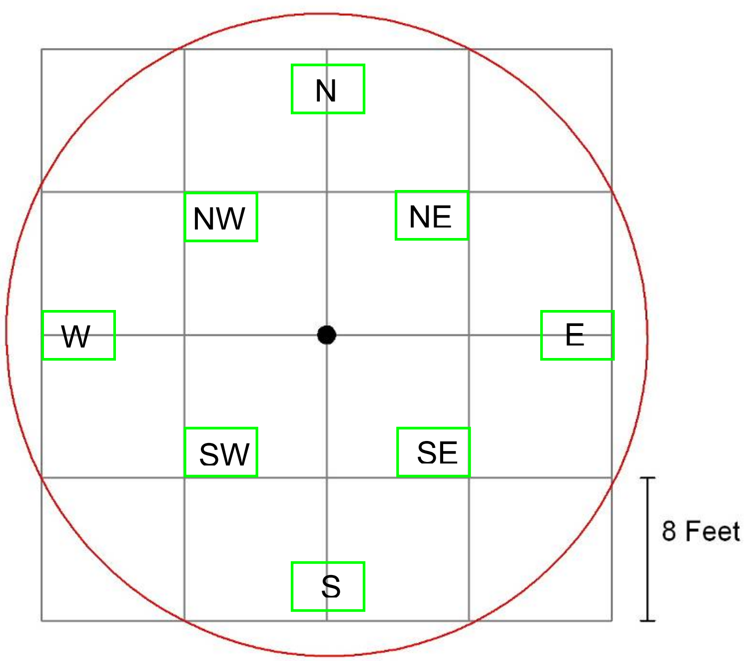


FIGURE A-4
Idealized DPF Locations within CT Layout
Shown is the proposed 5.5m-radius circle used for the ground truth measurements (red circle), the 2.4m grid cells as seen by the QuickBird satellite (gray lines), and the DPF locations (green rectangles). Ground-based PF measurements will be made within each DPF footprint (green rectangles).

Two methods were utilized in assessment of vegetative cover within each DPF. The first method consisted of spectral classification. Specifically, two ratios were calculated from the DPF photos: blue/red (3/1) and green/red (2/1). A threshold was visually set for the blue/red ratio to separate grass from substrate and another threshold was visually set for the green/red ratio that, when combined with the blue/red ratio, separated green grass from brown grass. The output classification image contained green, brown, and no vegetation classes.

The second method consisted of overlaying an ESRI shapefile grid of 50 points (digital pins) on each DPF photo. The center of each digital pin was used in the determination of vegetative cover. Each of the 50 digital pins (per DPF) was characterized as green, brown, silver, or no vegetation hits. This classification was then entered into the attribute table for the shapefile and copied to an Excel spreadsheet, where the mean percent cover was calculated for each site.

3.0 Results and Discussion

Direct comparisons of percent cover estimates between PF and DPF measurements for each CT were evaluated for accuracy and repeatability. In addition, the number of sub-samples (individual PF or DPF measurement) and their influence on mean CT percent cover estimates were evaluated. Specific comparisons completed in the study are listed below:

- DPF Percent Cover Estimation
- PF Percent Cover Estimation
- DPF and PF CT Percent Cover Comparison
- DPF and PF Economic / Labor Analysis

3.1 DPF Percent Cover Estimation

Two methods were used to characterize vegetative cover for each DPF: spectral classification and digital pin classification.

Spectral Classification

To automate DPF classification, spectral analysis was completed on a limited number of DPFs in the study. Results from the spectral classification exercise demonstrated the difficulty in identifying and separating "silver" grass (particularly on the right side of Figures A-5a and A-5b) from the underlying substrate. In addition, bright light-colored grass suffered the same problem as silver grass and was sometimes classified as substrate. Also problematic was the accurate separation of green grass from brown grass (i.e. shades of green appeared as brown in the classification).

Given the difficulties discussed above, spectral classification was not completed on all DPFs and it was not considered a viable option for DPF classification. That said, although spectral classification proved difficult and often inaccurate, more sophisticated remote sensing techniques that make use of additional information contained within the DPF may be the key to solving this problem. Specifically, incorporation of spectral signatures with image morphological features (shape, area, length, width, texture, etc.) will likely improve the classification of the DPFs and may result in a semi-automated approach to DPF cover characterization.

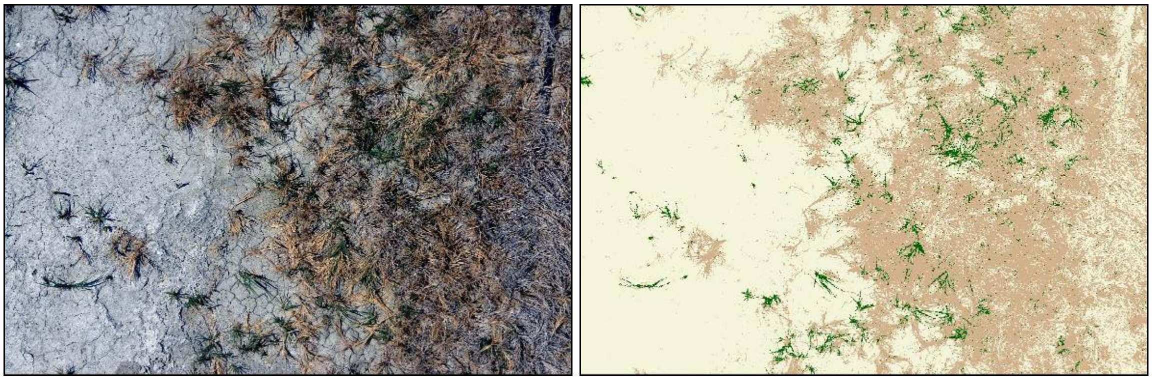


FIGURE A-5
Figure A-5a: DPF in Natural Color
Figure A-5b: DPF Spectrally Classified

Digital Pin Classification

Each DPF was analyzed for percent cover using the digital pin methodology. DPF percent cover values are presented in Appendix A.

In order to understand the number of digital pins needed for accurate DPF vegetative cover characterization, an efficiency analysis was completed to determine the number of pins needed to reach equilibrium in mean vegetative cover within each DPF as well as the number of DPFs needed to reach equilibrium per CT. Pins were randomly and sequentially added to the analysis. Results demonstrated that the area of equilibrium, where variability in calculated percent cover diminished, was near the 30-35 pin range (Figure A-6). This area of equilibrium represented the point at which introduction of additional pins into the percent cover estimation resulted in little or no change in the mean DPF percent cover estimate. This analysis demonstrated that only 30-35 pins are needed for accurate classification, thus resulting in substantial savings of time and labor compared to the classification of all 50 pins.

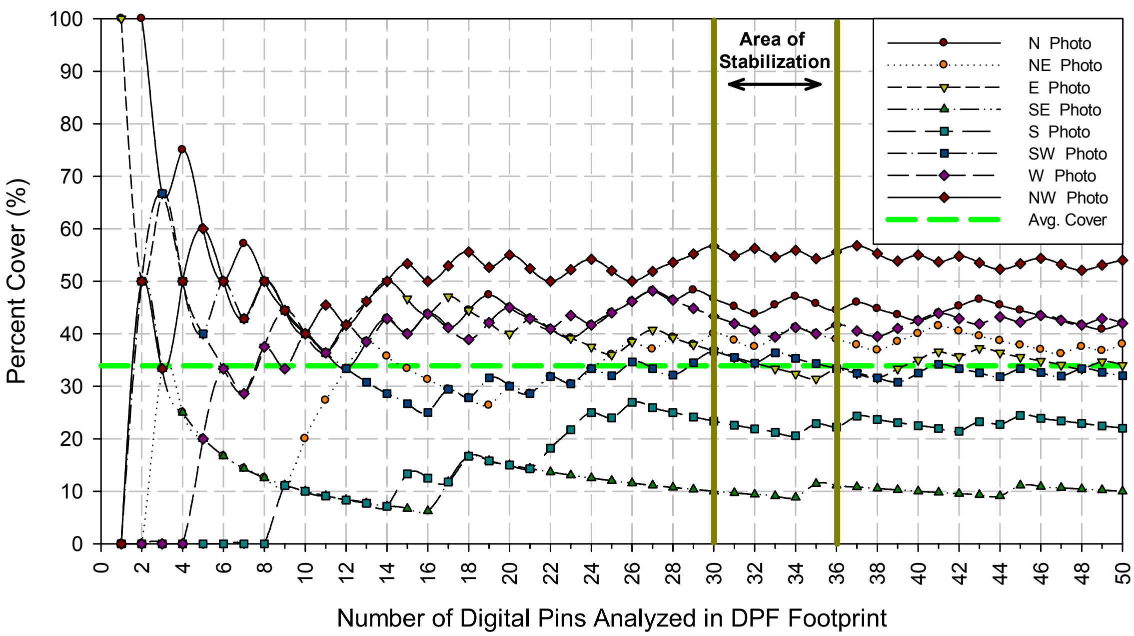


FIGURE A-6
Estimated Percent Vegetative Cover vs. Number of Digital Pins Analyzed for CT CS1001

The second part of the efficiency analysis was completed to determine the number of DPFs needed to reach equilibrium per CT. Results suggested that in most cases, equilibrium in the mean percent cover estimate was reached using 8 DPFs per CT. However, sparsely covered CTs (0-10%) had more cover variability and thus struggled to reach equilibrium using 8 DPFs (Appendix B). This is most likely a result of the inherent variability and non-uniformity of the sparsely covered CTs.

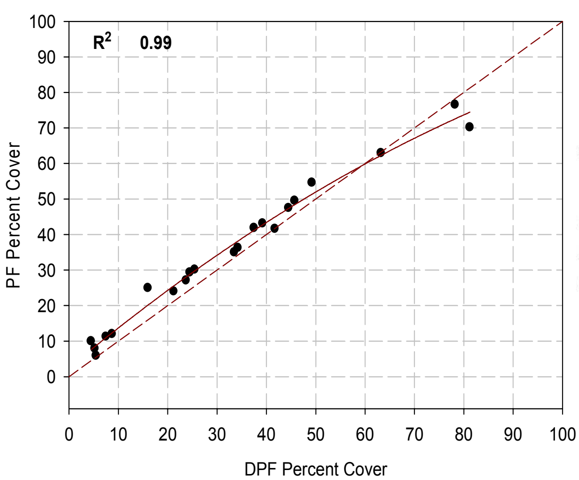
3.2 PF Percent Cover Estimation and Efficiency Analysis

GBUAPCD PF methodology was used to estimate percent cover on 21 of the 40 CTs used in the study (Figure A-1). Percent cover values from the PF methodology are given in Appendix B. Each CT was characterized by 28 PF measurements. Each position where the PF was dropped represented a sub sample used to calculate mean percent cover for the CT. An efficiency analysis was completed to determine if equilibrium in mean percent cover per CT was reached with the 28 sub samples. Results revealed that nearly all CTs reached equilibrium with the 28 sub samples (Appendix B), indicating that the CTs were sufficiently sampled to obtain a good estimate of the mean percent cover.

However, similar to the DPF efficiency analysis, results suggested that CT in the 0-10% cover range struggled to reach equilibrium. This is likely a result of the inherent variability and non-uniformity of the sparsely cover CTs.

3.3 Comparison of DPF vs. PF Results

A total of 21 CT locations were evaluated using PF and DPF ground truth methodology. Of the 21 CTs evaluated, 19 (91%) had less than or equal to 5% absolute difference between PF and DPF estimates (Appendix A). Regression results of PF and DPF demonstrated that the two methods tracked very well with an R^2 of 0.99 (Figure A-7a). Below 50% cover, the traditional PF tended to give slightly higher cover estimates compared to DPF, on average around 3.5% (Figure A-7b). Above 50% cover, methods tracked more closely, with DPF giving slightly higher cover estimates, on average around 1.5%. Overall, negligible differences between PF and DPF percent cover estimates were observed.



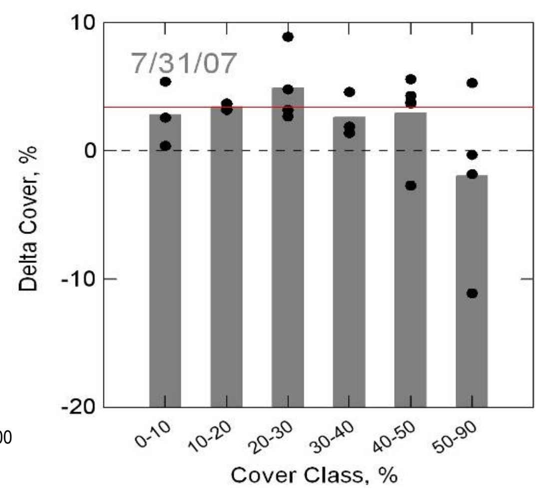


FIGURE A-7
Figure A-7a: DPF vs. PF Best Fit Regression
Figure A-7b: Change in Cover for each Cover Class

3.4 DPF and PF Economic / Labor Analysis

The economics of DPF and PF methodology were explored by assessing the labor required to complete a compliance monitoring event. For normal compliance monitoring events, DPF methodology required 1 person capturing DPFs for a total of 18 hours (Table A-2). Office analysis of the digital pins required the most time, averaging 1 hour and 15 min per CT, for a total of 50 hours per compliance monitoring event. Final processing and QA /QC efforts accounted for an additional 4 hours. The cumulative time required for compliance monitoring using DPF methodology was estimated at 72 hours (Table A-2).

Traditional PF methodology required substantially more personnel for field monitoring efforts. A total of three people were needed. Two people took PF measurements while a third transcribed results onto a hardcopy form, for a total of 120 hours. Office analysis consisted of transcribing PF measurements from hardcopy forms to excel format, for a total of 2 hours. Final QA / QC efforts accounted for an additional 2 hours per compliance monitoring event (Table A-2).

Results of this analysis demonstrated that significant time savings were realized through DPF ground truth methodology. Field labor was cut by 100 hours when compared to traditional PF methodology, due largely to the decrease in staff needed per compliance monitoring event. In total, DPF methodology saved 42 labor hours per compliance monitoring event when compared to traditional PF.

TABLE A-2
DPF and PF Economic Analysis
Economic analysis of total labor required to complete a compliance monitoring event using DPF and traditional PF

Category	DPF			Labor		
	Staff	Labor (Hours / CT)	Event Total (Staff x Labor x 40 Sites)	Personnel	Time (Hours / CT)	Event Total (Staff x labor x 40 Sites)
Fieldwork	1	0.45	18	3	1	120
Office Analysis	1	1.25	50	1	0.05	2
QA / QC	1	0.1	4	1	0.05	2
Total			72 hours			124 hours

4.0 Conclusions

This addendum presented the results from the GBUAPCD and LADWP collaborative DPF vs. PF comparison study. Conclusions from the study clearly indicated DPF percent cover estimates accurately replicated PF estimates (R^2 = 0.99). Specific conclusions generated from the study consisted of the following:

- Correlation between DPF and PF percent cover estimates was extremely high. DPF and PF methodologies result in essentially the same percent cover estimates.
- Spectral analysis of DPFs proved difficult and inaccurate. More sophisticated remote sensing techniques that take into account spectral signature as well as image morphological features (shape, area, length, width, texture, etc.) may be the key to successful spectral classification of DPFs.
- DPF mean percent cover equilibrium was reached using 30-35 digital pins per DPF compared to the normal 50 pins. This will result in a substantial time savings for future compliance monitoring events.
- CT mean percent cover equilibrium is reach for nearly all cover classes using 8 DPFs per CT location. The one exception is the 0-10% cover range. An increased number of DPFs per CT would result in increased accuracy, however improvement opportunity is small, considering the results already compare very well with each other (R^2 = 0.99)

- PF mean percent cover equilibrium was reached for all cover classes using 28 PF measurements per CT location. This indicates that the plot is sufficiently sampled to obtain a good estimate of the mean cover
- A substantial time savings of 50 hours per compliance monitoring event was realized using DPF methodology vs. PF methodology.

The results and conclusions from this study strongly indicate that DPF ground truthing methodology should be the preferred methodology for future compliance monitoring events.

APPENDIX A

APPENDIX A

Estimated Percent Cover for CTs using PF and DPF Methodology

PF and DPF percent coverage estimates

Calibration Target	PF Percent Cover	DPF Percent Cover	Absolute Difference
CS1001	36.2%	34.3%	2.0%
CS1002	NA*	41.5%	NA*
CS1003	NA*	34.8%	NA*
CS1004	NA*	11.5%	NA*
CS1005	24.0%	21.3%	2.7%
CS1006	NA*	11.3%	NA*
CS1007	34.9%	33.5%	1.4%
CS1008	54.6%	49.3%	5.3%
CS1009	9.9%	4.5%	5.4%
CS1010	41.8%	37.5%	4.3%
CS1011	70.2%	81.3%	11.1%
CS1013	27.0%	23.8%	3.3%
CS1015	NA*	41.0%	NA*
CS1021	NA*	81.3%	NA*
CS1023	NA*	0.3%	NA*
CS1024	NA*	36.8%	NA*
SVT04A	NA*	36.3%	NA*
SVT10A	12.0%	8.8%	3.2%
T5-4D1	76.5%	78.3%	1.7%
T5-5A1	29.3%	24.5%	4.8%
T5-5D1	30.1%	25.5%	4.6%
T6-4C1	NA*	59.3%	NA*
T6-5D1	5.9%	5.5%	0.4%
T6-7B1	11.2%	7.5%	3.7%
T6-7D1	7.9%	5.3%	2.7%
T6-7D2	24.9%	16.0%	8.9%
T7-5B2	47.4%	44.5%	2.9%
T7-5B3	41.6%	41.8%	0.2%
T7-7C1	43.1%	39.3%	3.9%
T7-7D1	49.5%	45.8%	3.7%
T8-3A	NA*	68.5%	NA*

APPENDIX A

Estimated Percent Cover for CTs using PF and DPF Methodology

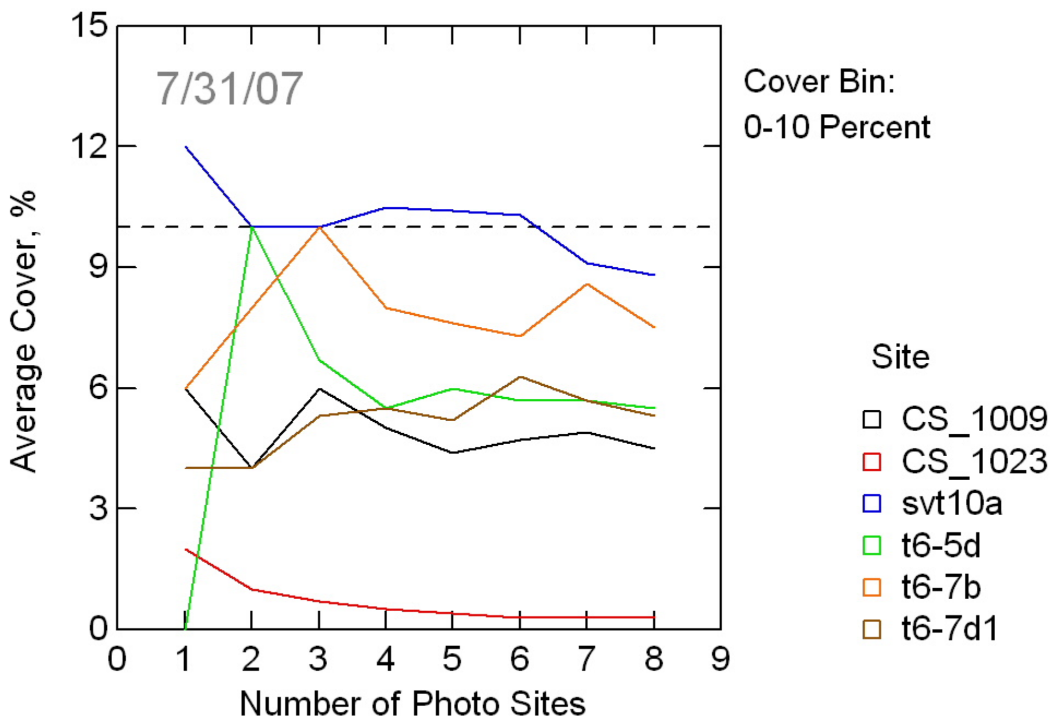
PF and DPF percent coverage estimates

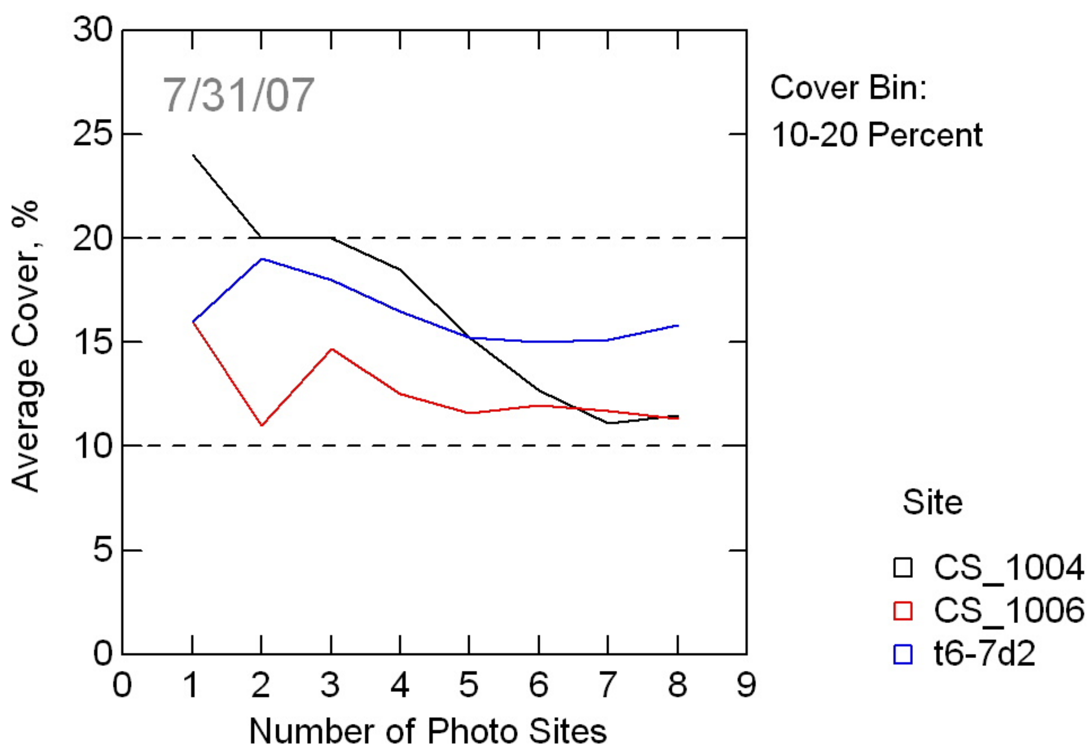
Calibration Target	PF Percent Cover	DPF Percent Cover	Absolute Difference
T8-3B	NA*	17.0%	NA*
T8-4A	NA*	45.5%	NA*
T8-4B	NA*	62.0%	NA*
T8-4C	NA*	39.5%	NA*
T8-5B1	62.9%	63.3%	0.3%
T8-5C	NA*	58.8%	NA*
T8-5D	NA*	66.3%	NA*
T8-6B	NA*	36.8%	NA*
T8-6C	NA*	36.8%	NA*

* Site not sampled using PF methodology

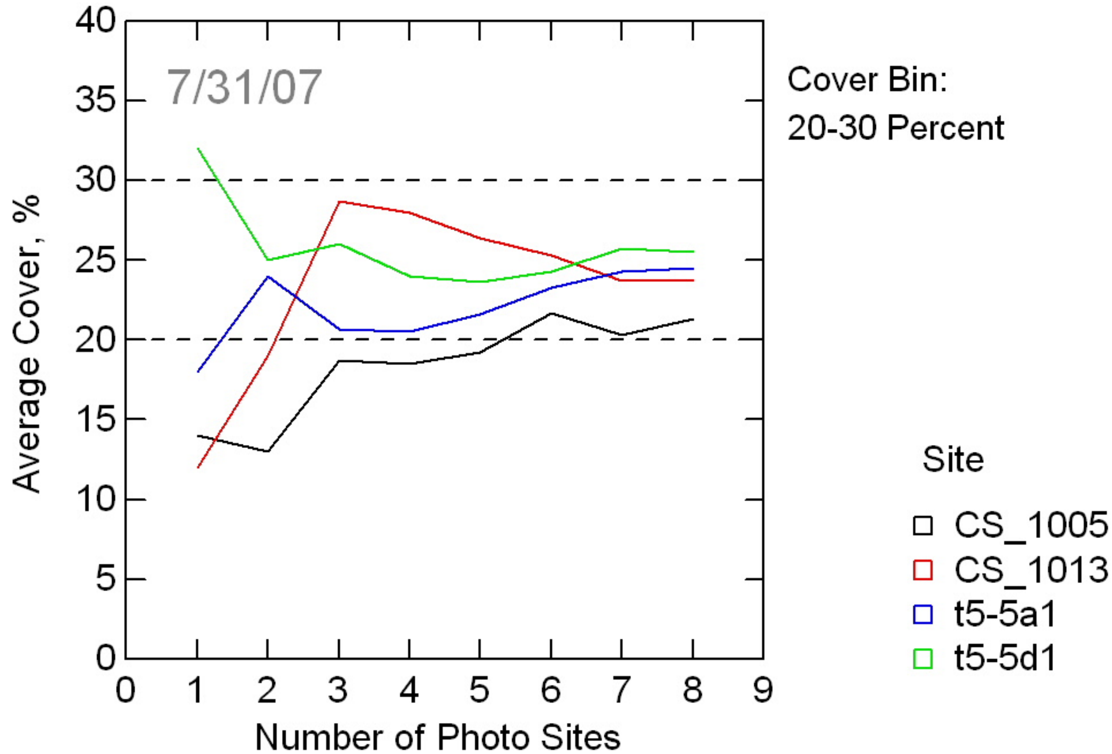
APPENDIX B

1. DPF Efficiency Analysis Graphs





Appendix B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Average Cover, %
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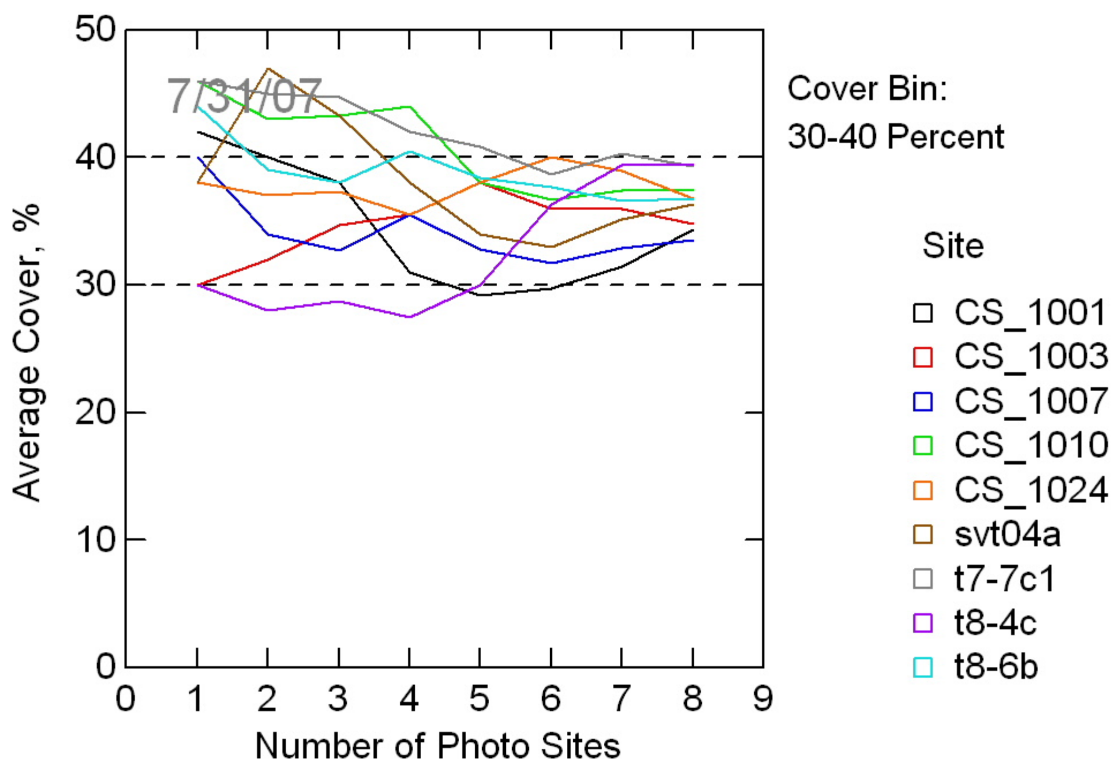
t5-5d1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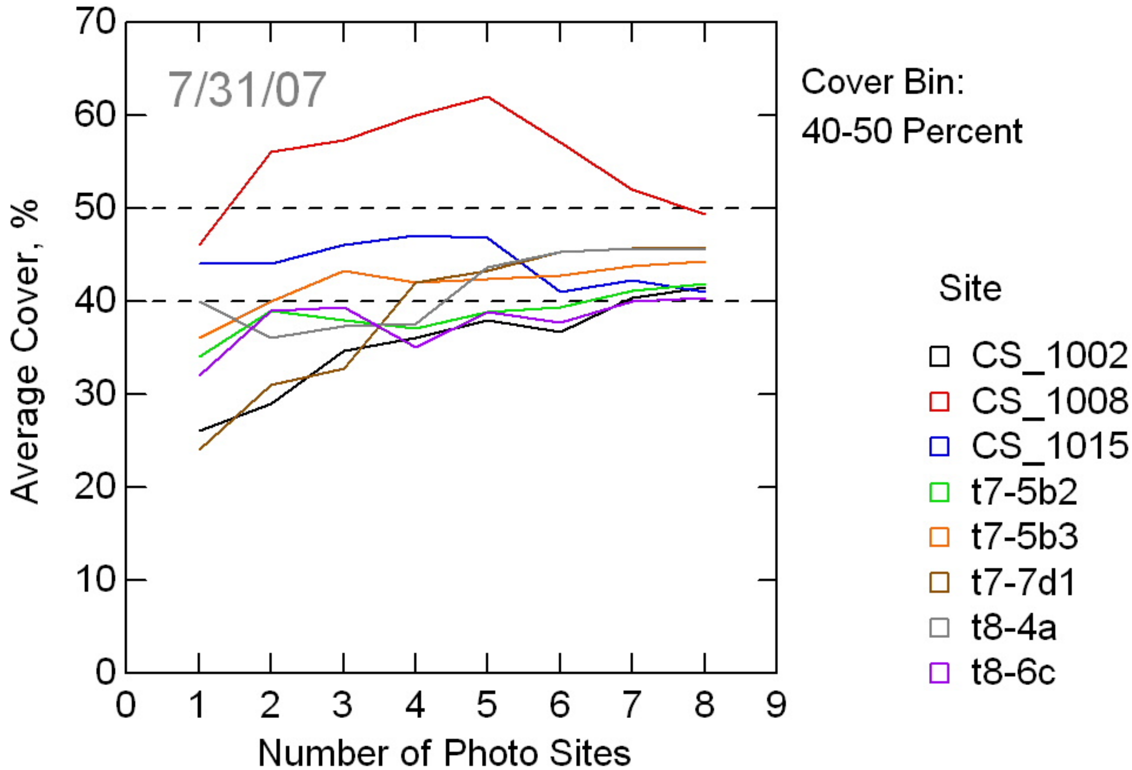
Appendix B



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3
4
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6
7
8
9
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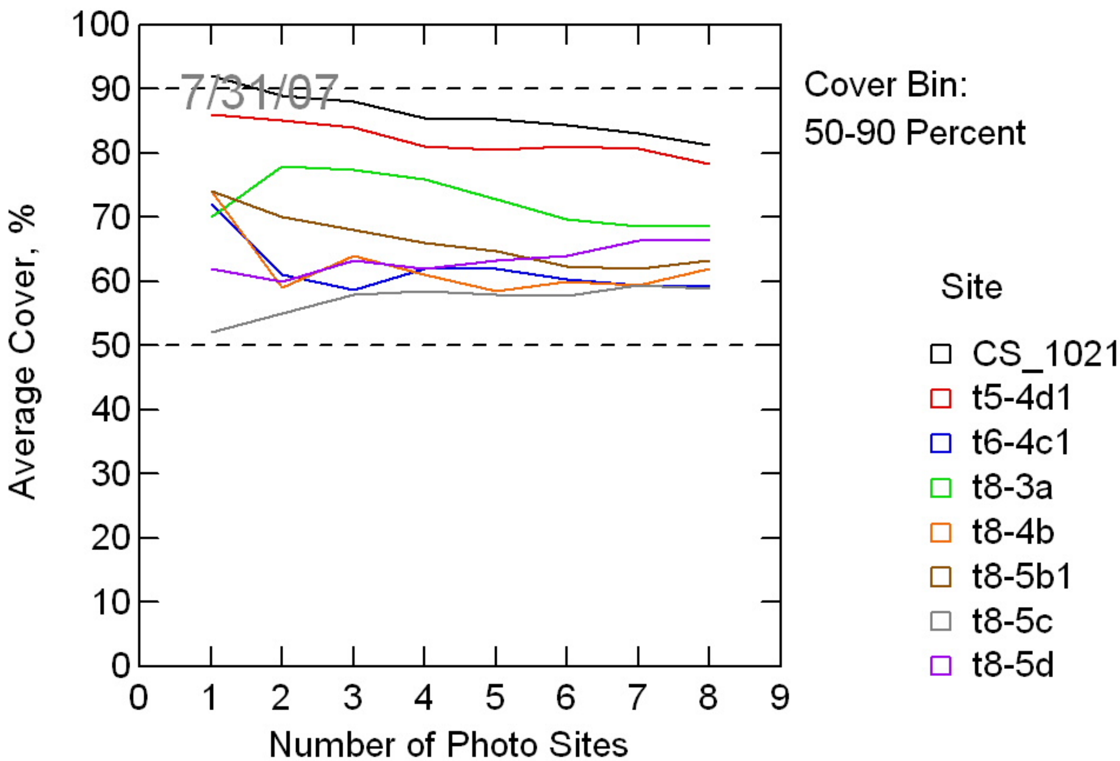
Appendix B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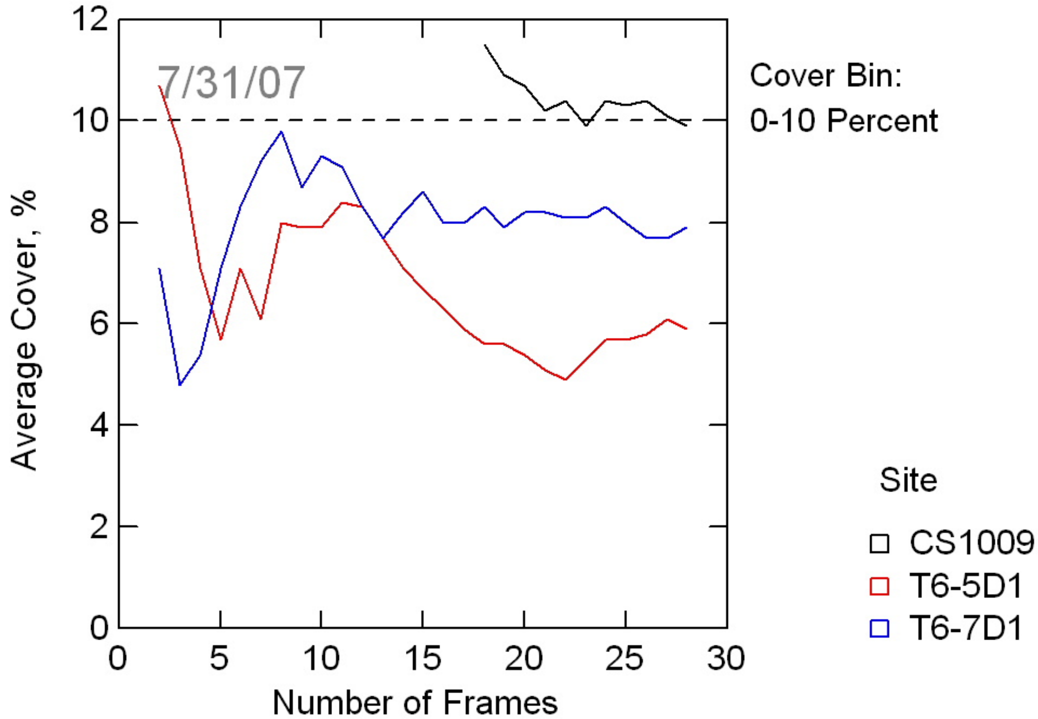
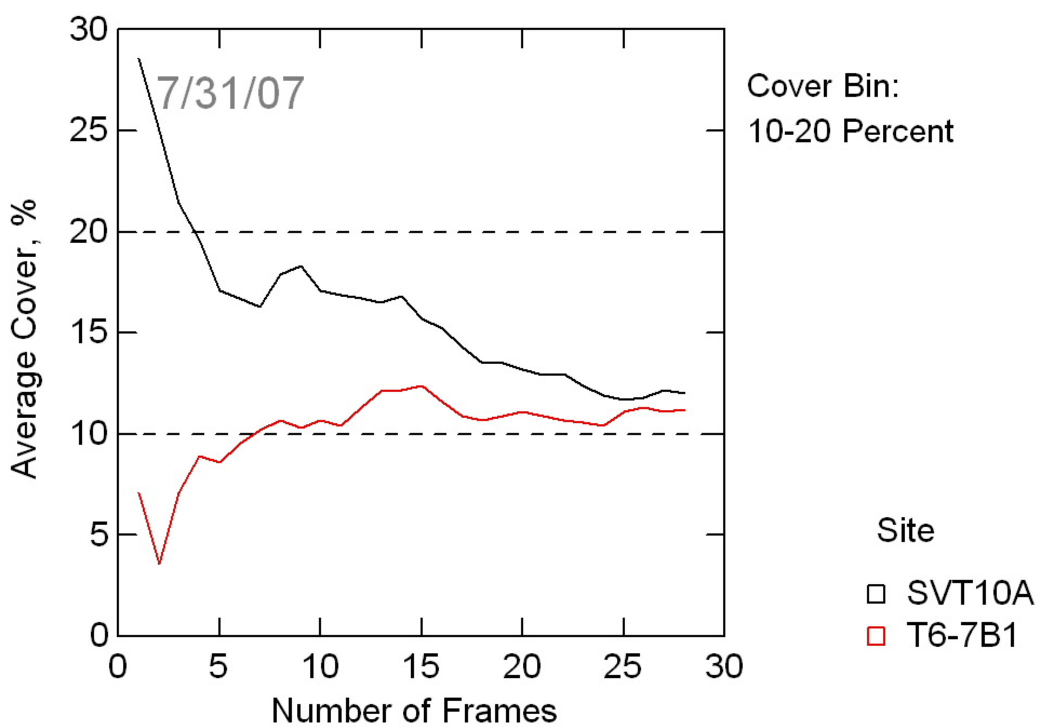
2. PF Efficiency Analysis Graphs





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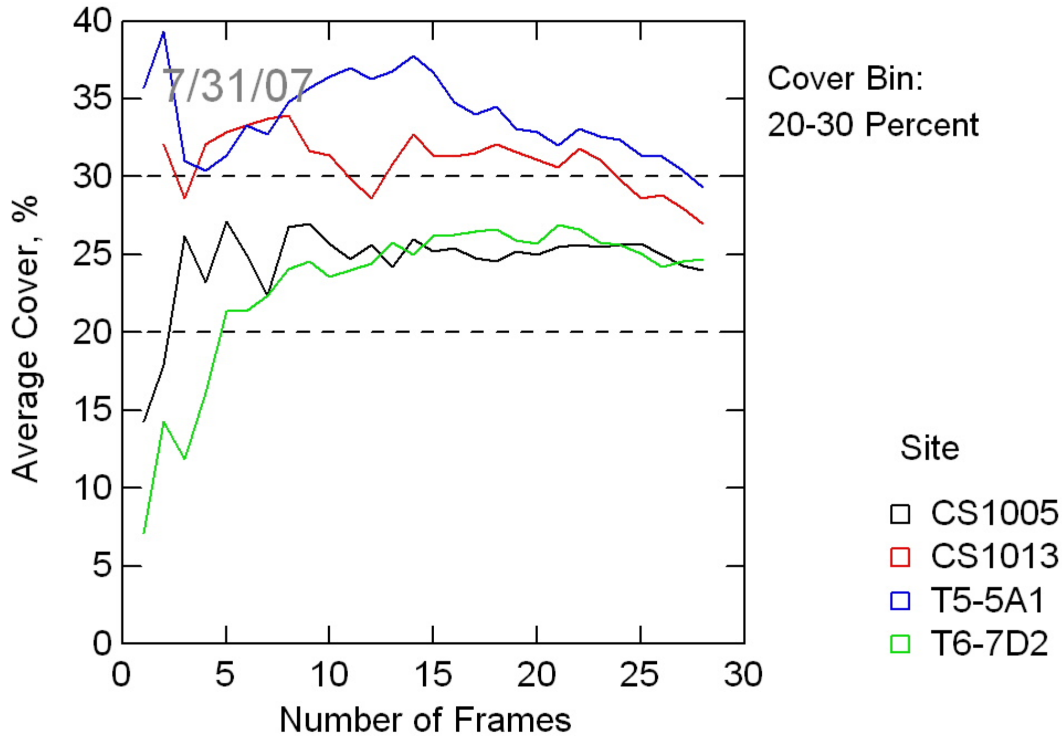

7/31/07
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20-30 Percent
Average Cover, %
Number of Frames
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Site
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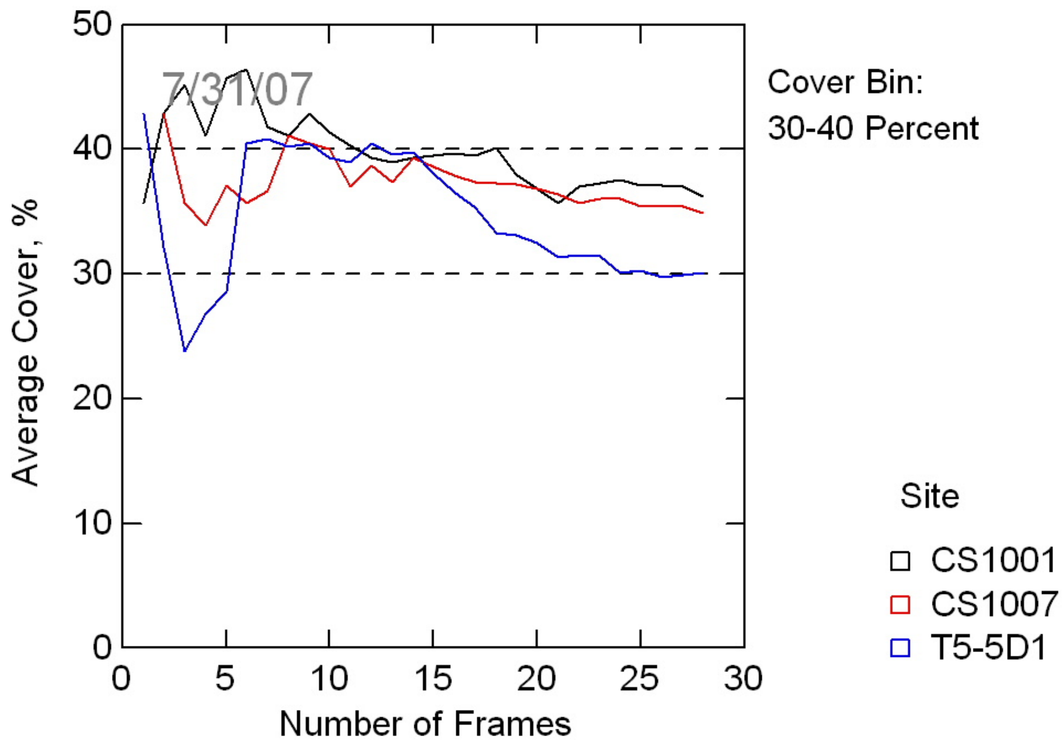
T5-5A1
T6-7D2

Appendix B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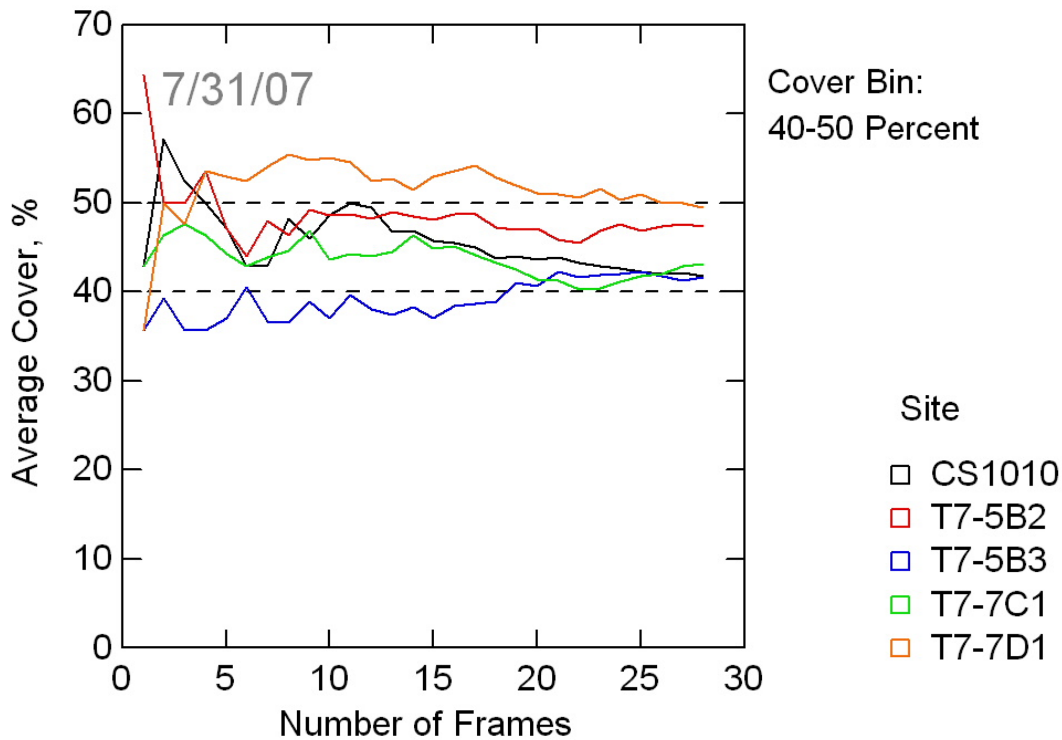
Appendix B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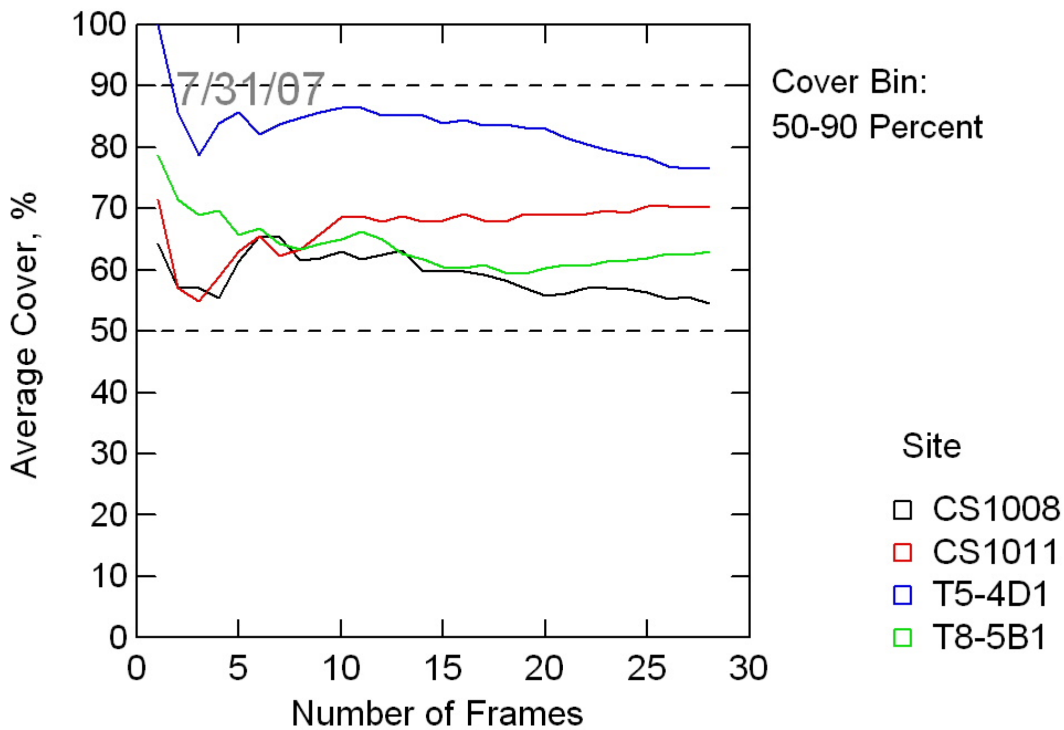
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Average Cover, %
Number of Frames
Site
CS1008
CS1011
T5-4D1
T8-5B1

MEMORANDUM

TO: File

FROM: John Dickey

DATE: January 10, 2008

SUBJECT: Notes on the January 2008 Version of the Owens Lake Managed Vegetation Operation and Management Plan

The purpose of this memo is to summarize items that were reviewed after discussion of the August 2007 version of the Owens Lake Managed Vegetation Operation and Management Plan, and to summarize changes made to create the January 2008 version of the Owens Lake Managed Vegetation Operation and Management Plan (Plan).

Two aspects of the vegetative cover analysis that form part of the basis for the Plan were reviewed and altered: geometric correction of the imagery, and analysis of ground truth data (digital images of the plant canopy) along with associated image calibration. The review and modification are briefly summarized in the following sections.

GEOMETRIC CORRECTION OF IMAGE

Summary: Changes to geometric correction requested by Great Basin Air Pollution Control District (GBUAPCD) were implemented. A set of ground control points collected during fall 2007 and now used by GBUAPCD were employed to geometrically correct satellite imagery... The changes had no significant effect on cover results. No specific changes to the Plan were technically necessary from the standpoint of accuracy. Nevertheless, the revised geometric correction was employed in cover estimates in the new version of the Plan.

LADWP had historically employed a mixture of surveyed points on the ground with engineering drawings to establish ground control points for geometric correction of images. During fall 2007, GBUAPCD collected a set of GPS surveyed ground control points (GBUAPCD Points) to use for the same purpose. So that imagery in the Plan would be corrected in a manner consistent with these new points, the geometrically corrected image used to develop the Plan was shifted (re-corrected) to match the GBUAPCD Points.

One of the concerns raised by GBUAPCD was that the method previously employed by LADWP might have resulted in very different and/or erroneous geometric correction, possibly calling into question work based on previously corrected images, including previous versions of the Plan. This hypothesis was tested, and the results suggest that the difference between previous calibrations and that achieved with GBUAPCD Points is slight, with a mean 1.8 pixel shift (with direction and magnitude varying across the study area). This shift is less than the inherent scale of error in image data. There is no evidence that either correction basis is erroneous. However, consistency between GBUAPCD and LADWP processes is preferred and so the GBUAPCD points were used for this Plan and will be used in to the future.

To further assess the potential impact of a shift on image interpretation, image analysis areas at each image calibration target location (5.5m circles) were shifted (in the cardinal directions north, east, south, and west) by 1.8 pixel, and compared to results for the original, unshifted calibration target area (see Figure 1).

The average 4/2 ratio values were extracted for each of the shifted calibration target areas, and regressed against average 4/2 values for the original calibration target area. Results are shown in Figure 2, showing a tight (R^2 = 0.98) 1:1 relationship (i.e., practically identical ratio values for shifted and unshifted target locations with no systematic bias). Of the 49 calibration targets, only one (in T5-6D) exhibited significantly different average 4/2 ratio values when shifted in the 4 cardinal directions. This area is shown in Figure 3, where the localized effect of a drain line running close to the calibration target appears to be the source of this difference.

Another way of looking at the magnitude of change is to compare it to the range of 4/2 ratio observations across the site. A box plot of the observed changes is shown on Figure 4. The magnitude of these changes relative to the range of observations is minute.

In general, these results suggest a very close relationship between results for shifted and unshifted calibration targets, and therefore little effect of the change in geometric correction basis on calibration of images. Results developed and discussed based on previous image geometric correction would have been virtually identical had the more recent set of GBUAPCD Points been used for these analyses.

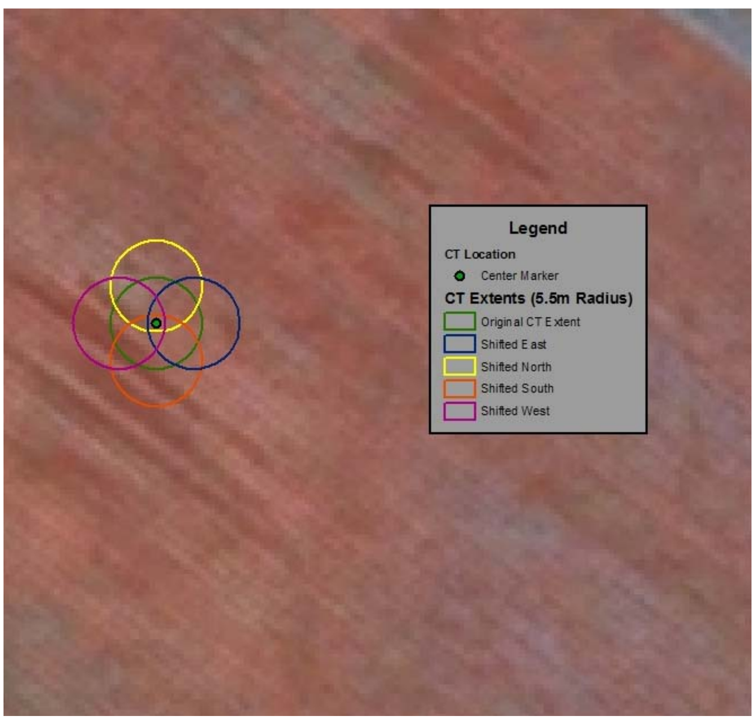


Figure 1. Original and shifted calibration target areas. Displacement is 1.8 pixels in each of four cardinal directions.

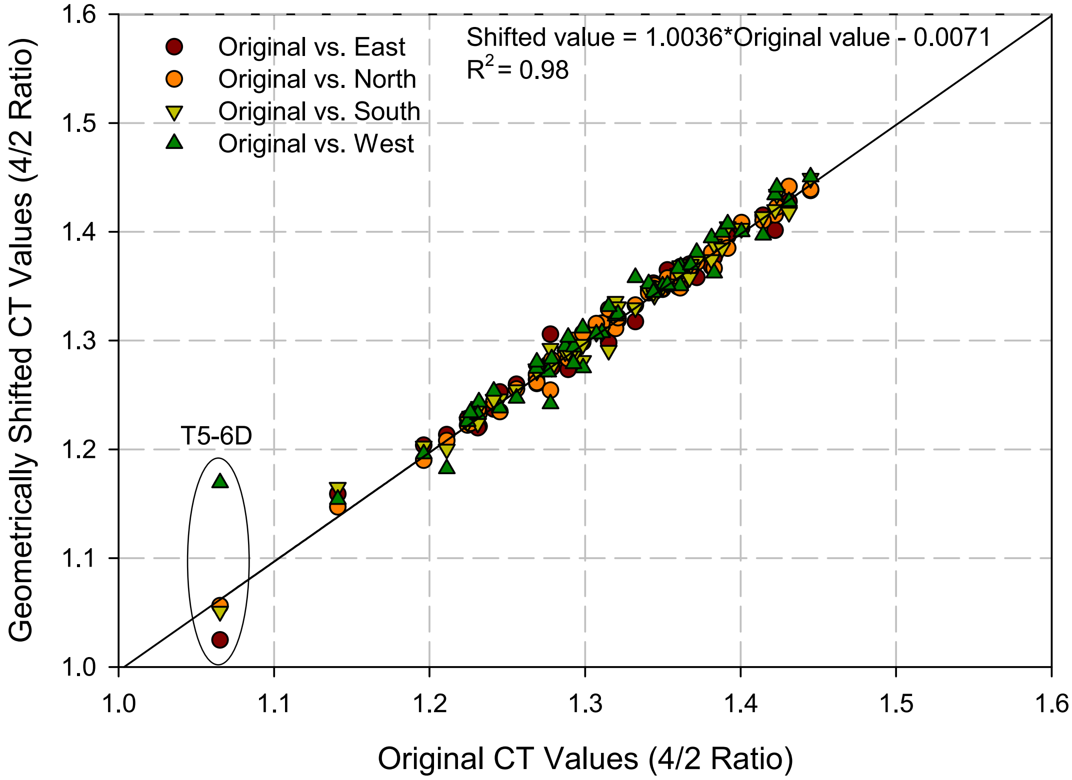


Figure 2. The 4/2 ratio for shifted versus original calibration target areas.

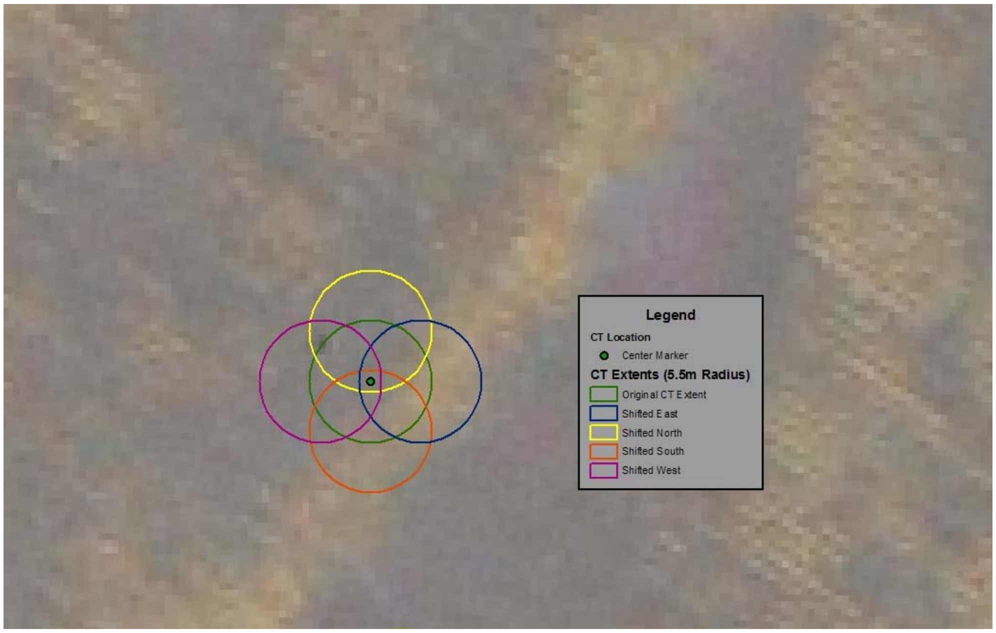


Figure 3. Original and shifted calibration target areas in T5-6D.

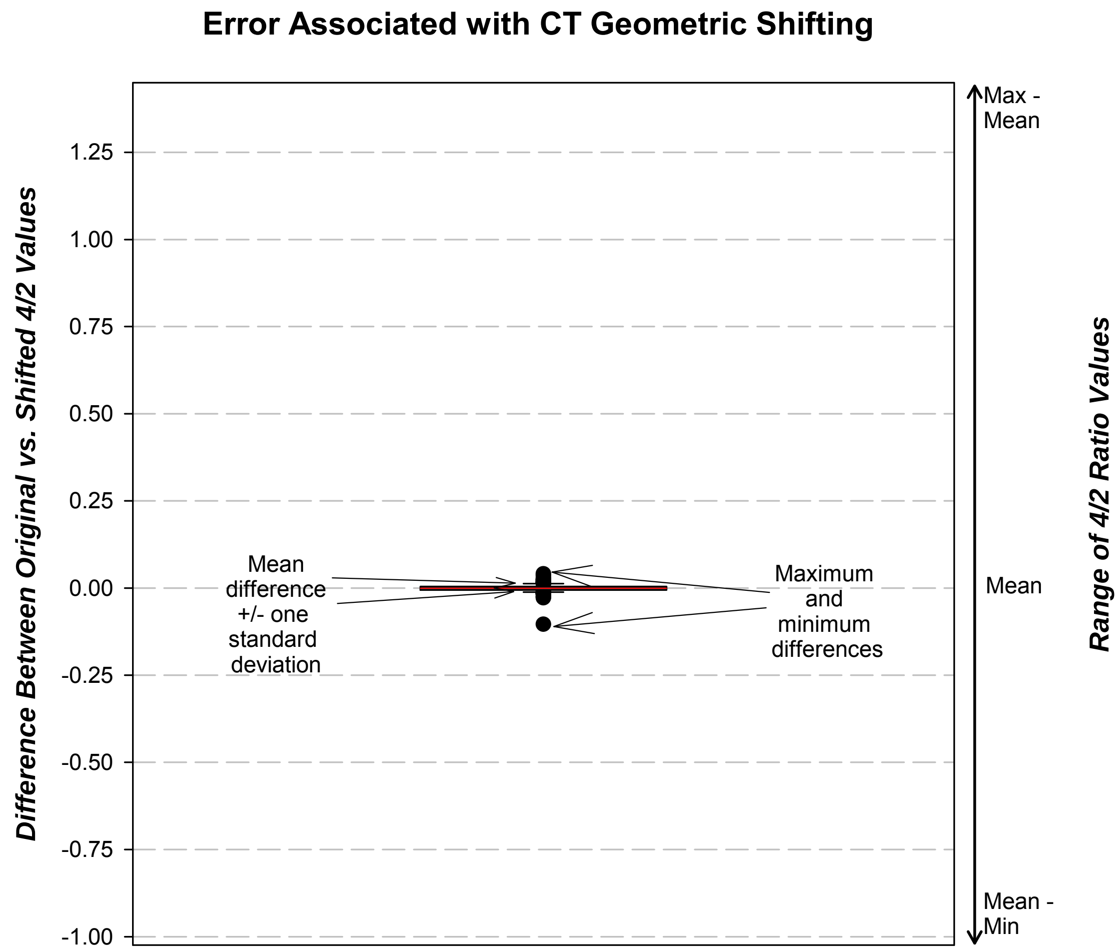


Figure 4. Differences between original and shifted image analysis area results (average 4/2 ratio within shifted and unshifted image analysis areas).

Ground Truth Data Re-analysis and Re-calibration of Satellite Image

Summary: A change to ground truth digital image analysis was implemented as requested by GBUAPCD. The change resulted in a significant but relatively consistent increase in vegetative cover results. It being essential that the Plan be consistent with methods that will be used to evaluate cover in the future, it was essential to re-analyze cover data and revise the Plan to reflect new cover results.

During discussion of image calibration that took place in spring and summer of 2007 between LADWP and GBUAPCD, GBUAPCD expressed a preference for a particular method of assessing the amount of vegetative cover in low-altitude (below 20') digital images of the plant canopy. The preferred method closely mimics a physical point frame, long the standard employed by GBUAPCD for these meaurements. This "digital point frame" (DPF) method consists of a visual inspection of vegetation that is visible on the high-resolution image with a standard grid of observation points overlaid on the image, then calculating the percent of cover (vegetation hits/[hits+misses]) observed. The points and an image are shown at two scales in Figure 5. The percentage of hits is then used to represent the percent cover for the DPF location in question. These estimates of cover can then be used to calibrate satellite imagery by relating them to spectral indices representing the same points in space and time. These indices are calculated from data underlying a concurrent satellite image. Indices selected are those that are most sensitive to observed vegetation on the date in question.

This GBUAPCD-preferred method was agreed upon as the method to be used for future ground truth efforts.

By contrast, LADWP had in the past employed a spectral technique to allow a computer to automatically differentiate between plant canopy and everything else on the DPF image, then count the "vegetation" and "not vegetation pixels on the photo. The ground truth data used to develop the August 2007 Plan were analyzed by this method. The goal of the present work was to evaluate the difference between the two methods, and to incorporate GBUAPCD's preferred method into the image calibration used for the Plan. The method employed for this work was the following:

- Selected 7 dates to evaluate: 11/2004, 3/2005, 5/2005, 8/2005, 2/2006, 5/2006, and 8/2006.
- Visually counted vegetation hits at pins in all DPF images available for these 7 dates (25 pins per DPF, average 50 DPFs per date, and 7dates, for a total of 8750 pins).
- Compared spectral percent cover estimates to those developed from visual pin counts.

The comparison of cover estimates from spectral and pin counting methods is shown in Figure 6. Pin counting resulted in generally higher cover estimates across the board, but the two methods show a strong relationship (R^2 = 0.85). Where the spectral method indicated moderate to high (20 to 70 percent) cover, pin counting showed about 20 percent more cover.

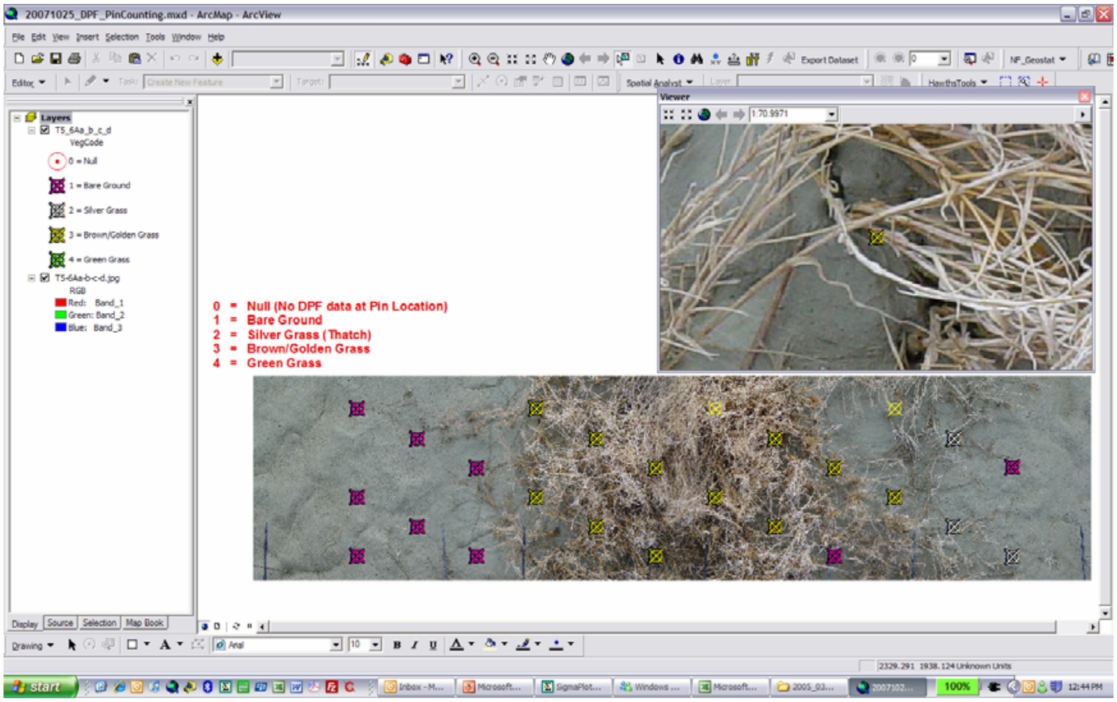


Figure 5. Digital point frame visual pin count analysis results for one ground truth image, showing points overlain on image. Note that software allows for points to be examined at various scales (see zoomed point at upper right) to facilitate identification of the proper classification for each point.

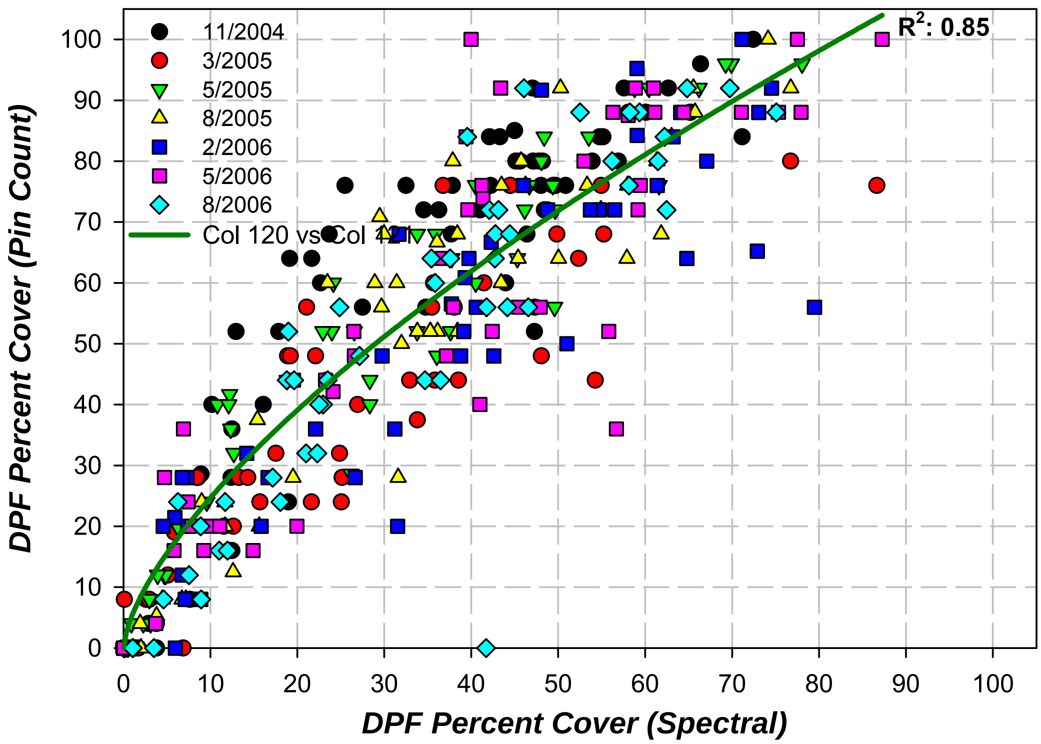


Figure 6. Comparison of results for ground-truth images analyzed by visual pin counting and spectral methods.

A comparative review of images seemed to suggest that the reason for the lower average cover estimate by the spectral technique was the inability of the spectral technique to delineate foliage consistently and reliably over a broad range of color classes. The scatter of data is due partly to the same cause, and partly to the fact that visual pin counting samples a relatively low percentage of the available points on the image, sometimes exaggerating, sometimes underestimating the percentage of the surface covered by foliage.

Since the visual pin count method resulted in a significantly different level of vegetative cover, and since the Plan must reflect methods that will be used by the GBUAPCD to measure cover on the ground in the future, the following additional steps were taken:

- Re-calibrated three satellite images (taken on 3/2005, 2/2006, and 7/2007) based on cover estimates from pin counts. According to the calibration methodology agreed to with GBUAPCD, each time a calibration is carried out, the statistical performance of several spectral indices for vegetation are compared. The index with the best performance is selected to create a vegetation cover map. This process resulted in the selection of a different spectral index for vegetation than was previously (August 2007) employed for the March 2005 vegetation map. Best performance was achieved with the 4/2 ratio.
- Revised the Plan and the *Approach to the Managed Vegetation Operation and Management Plan* documents (i.e., the vegetative cover levels shown in both documents) based on these new cover estimates.

In general, this results in an apparent requirement of higher levels of vegetative cover. However, the more critical issue is that of consistency between cover measurement methodology used to develop the Plan (based on the 3/2005 image), and then to evaluate future conditions. With a consistent method, the real point of reference is not a number, but rather the condition upon which the standard is based. That standard remains unchanged in this most recent version of the Plan. The numeric changes should therefore result in the same protection of the land surface and of consequent dust control.

MEMORANDUM

TO: File

FROM: John Dickey

DATE: May 24, 2008

SUBJECT: Procedure for transforming vegetative cover grid results for regulatory comparisons under the Owens Lake Managed Vegetation O&M Plan

Under the Owens Lake Managed Vegetation O&M Plan (May 2008 Version), a set of quantitative criteria were established, including average cover, and the percentage of the area in grid cells of 0.1, 1, 10, and 100 acres that have >5%, >10%, and >20% cover. In the future, these % cover and % area results will be compared annually during the October-November period to the baseline reference criteria from November 2004. It is therefore useful to have an archiving and analysis toolset for storing cover data, making the needed calculations, and making comparisons with baseline comparisons. This memo summarizes this toolset.

Develop vegetative cover layer: NewFields 2007 and 2008 document agreed methods for determining total vegetative cover.

Grid and vegetated area GIS layers: These layers are employed to develop % cover results for grid cells across the 0.1-to-100-acre range on the Site. Vegetation map development methods are documented in NewFields (2007).

MV cover.mdb: This is an access database into which grid % cover results are imported as tables. A series of ten queries are then run to produce results that can be compared to the baseline reference criteria. The queries are numbered 1 to 10 for the March 2005 data, 11 to 20 for November 2004, 21 to 30 for October 2006, and 31 to 40 for November 2007. It is recommended that the most recent queries be renamed and updated for future dates, beginning with the lowest numbered query. For example, in fall 2008, the first step would be to import grid results for that period into four appropriately named tables. The second step would be to rename Query 31 to Query 41, and to update all references to reflect the fall 2008 image data sources. The user would then proceed to update queries in order through a new Query 50. The results of Query 50 would be used in the next tool.

Reference cover for MV OM.xls: Make a copy of the "New date template" worksheet, and then copy the data resulting from the current query (numbered a multiple of ten) where it says, "Paste data here". Insert rows so that the first line of the <5%, <10%, and <20% blocks of results occur every fourth row, as shown by the colored blocks. Then copy and paste those data into the block with cell A1 at the upper left. Where "#N/A" shows on lines 2 through 5 in columns R, S, and T, enter "0". Review the pale yellow highlighted cells and investigate any negative numbers, which indicate that cover on this date may in some areas be deficient relative to the reference cover levels.

References:

NewFields. 2007. Methods Used for Verification of Vegetative Cover on the Managed Vegetation Dust Control Measure.

NewFields. 2008a. Notes on the January 2008 Version of the Owens Lake Managed Vegetation Operation and Management Plan (January 10, 2008 memo from John Dickey to File).

APPENDIX 3.
AIR SCIENCES INC. 2006. MANAGED VEGETATION CONTROL EFFICIENCY STUDY, OWENS DRY LAKE, CALIFORNIA

AIR SCIENCES INC.
DENVER • PORTLAND

TECHNICAL MEMORANDUM

MANAGED VEGETATION CONTROL EFFICIENCY STUDY, OWENS DRY LAKE, CALIFORNIA

PREPARED FOR: Richard Harasick, Los Angeles Department of Water & Power

PREPARED BY: Mark D. Schaaf, Air Sciences, Portland
Maarten Schreuder, Air Sciences, Portland

PROJECT NO.: 179-1-32

COPIES: Rich Coles, CH2M HILL, Santa Ana
John Dickey, CH2M HILL, Sacramento

DATE: July 24, 2006

Abstract

This technical memorandum summarizes the results of a study designed to measure the PM_{10} control efficiency of the managed vegetation (MV) dust control measure (DCM) on the Owens (dry) Lake, California. In its current configuration, the MV dust control measure consists of approximately 2,100 acres (851 hectares) of saltgrass on the southern end of the Owens Lake. The MV DCM was installed and planted in the spring and summer of 2002. Since the spring of 2004, the Los Angeles Department of Water & Power (DWP) has operated monitoring equipment in and over the MV area, which records the percentage of the saltgrass cover, surface moisture content, surface crust conditions, and sand motion within the DCM. The monitoring system consists of:

- Twenty-four sand motion monitoring sites, targeting six sites in each of the 4-percent vegetation cover ranges (0 to 10 percent, 11 to 20 percent, 21 to 30 percent, and 31 to 40 percent);
- Two 10-meter-tall meteorological towers within the MV area; and
- Six real-time PM_{10} monitors (TEOMs) on the perimeter of the MV area.

This technical memorandum summarizes the measurement and calculation procedures used to assess sand motion, sand motion control efficiency, and vegetative cover for the period from May 2004 through April 2006. The monitoring results of this nearly two-year period show that MV is highly effective in suppressing sand motion, even at a low vegetation cover. The sand motion was controlled by 99 percent or more at a saltgrass areal coverage

of 20 percent or more. This level of sand motion and PM_{10} control was achieved at far less than the 50-percent cover requirement in the 2003 Revised Owens Valley State Implementation Plan, or 2003 SIP (GBUAPCD, 2003, p. 5-8). Very high PM_{10} control was also measured at lower percent vegetation covers within the MV area. In the zero to 20 percent cover range, sand motion was reduced by an average of 97 percent (range 75 to 100 percent). This control is thought to be achieved by a combination of factors, including:

- The saltgrass cover is effectively sheltering the surface.
- The drip irrigation is keeping the soils relatively moist for about seven months per year (April to October).
- The saltgrass furrows are aerodynamically rough, reducing the wind speed and sand motion within the MV area.
- The sand and sand-sized particles are being trapped along the margins of the area, reducing the amount of particles available to abrade surfaces within the MV area.

Introduction

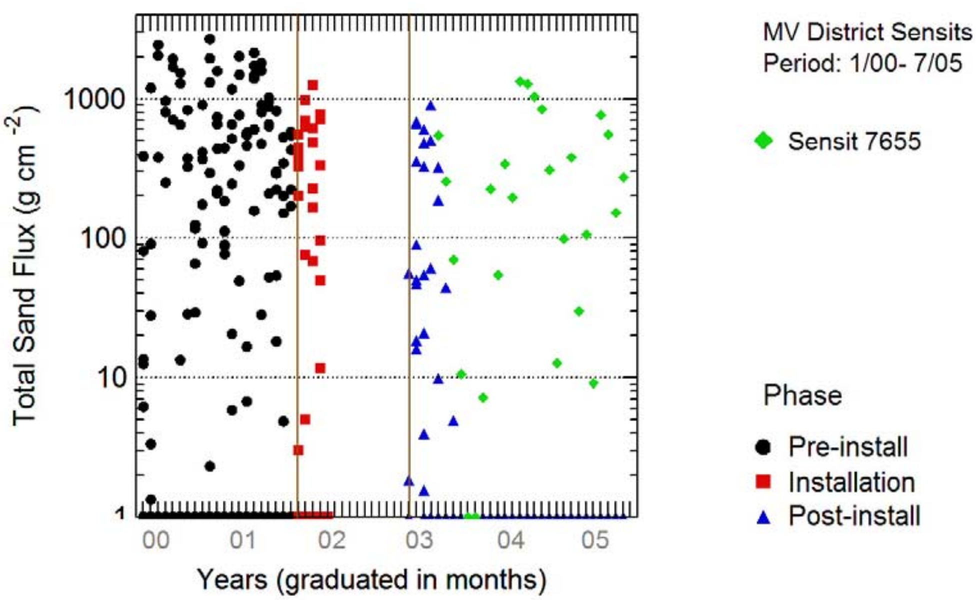
The 2003 Revised SIP included three options for controlling dust on the Owens dry lakebed (GBUAPCD[1], 2003). Managed vegetation was one of those options. Based on on-site research efforts as well as literature reviews, the District concluded that "…more than 99 percent reduction of soil erosion and PM_{10} will be achieved at Owens Lake with saltgrass cover of 50 percent" (GBUAPCD, 2003; p. 5-8). In the spring and summer of 2002, DWP implemented the MV DCM by planting native saltgrass on approximately 2,400 acres (currently 2,100 acres) north of the Dirty Socks monitoring site. The MV area was largely bare for the first year until the saltgrass cover established itself during the 2003 growing season. After the saltgrass was established, the sand motion was significantly reduced and is essentially non-existent within the MV area. The sand motion reduction trend is supported by monitoring data from the District sand motion network, Figure 1, as well as from the DWP monitoring network. The latter is the subject matter of this technical memorandum. The District's monitoring network recorded high cumulative sand fluxes during the period preceding the installation, as well as during the initial phase of construction (Figure 1). Sand motion remained high during the initial months of 2003, when saltgrass had been planted but not yet established. However, since the fall of 2003, sand motion within the MV area was eliminated at all but one of nine District monitoring locations. The exception was Sensit 7655, located on the southern fringe of the MV area and clearly not representative of the remaining area (Figure 1).

[1] GBUAPCD (Great Basin Unified Air Pollution Control District). 2003. Owens Valley 2003 Revised PM_{10} Planning Area Demonstration of Attainment State Implementation Plan. GBUAPCD, Bishop, California.

To better understand the temporal and spatial dynamics of sand motion in relation to saltgrass density and distribution, DWP has monitored vegetative cover, sand motion, meteorology, and PM_{10} concentrations within and around the MV area beginning in May 2004. This technical memorandum summarizes the monitoring network; data collection and analysis methodologies; and resulting sand motion, vegetative cover, and sand flux control efficiencies in space and time. The data included in this analysis is from May 2004 through April 2006.

Figure 1: Monthly total sand flux in the managed vegetation DCM from January 2000 to June 2005, as measured by the District sand motion network.

The three phases indicate pre-installation, installation, and post-installation (black circles, red squares, and blue triangles, respectively). Sand flux values of “1” indicate marginal or no sand motion, from zero to 1 gram of collected sand mass. The absence of data points in 2002 indicates a temporary removal of sensors to accommodate construction activities. Sensit 7655 (green diamonds) is the only location to show significant sand motion after 2003. This monitoring site is located in the far southeast corner of the MV DCM, and arguably not representative for the DCM in general, since it is located less than 500 feet from the edge, close to sand dunes just outside of the MV DCM, and has a low grass cover (~10%).



Methodology

Approach Summary

The objective of this study is to better understand the relationship between sand motion and saltgrass cover. The monitoring instruments required to achieve this objective included: a network of 24 sand motion monitoring sites, two 10-meter-tall meteorological towers, and six real-time PM_{10} monitors (Tapered Element Oscillating Microbalance instruments, or TEOMs). The data from these monitors were recorded and processed on an hourly time resolution basis. Hourly sand motion data were used to calculate sand flux and then matched with hourly wind speed. Baseline sand fluxes were calculated for the pre-construction data period from January 2000 through October 2001. This is the period between the start of data collection by the District and the start of construction activities in the MV DCM. This baseline, which expresses pre-construction sand flux as a function of wind speed, established the reference to calculate the control efficiency, normalized by wind speed. The control efficiency, CE, is defined as the absolute decrease in sand flux after the establishment of the saltgrass vegetation, and it is expressed as a percentage of the baseline or uncontrolled sand flux at a similar wind speed. The saltgrass cover was estimated for each month at each of the locations of the sand motion monitors. Based on this information, the sand flux control efficiency was expressed as a function of saltgrass cover.

For reasons of brevity, the discussion of the TEOM locations, data analysis procedures, and results are not included in this memorandum and will be included in a future memorandum.

Sample Collection – Sand Motion

Equipment and Network

The sand motion was measured using a network of 24 monitoring locations (Figure 2a and Figure 2b). Each monitoring location was equipped with two pairs of instruments—one Cox Sand Catcher (CSC) and one Sensit in a pair—with one pair located between the rows of grass, and the other located within the grass row (Figure 3). The CSC is a passive sampling device consisting of an adjustable PVC-tube buried in the ground, and used to collect sand and sand-sized particles being transported across the site by the wind (Figure 3). Sensits are cylindrical electronic devices that record the particle counts and kinetic energy of sand and soil particles colliding with the sensor (Figure 3). Both instruments were installed with their collection surfaces at a height of 15 cm above the mean ground level. While CSC sand masses are collected on a monthly basis, Sensits provide a signal time resolved to five minutes. Using mathematical relationships between the sand mass collected by the CSC and the signal collected from the Sensits, hourly sand flux estimates were calculated (see next section). The sand motion monitoring using the CSC-Sensit pairs in the MV DCM was commenced in May of 2004 and is ongoing.

All instrumentation was audited on a regular basis to ensure the quality of the data collected. The auditing and quality assurance procedures are documented in separate DWP documents.

Figure 2a: Image of the MV DCM as seen by the QuickBird remotely sensed NDVI signal, February 2006.

Lighter colors indicate increasing saltgrass cover. The sand motion monitoring locations are indicated with the yellow squares. The meteorological towers are indicated by the red diamonds.

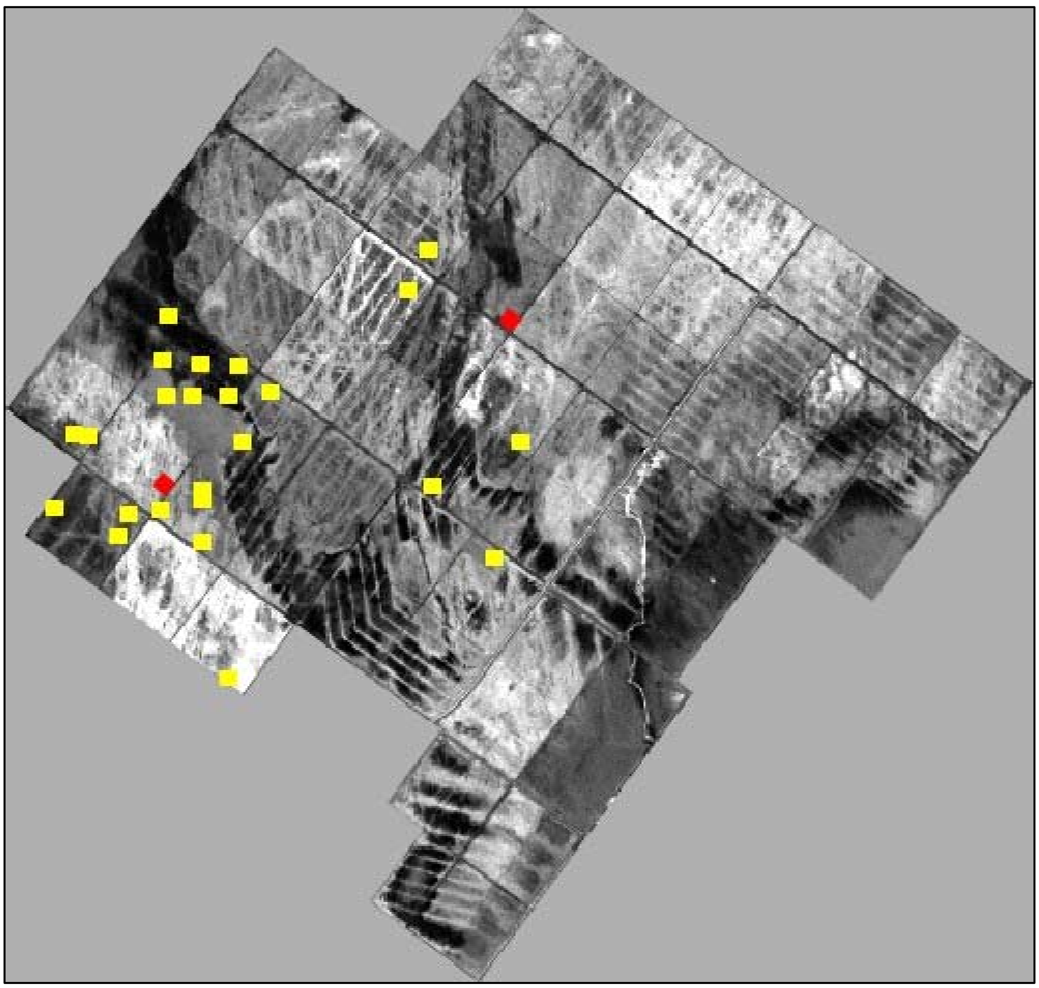


Figure 2b: Managed vegetation map with locations of sand flux monitoring sites.

Shown are monitoring sites operated by the Districts since 2000 and Spring of 2007, indicated as purple and and green circle, respectively. Monitoring sites operated by the DWP (May 2004 to September 2006) are indicated as the gray and blue circles (colors indicate the different configuration over time).

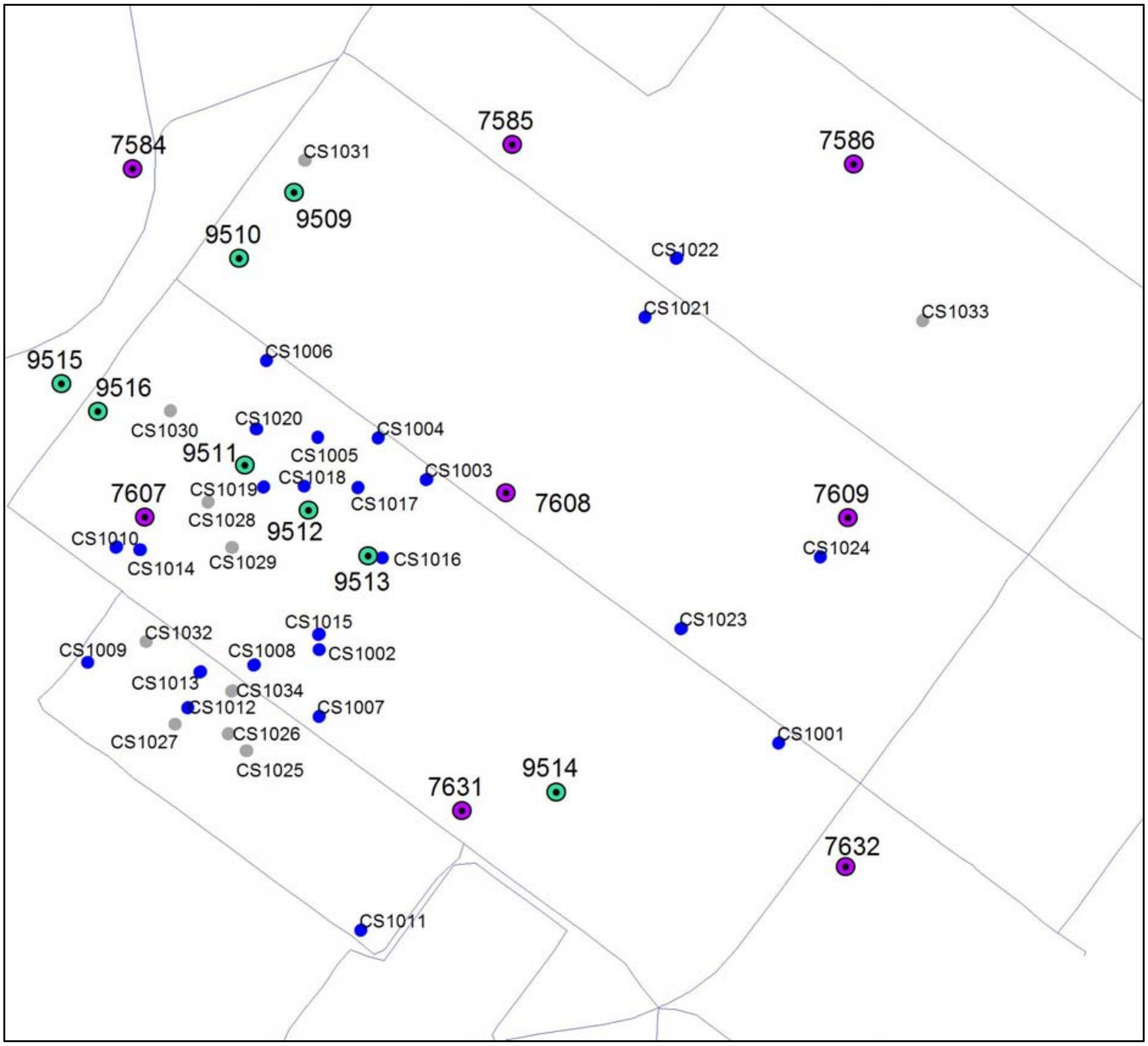
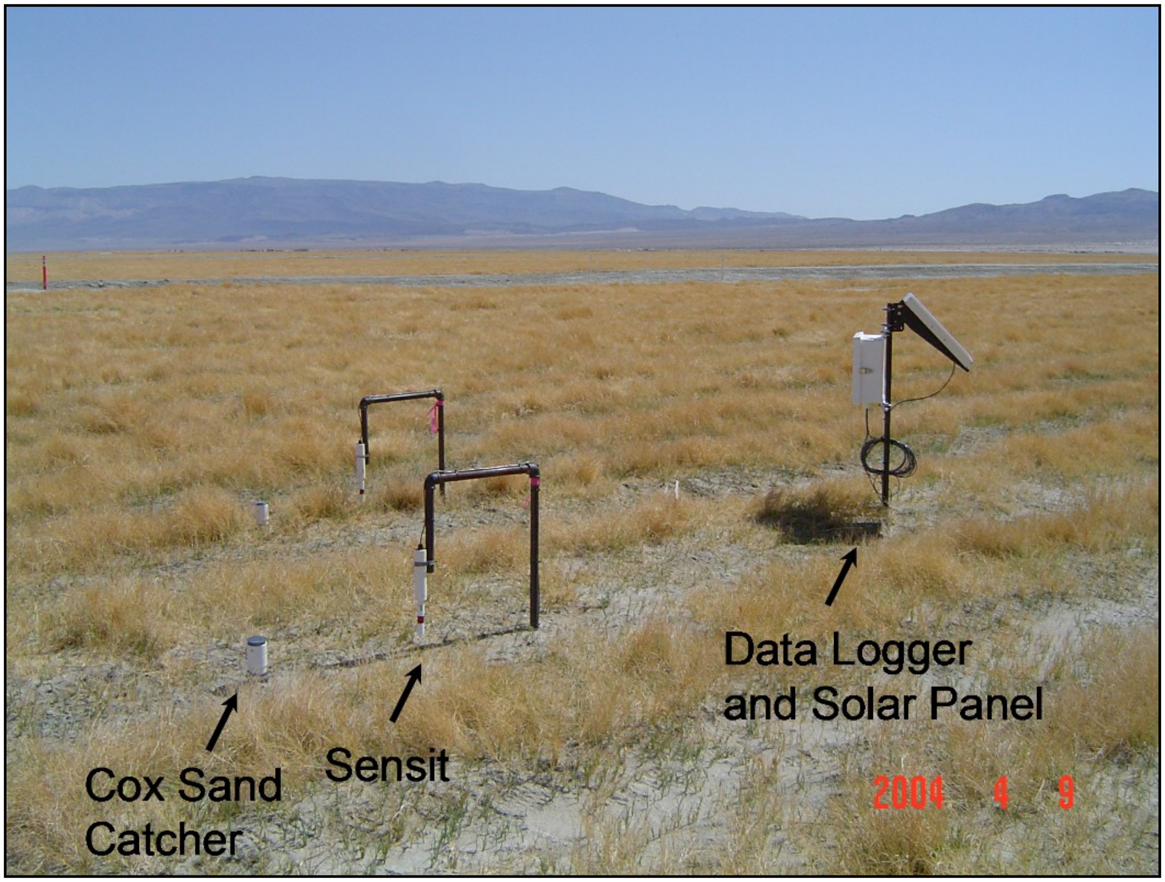


Figure 3: View of the Sensit-CSC collection site in the MV DCM operated by DWP.



CSC sand masses were collected in the field approximately once a month. Samples were then transported to the laboratory in Keeler, where they were weighed and the results entered into the Site Information Management System (SIMS). Sensit and meteorological data were downloaded in the field once a week and also uploaded to the SIMS database. The data set was screened to eliminate records representing erroneous data, missing data periods, erratic Sensit data, and periods of low wind speed (hourly wind speed less than 5 m s^{-1}).

The next step was to develop the CSC sand mass to Sensit relationships to distribute the sand mass within the (monthly) collection period, resulting in estimated hourly sand fluxes. The CSC sand mass was time-resolved into an hourly sand flux only when the total collection mass weighed more than 5 grams, or when the collection mass was between one and five grams and there was a clear relationship between CSC sand mass and Sensit observations. Sand masses less than 1 gram were typically not time-resolved because of the measurement uncertainty. Hourly sand flux is expressed in gram per square cm per hour (g

cm^{-2} h^{-1}). When these data are adjusted my means of a scaling factor (the K-factor), a PM_{10} emission rate can be estimated. The hourly sand fluxes formed the basis for the sand motion control efficiency calculation described in the Data Analysis and Results Sections.

Sample Collection – Meteorological Data

An important driving factor of sand motion on the Owens playa is wind speed. Because of this, the control efficiency calculations were normalized by the hourly wind speed (see Control Efficiency Calculation section). Wind speed and several other meteorological parameters are recorded at two 10-meter meteorological monitoring towers (for example, Figure 4) located inside the MV area (Figure 2). The hourly data provided by these towers include: wind speed at three heights above the ground (1, 2, and 10 meters), wind direction (10 meters), temperature (2 and 10 meters), and relative humidity (2 and 10 meters). Meteorological monitoring began in December 2004, and is ongoing. Meteorological data are stored on a five-minute basis and downloaded to a laptop computer in the field on a weekly basis. The data are then uploaded to the SIMS database for quality control and processing.

Sample Collection – Vegetative Cover

Saltgrass cover across the MV area was determined periodically using a combination of remote sensing and ground-based sampling techniques. The remote sensing data were collected by satellite (QuickBird)-mounted sensors, and images were obtained every one or two months. The Normalized Difference Vegetation Index (NDVI) was calculated from the QuickBird data, and is shown as the gray-scale background in Figure 2. This map was used to estimate the cover over the entire MV DCM at an 8-foot by 8-foot pixel resolution. The estimated cover was transformed to a color scale to improve the visualization of its spatial distribution (Figure 5). Ground-based cover measurements were used to calibrate the NDVI map, which allows for the estimation of vegetative cover over the entire MV DCM. The calibration procedure was based on saltgrass cover measurements at 24 sites, at which sand motion also was measured. The cover measurement was based on a “digital point frame” (DPF) method.

The DPF method consists of a series of digital photographs along a fixed, representative, 5- by 1.25-foot transect located approximately 10 feet away from the sand motion instruments. The digital images from each transect were merged in the lab and electronically analyzed for both green (live) and brown (dead, senescent) grass cover, as well as bare soil. The estimated cover at these 24 sites on the ground was then linked to the corresponding remote sensing NDVI values. Based on this information a calibration equation was developed. The calibration equation is applied in two ways. First, it is used to estimate cover over the entire MV area. Second, is it used to estimate the saltgrass cover at the 24 sand motion monitoring sites. A more detailed description of the cover estimates at the monitoring sites is provided in the (following) Data Analysis section.

Figure 4: View of a 10-meter meteorological monitoring tower (located at a shallow flood DCM).

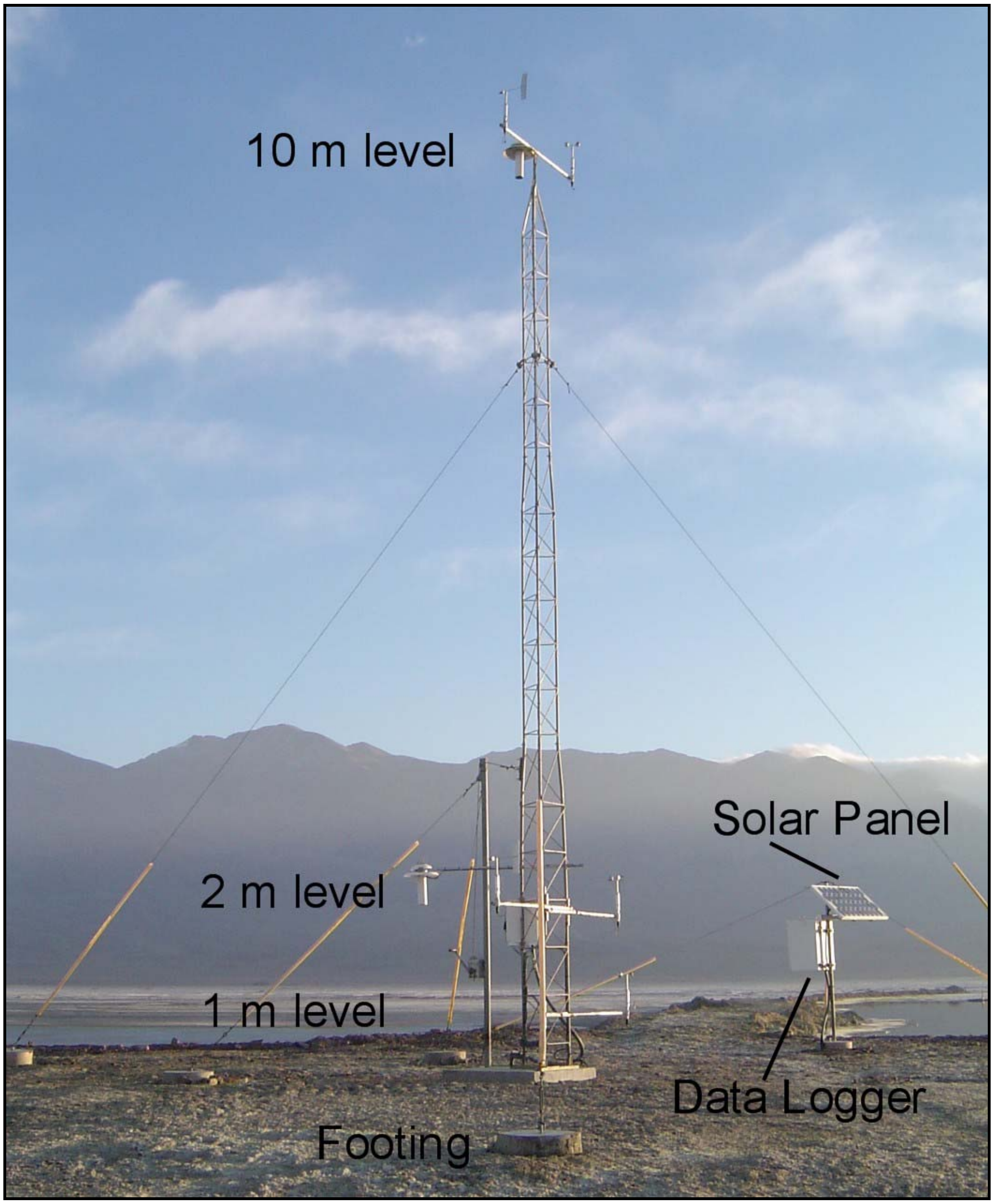
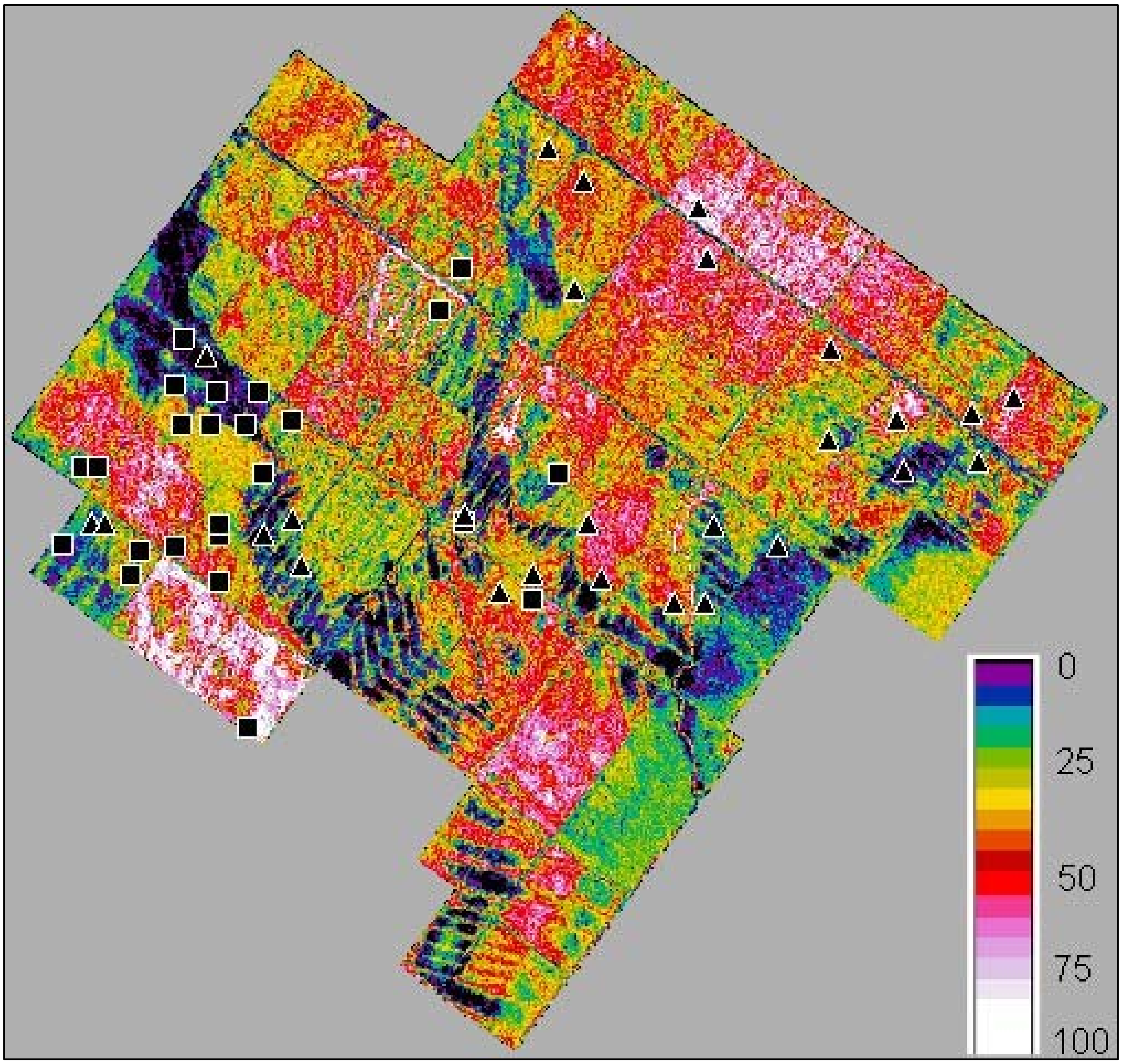


Figure 5: Image of the MV DCM, with the NDVI signal converted to saltgrass cover classes, February 2006.

The lowest vegetation cover is indicated by black shading, and highest cover by white shading. Sites equipped with sand motion monitors and used to develop the cover calibration equation are indicated as black squares. Sites used to independently verify the satellite calibration are shown as black triangles.



Data Analysis

Vegetative Cover by Collection Period

During the analysis period, May 2004 through April 2006, saltgrass cover was estimated each month based on an area of 24 feet by 24 feet around the Sensit location, equivalent to 9 pixels on the QuickBird satellite image. Since QuickBird images are not available for all months, data filling and smoothing procedures were applied. For the 24-month period, QuickBird-based cover estimates were available for 16 months, or for 66 percent of the period. For months for which satellite-based cover estimates were not available, the cover was estimated as the average cover in the months preceding and following the month with the missing cover data. Next, the three-month moving average cover was calculated. For example, the estimated cover for July 2005 was calculated as the average cover for June through August 2005. This second processing step provided a reasonably robust temporal trend in cover for each of the Sensit locations. For example, a time series of estimated cover at Sensit location 118, Figure 6, shows an increase in saltgrass cover during the growing season (April through October), and a decrease during the winter months due to senescence (dying and shrinking) of the saltgrass foliage. It should be noted, however, that since the calibration procedures of the NDVI-based remote sensing images distinguishes between green grass (live), brown grass (dead), and bare soil, the NDVI images can be calibrated during any month of the year.

The vegetative cover at each of the monitoring locations was categorized on the basis of four cover classes: 0 to 10 percent, 11 to 20 percent, 21 to 30 percent, and 31 to 40 percent. The number of sites in each cover category over time is summarized (for part of the analysis period) in Figure 7. The distribution of sites of by cover class does show variability over the 14-month period (Figure 7). The dynamics of the changes in the distribution by cover class are due to a combination of several factors, including:

- Growth during spring and summer (green bars) leads to a loss of sites in the lower two cover classes.
- Senescence of the grass in fall and winter essentially reduces the "projected area" of the (brown) grass and thereby shifts the distribution back to lower cover classes.
- Random error in the estimating procedure. The latter can result in shifts between cover classes from month to month, especially when the actual cover is close to the threshold value separating two cover classes.

Figure 6: Estimated saltgrass cover at Sensit 118 from March 2005 through April 2006, based on QuickBird NDVI processed values.

Shown are months of senescent grass only (brown bars) and the growing season (green bars).

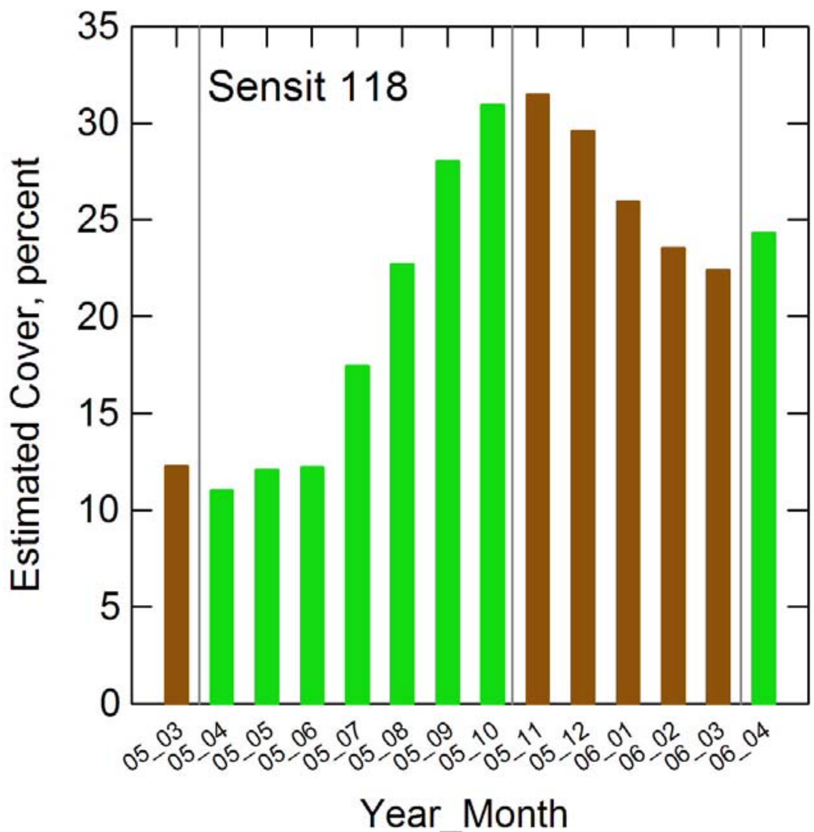
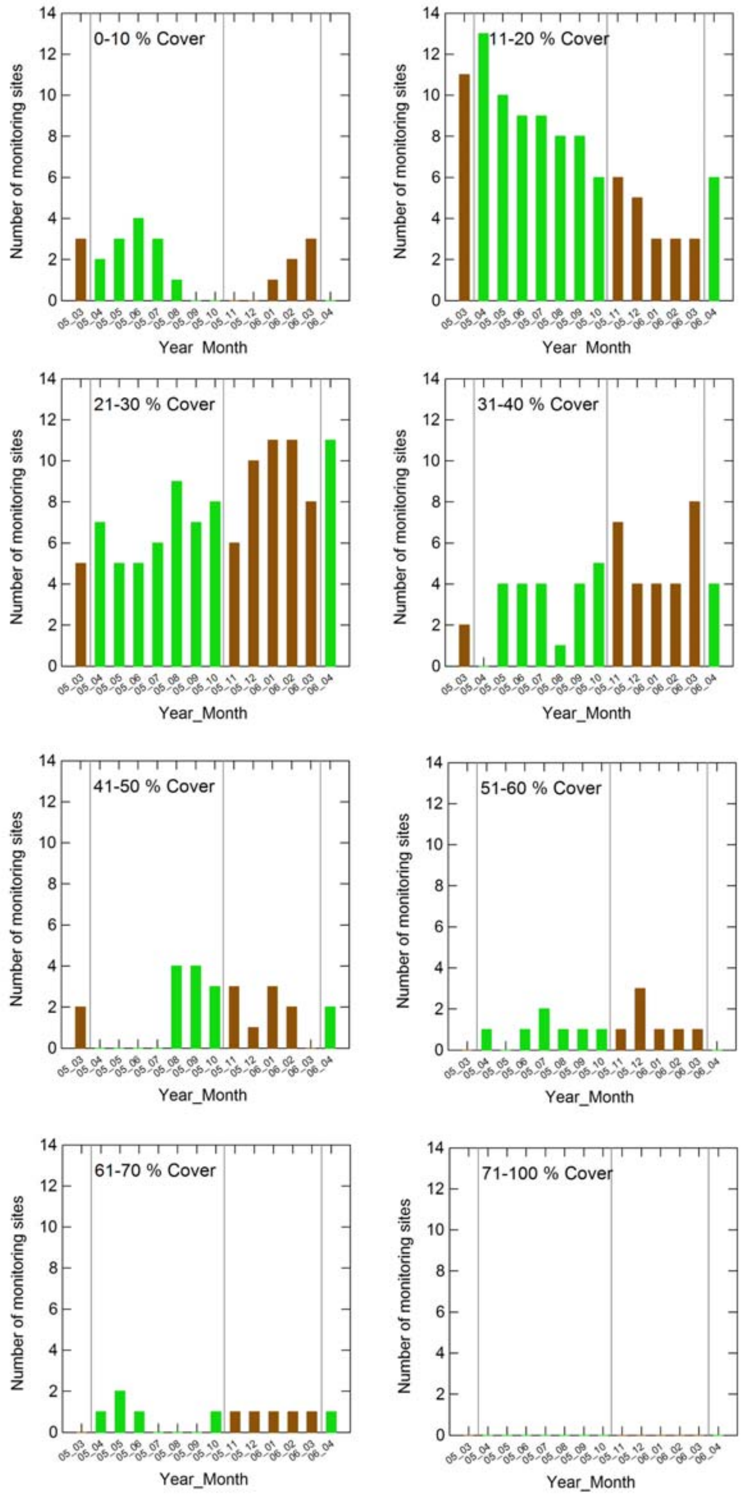


Figure 7: Distribution of sand motion monitoring sites by cover class by month, March 2005 through April 2006, using QuickBird-based NDVI processed values.

Shown are months of senescent grass only (brown bars) and the growing season (green bars).



Control Efficiency Calculation

The control efficiency, CE, is defined as the reduction in sand flux with the managed vegetation DCM in place over the uncontrolled, pre-DCM sand flux:

$$CE = 100\% * \left[\frac{(SF_{Baseline,WS} - SF_{Controlled,WS})}{SF_{Baseline,WS}} \right] \qquad [1]$$

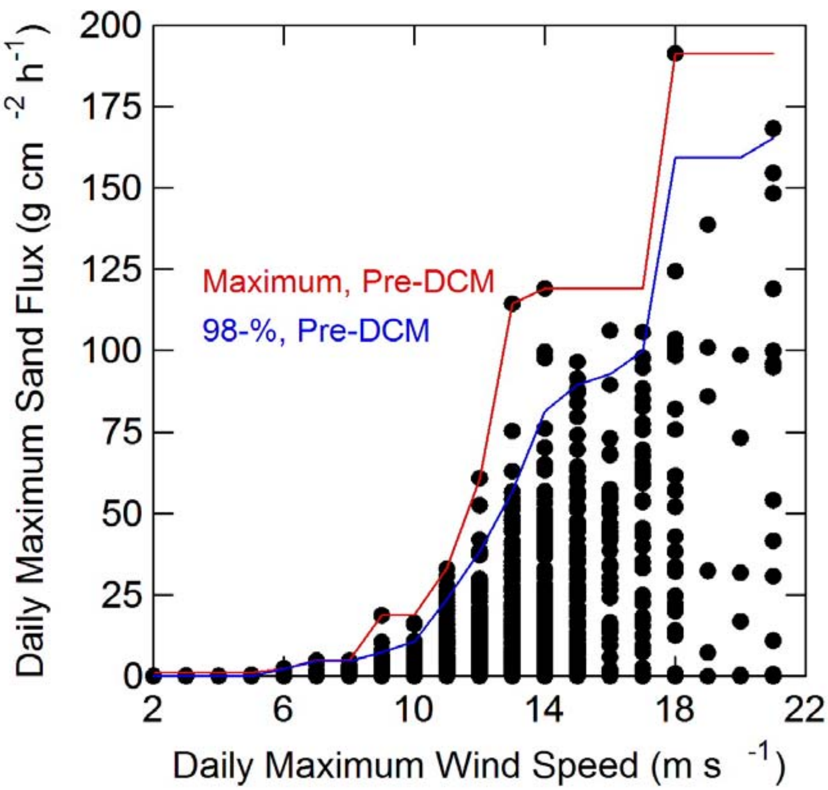
where CE is the achieved control efficiency in percent, $SF_{Baseline,WS}$ the pre-DCM, uncontrolled sand flux (g cm^{-2} h^{-1}), also referred to as the baseline, and $SF_{Controlled,WS}$ the controlled sand flux with managed vegetation in place (g cm^{-2} h^{-1}). Both the baseline and controlled sand fluxes are normalized by the wind speed, WS.

The baseline sand flux was based on the pre-construction period, January 2000 through October 2001. The construction of the MV area began in November of 2001. Hourly sand flux was calculated based on all sand motion sites operated by the District located in or right on the edge of the MV area, a total of 11 sites. For each calendar day in the pre-construction period, the maximum hourly sand flux was matched with the maximum hourly wind speed at the Dirty Socks meteorological monitor. Any sand fluxes below a significance threshold, set at a value of 0.5 g cm^{-2} $hour^{-1}$, were excluded from the baseline analysis. This lower threshold of "significant" sand motion is consistent with the screening procedures used by the District in the Dust ID modeling protocol (GBUAPCD, 2003). A single wind speed class, with a 1 meter per second (m s^{-1}) resolution, was assigned to each day and each location with a significant sand flux. The resulting screened database was used to extract the baseline sand flux, representing the pre-DCM uncontrolled sand flux. The baseline sand flux was calculated as the 98^{th}-percentile sand flux of all days at all locations by wind speed class. The results of this analysis are summarized in Figure 8, with the blue line indicating the baseline sand flux, the 98^{th}-percentile, normalized by wind speed.

Sand flux and wind speed from the DWP monitoring network in the MV DCM were analyzed based on the following procedures. The maximum hourly wind speed was calculated for each day using the meteorological tower located most central (northern most) in the MV DCM (Figure 2). The District's Dirty Socks meteorological tower was used from May 2004 through mid December 2004, until data from the DWP-operated towers became available. Hourly wind speed and wind direction between the two DWP towers tracked each other well so that no significant error is introduced into the analysis by using only one of the two meteorological towers. Similar to the procedures as described for the baseline sand flux calculation, the maximum hourly sand flux was calculated at each of the 24 sites (48 monitor pairs total: one pair in the planted row, one pair between the planted rows as shown inf Figure 2) with a daily time resolution (by calendar day). Maximum daily sand fluxes above the significance threshold of 0.5 g cm^{-2} h^{-1} were matched with the maximum wind speed and the corresponding wind speed class. Next, CE was calculated using Equation [1], and the initial results were graphically summarized. These visual summaries assisted in identifying any periods and monitoring locations with significant sand motion. Moreover, these summaries also aided in identifying periods and locations that were likely affected by human disturbance activities and therefore should be removed from the final data set. Based on this screening analysis, sand flux data were removed for three time periods, at one or more monitoring locations. The screening analysis is discussed in more detail in the Results Section and Appendix A.

Figure 8: Baseline sand flux in MV DCM, January 2000 through October 2001.

The data points are daily maximum hourly sand flux as a function daily maximum hourly wind speed class. The lines indicate the maximum and 98th-percentile by wind speed (red and blues lines, respectively).



Results

The first screening step consisted of only considering the maximum daily sand fluxes above the significance threshold of 0.5 g cm^{-2} h^{-1}, as indicated in the previous section. The data set based on this first screening level resulted in sand fluxes (normalized by wind speed) that were considerably lower than the baseline for the period preceding the DCM installation. This data set contained several high sand fluxes during the 24-month analysis period. A closer look at the temporal and spatial distribution of these high values, linked with DWP construction and maintenance records for this area, indicated that many of the high sand fluxes were associated with unavoidable human disturbance of the surface crust near the monitoring sites, due to construction and maintenance activities. These disturbance activities consisted of three distinct periods:

1. Saltgrass replanting over the entire MV DCM (April 2004 - May 2004).
2. Drip line replacement in a subsection of MV DCM (December 2005 - March 2006).
3. Phase V shallow flood construction adjacent to the southwest corner of the MV DCM (January 2006 - current).

Each of these activities had a distinct effect on the sand motion data (Appendix A),and the data from one or more sites were subsequently excluded from the final database.

Based on the screened database, observed sand fluxes were compared to the baseline (Figure 9). The highest observed sand fluxes occurred in the cover classes below 20 percent (Figure 9). Moreover, observed sand fluxes were well below the baseline sand flux (Figure 9). In the next analysis step the observed control efficiency, CE (Equation [1]) was calculated. The majority of CE values were well above 90 percent (Figure 10). The only CE values below 90 percent were observed at site 70/71 (Figure 10). This is not unexpected since this site is located on a sandy soil type, has low grass cover (~13 percent), and is located only 300 feet from the edge of the DCM (Appendix A). When expressed as the average CE, the control efficiency of the MV DCM is equal or greater than 99 percent at saltgrass coverage levels of 20 percent or more (Figure 11).

Figure 9: Sand flux from the DWP monitoring network in the MV DCM, by cover class, normalized by wind speed.

Cover classes are differentiated by symbols and colors. The baseline is indicated with the blue line.

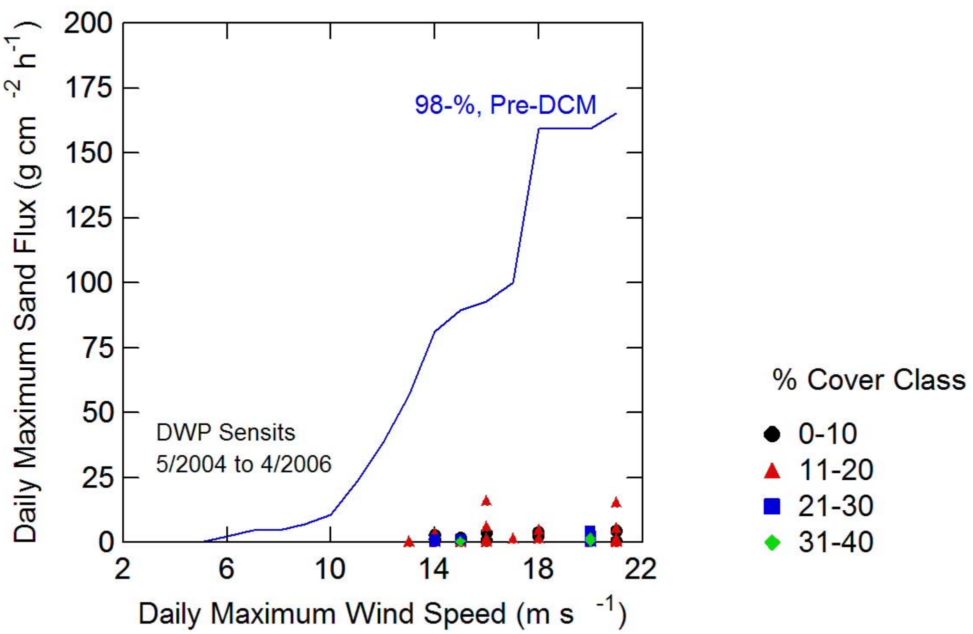


Figure 10: Control efficiency from the DWP monitoring network in the MV DCM.

Data are screened for valid data only. Symbols indicate monitoring sites 70 and 71 (red stars), and all other monitoring sites (blue circles).

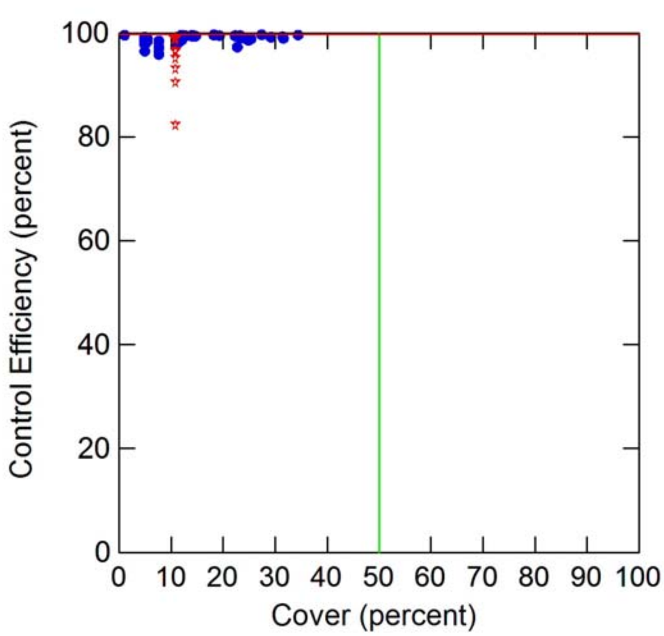
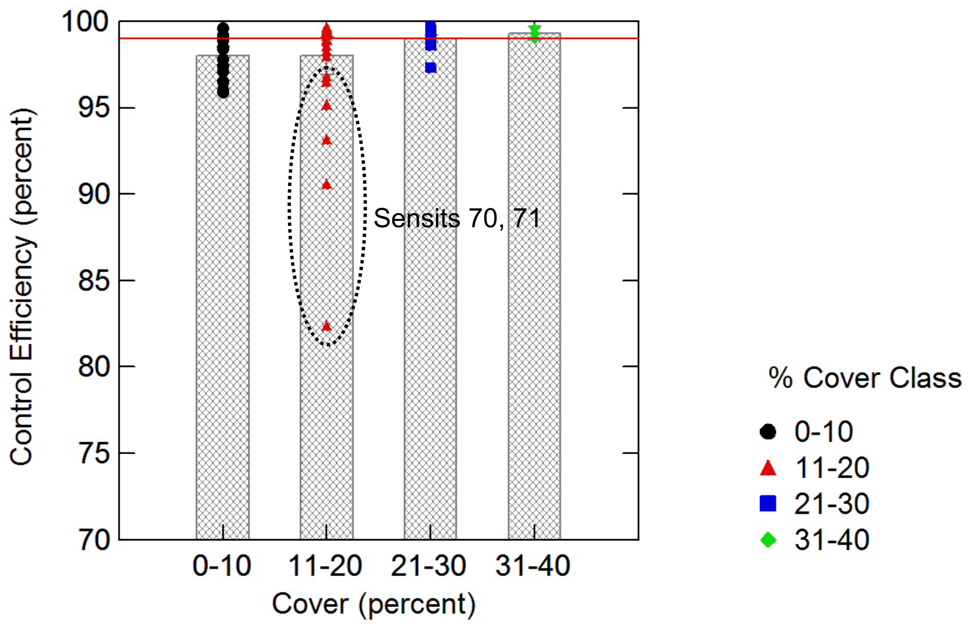


Figure 11: Control efficiency from the DWP monitoring network in the MV DCM, by cover class, normalized by wind speed.

Data are screened for valid data only. Shown are the (arithmetic) mean (gray bar) and the actual values. The red line indicates the 99-percent control threshold. Sample sizes are: 0 to 10%-18, 11 to 20%- 44, 21 to 30%- 24, 31 to 40%- 6, and, >40%-zero. (No sand fluxes above the significance threshold are observed).



Discussion and Conclusions

The data collected over the 24-month period indicate that an average of 99 percent control of sand flux is effectively achieved at saltgrass covers of 20 percent or more (Figure 11, Figure 12, Table 1). A very high level of sand flux control is also observed at lower saltgrass cover, with average control efficiencies of ~97.5 percent in both the 0-to-10- and 11-to-20-percent cover bins (Figure 11, Figure 12, Table 1). This level of control is attributed to a combination of factors, including:

- The saltgrass cover is effectively sheltering the surface.
- The drip irrigation is keeping the soils relatively moist for about seven months per year (April to October).
- The saltgrass furrows are aerodynamically rough, reducing the wind speed and sand motion within the MV area.

- The sand and sand-sized particles are being trapped along the margins of the area, reducing the amount of particles available to abrade surfaces within the MV area.

It should be noted that the control efficiency in the cover classes with a saltgrass cover above 40 percent was so high that the results were not included in the summary Figure 11. While sand motion was monitored in these cover classes during the entire period (Figure 7, Table 1), none of the sand fluxes observed in these cover classes exceeded the significance threshold (sand flux 0.5 g cm^{-2} h^{-1}). Only seven days with maximum hourly sand fluxes above 0.01 g cm^{-2} h^{-1} were observed in these cover classes in the entire analysis period. Therefore, at a saltgrass cover of above 40 percent the observed and average control efficiency was effectively 100 percent (Table 1).

It should also be noted that the absence of sand motion in the higher cover classes cannot be attributed to the lack of wind. Over the analysis period of a total of 699 days, 455 days, or 65 percent, of the total number of days exceeded the threshold wind speed for sand motion (i.e., 7.5 m s^{-1} for at least one hour per day). Twenty percent of the total number of hours in the period (16,776 hours), or nearly 3,400 hours, exceeded this threshold wind speed. This indicates that the observed wind speed distribution exceeded the sand motion frequently enough during this period to initiate sand motion if the surface in the MV area would be susceptible to erosion (Table 1). Instead, no significant sand motion was observed with a vegetation cover of 40 percent, and for vegetation covers below 40 percent very high control efficiencies were achieved (Table 1, Figure 12).

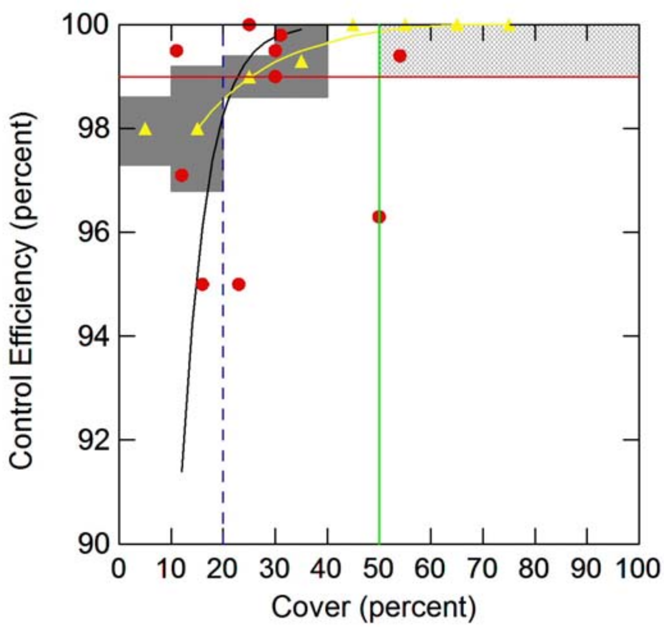
Table 1: Number of monitoring sites and CSC-Sensit pairs by cover class and by collection period, and overall average control efficiency (CE) by cover class.

Values represent the average number of sites by class and period (24 months total), the number of monitor pairs (48 total), and the average CE. The values in brackets represent the observed range. The "number of days by site with a significant sand flux" is derived from a total of 455 days during which the wind speed exceeded 7.5 m s^{-1} for at least one hour per day. With 48 monitors, this produced over 20,000 data points.

Parameter	Saltgrass Cover Class		
Average and (Range)	0-20 percent	20-40 percent	>40 percent
Number of monitoring sites	7 (2 to 15)	11 (6 to 16)	4 (1 to 9)
Number of monitor pairs	14 (4 to 30)	22 (12 to 32)	8 (2 to 18)
Number of days with significant sand flux (out of 455)	15	5	0
Number of days with significant sand flux (out of >20,000)	49	16	0
Control Efficiency	98.0% (82.4 – 100)	99.1% (97.3 – 100)	100% (99.8 - 100)

Figure 12: Control efficiency from the DWP monitoring network in the MV DCM, by cover class, in relation to the research results referenced in the 2003 SIP (GBUAPCD, 2003).

The DWP results are shown as the (arithmetic) mean CE (yellow triangles and regressed line) and the 95-percent confidence interval (solid gray bars). The District data (GBUAPCD, 2003) are shown as actual data points (red circles), the 50 percent cover threshold (green line) required to achieve 99-percent control of sand motion (light gray shaded box), and the control efficiency relationship developed for Owens Lake by Lancaster (1996).



APPENDIX A

Data Screening Procedures

Data Screening Procedures

Step 1

The first level of data screening consisted of filtering the raw data set of hourly sand fluxes for the entire 24-month period and all monitoring pairs for values above the minimum threshold of 0.5 g cm^{-2} h^{-1}. This threshold of "significant sand flux" is consistent with the screening procedures used by the District in the Dust ID modeling protocol (GBUAPCD, 2003). The resulting data were then compared with the baseline (Figure A.1), and the control efficiencies were calculated (Figure A.2).

Step 2

In the second step of the screening procedures, periods during which construction or maintenance related surface disturbance occurred, in or adjacent to the MV DCM, were identified (Figure A.3, Figure A.4). This analysis consisted of a close examination of the temporal and spatial distribution of the high sand flux values. In many cases the occurrence of the highest sand fluxes was associated with unavoidable human disturbance near the monitoring sites, due to construction or maintenance activities. The timing (to a daily resolution) and location of these activities was traced back using observations from field personnel, as well as detailed construction and maintenance records and maps. The identified construction and maintenance related activities in and around the MV DCM during the analysis period consisted of three distinct activities.

Replanting of Saltgrass

In the late spring of 2004, saltgrass was replanted throughout the entire MV DCM in order to fill in areas where the initial establishment of saltgrass was insufficient. The startup period of the DWP sand motion monitoring overlapped with the replanting effort. Many of the DWP monitors showed significant sand motion only during the first month, May 2004, when replanting was recent or still ongoing (Figure A.3, Figure A.4), but no significant activity thereafter. Based on the overlapping of these two activities, the May 2004 period was removed from the control efficiency analysis for the entire MV DCM.

Maintenance of Drip Lines

In December of 2005, new drip lines were installed over a significant portion of the MV DCM. This involved heavy equipment, including tractors, which radically disturbed surface crusts in these areas. Field personnel documented the area where the surface crust was severely disturbed during these maintenance activities and developed a list of the monitoring sites potentially affected by the surface disturbance. In the early winter of 2006 most of these sites, which had not shown significant sand motion until then, became highly emissive (Figure A.3, Figure A.4). In comparison, areas where the drain line replacement did not take place did not show any significant sand motion during this period. Moreover, the (potentially) affected sites were documented several weeks before these sites actually became emissive. Based on the insufficient time frame for the salt crust to heal after the disturbance, the period from December 2005 through March 2006 was removed from the control efficiency analysis for five monitoring sites (10 monitoring pairs) affected by maintenance activities originating in December 2005.

Phase Shallow Flood Construction

In January of 2006, Phase V shallow flooding construction activities commenced adjacent to the MV DCM near the southwest corner of the DCM (Figure A.5). One of the monitoring sites just inside of the berm of the MV DCM appeared to be strongly affected by these activities (Figure A.3, Figure A.4). This site, Site 70/71 (Figure A.5), is characterized by a low saltgrass cover, approximately 13 percent, and did show significant sand motion in 2005 before the Phase V construction commenced. However, sand fluxes increased three-fold within two weeks of the onset of Phase V construction. Based on this information, the period from January 2006 and onwards (as construction is still ongoing) was removed from the control efficiency analysis for Site 70/71.

Step 3

In the third screening step the sand flux data for period and Sensit combinations affected by surface disturbance due to construction and maintenance activities, as identified in Step 2, were removed from the data set. The resulting data set indicated that the observed sand fluxes were considerably lower than the baseline (Figure A.6). Moreover, the only site with significant sand motion is Site 70/71. This is not unexpected since this site is located on a sandy soil type, has a low grass cover (~13 percent), and is located only 300 feet from the edge of the DCM (Figure A.5). The resulting screened CE values range from 75 to 100 percent at Site 70/71, and are over 90 percent at all other sites (Figure A-7). A more in depth breakdown of CE by saltgrass cover is provided in the Results Section and the Discussion and Conclusions Section.

Figure A.1: Sand flux from the DWP monitoring network in the MV DCM, May 2004 to April 2006, normalized by wind speed.

The baseline is indicated by the blue line. Data are screened by threshold level only (Step 1).

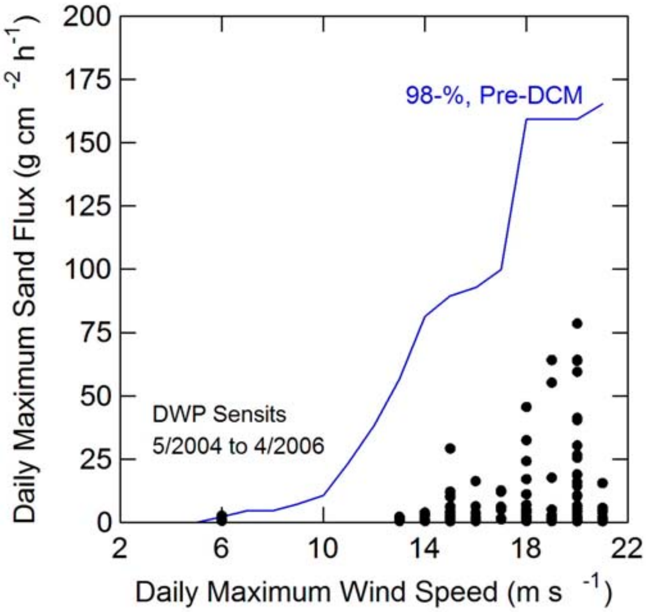


Figure A.2: Sand flux control efficiency (percent) as a function of saltgrass cover, May 2004 to April 2006, normalized by wind speed.

The lines indicate a 50-percent cover and the 99-percent control level, based on the 2003 SIP (respectively, green and red line). The data are screened by threshold level only (Step 1).

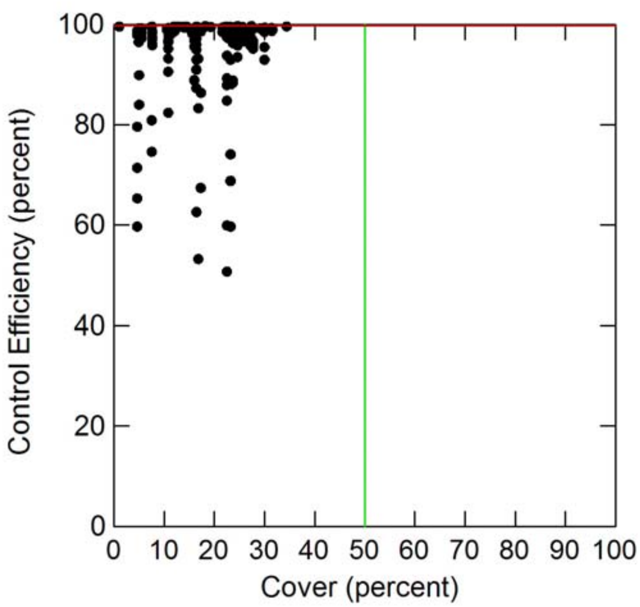


Figure A.3: Sand flux from the DWP monitoring network in the MV DCM, May 2004 to April 2006, normalized by wind speed.

The baseline is indicated by the blue line. The data are screened by threshold level (Step 1). The construction and maintenance periods are differentiated by symbols and colors (Step 2).

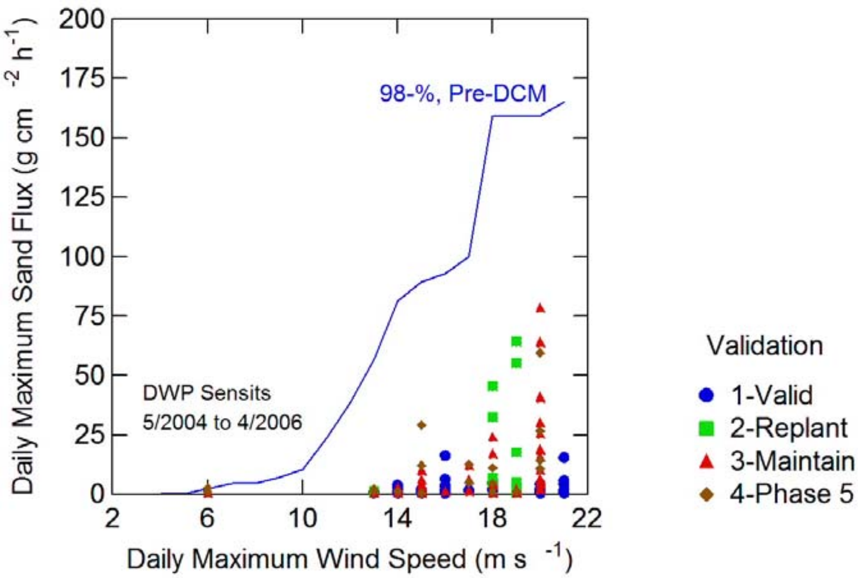


Figure A.4: Sand flux control efficiency (percent) as a function of saltgrass cover, May 2004 to April 2006, normalized by wind speed.

The lines indicate a 50-percent cover and the 99-percent control level (green and red lines, respectively). Data are screened by threshold level (Step 1). Construction and maintenance periods are differentiated by symbols and colors (Step 2).

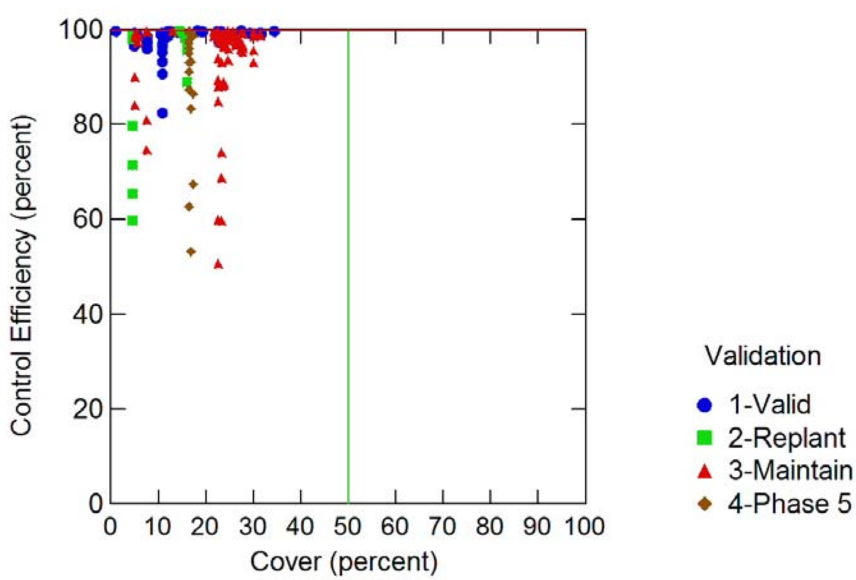


Figure A.5: The south west corner of MV DCM as seen by QuickBird satellite imagery in January 2006 (Panel A) and February 2006 (Panel B).

Monitoring Site 70/71, located approximately 300 feet from the edge of the DCM, is indicated as a red star. Severe ground disturbance due Phase V construction is visible in the February image, but is absent in the January image.

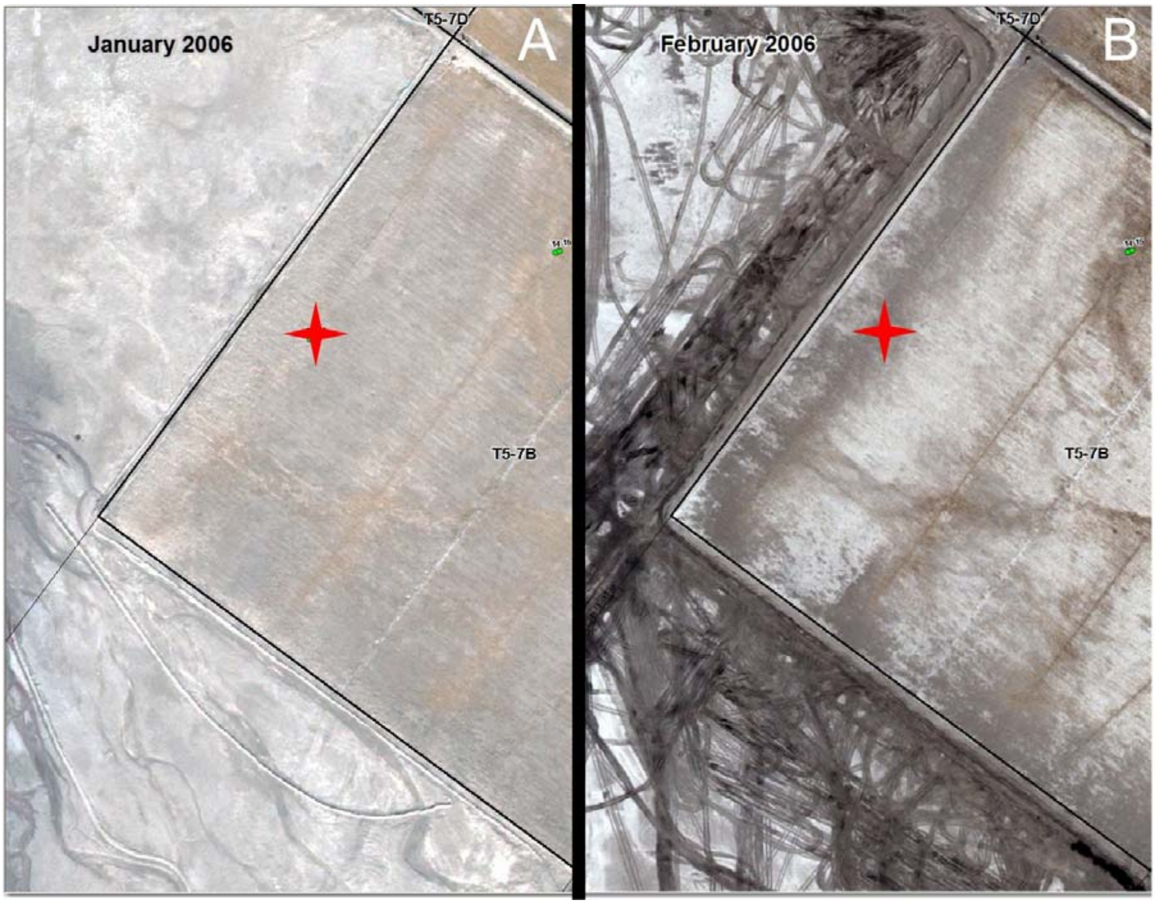


Figure A.6: Sand flux from the DWP monitoring network in the MV DCM, May 2004 to April 2006, normalized by wind speed.

The baseline is indicated by the blue line. The saltgrass cover classes are differentiated by symbol and color. The data are screened by threshold level (Step 1) and construction and maintenance periods (Step 2 and Step 3).

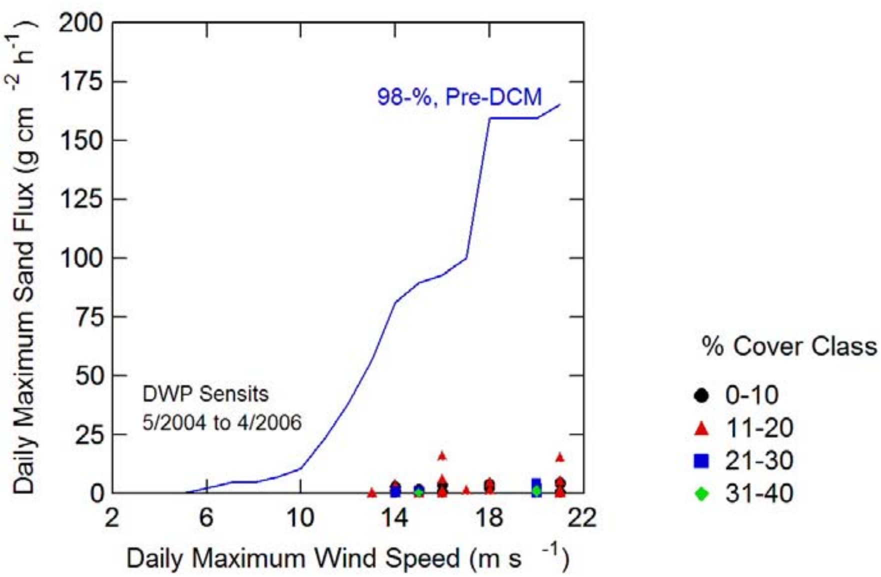
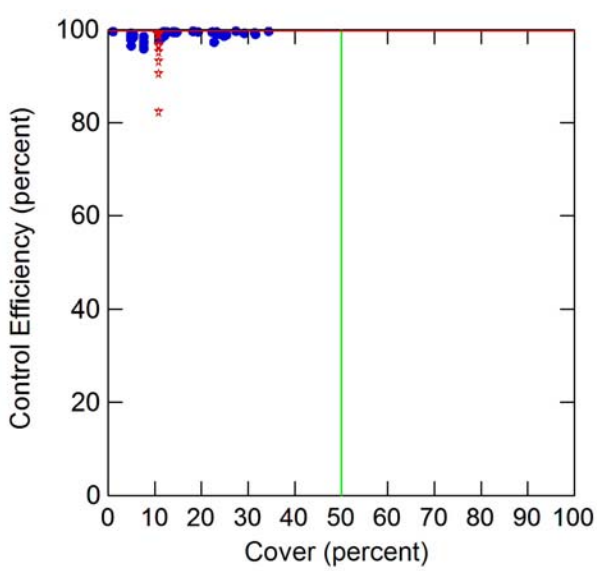


Figure A.7: Sand flux control efficiency (percent) as a function of saltgrass cover, May 2004 to April 2006, normalized by wind speed.

The lines indicate a 50-percent cover and the 99-percent control level (green and red lines, respectively). The symbols represent Site 70/71 (red stars) and all other monitoring sites (blue circles). The data are screened by threshold level (Step 1) and construction and maintenance periods (Step 2 and Step 3)



APPENDIX 4.
AIR SCIENCES INC. 2007A. DEMONSTRATION OF 99 CONTROL EFFICIENCY FOR THE MANAGED VEGETATION DUST CONTROL MEASURE.

AIR SCIENCES INC.
DENVER • PORTLAND

TECHNICAL MEMORANDUM

DEMONSTRATION OF 99-PERCENT CONTROL EFFICIENCY FOR THE MANAGED VEGETATION DUST CONTROL MEASURE

PREPARED FOR: Duane Ono, GBUAPCD
Mark Schaaf, Air Sciences

PREPARED BY: Kent Norville, Air Sciences

PROJECT NO.: 228-7

COPIES: Richard Harasick, LADWP
Ted Schade, GBUAPCD

DATE: June 27, 2007

This modeling report outlines the methods, data, and assumptions for the air quality dispersion analysis used to evaluate whether the Owens Lake managed vegetation (MV) area has met the required 99-percent control efficiency as defined under the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan 2003 Revision (RSIP). The approaches used in this analysis follow those outlined in the RSIP.

Model Selection

Following the RSIP, Air Sciences used the CALPUFF modeling system files generated for the Winter 2007 Dust ID modeling analysis. The specific model versions were CALPUFF version 5.711b (051216) and CALMET version 5.53b.

Meteorological Data

For this analysis, data from two calendar years (2005 and 2006) were used. The monthly CALMET data sets were already processed as part of the Dust ID program by the District's consultant.

Sand Catches

According to the RSIP, PM_{10} emission rates are computed on the basis of sand flux, which is computed using data from Cox Sand Catchers (CSC) and Sensits. The CSC is a passive collection device that captures wind-transported sand and sand-sized particles. Sensits are real-time particle motion sensors used to time-resolve the mass collected by the CSC. Both instruments were installed to sample at a height of 15 cm above the surface.

Within the MV area, the District operated eight long-term sand catch sites, identified as: 7585, 7586, 7607, 7608, 7609, 7610, 7631, and 7632 (Figures 1 and 2). In 2005, the resolution of the sand catches was 1 gram as the sand masses were measured in the field. In 2006, the District began weighing the sand masses in its laboratory, and the resolution is now lower than 0.1 grams. In mid December 2006, the District added six more sand catch sites: 9509, 9510, 9511, 9512, 9513, and 9514 (Figure 2). In January 2007 (outside the period covered by this modeling analysis), the District added two more sites: 9515 and 9516 (Figure 2). The 2006 sand catch masses for these 13 District sites operating during calendar year 2006 are shown in Table 1. Sites with a single collection greater than 5 grams are highlighted in yellow.

Table 1: District sand catch sites with collected sand masses by year (largest and total).

	2005		2006	
District Sites	Largest Collection (grams)	Total Mass (grams)	Largest Collection (grams)	Total Mass (grams)
Long-Term Sensits				
7585	0	0	2	2
7586	0	0	1	1
7607	1	1	1.5	1.5
7608	0	0	0	0
7609	0	0	1	1
7610	0	0	1	1
7631	0	0	0.4	0.4
7632	0	0	0.2	0.2
Installed December 2006				
9509	--	--	0	0
9510	--	--	0	0
9511	--	--	54	54
9512	--	--	4	4
9513	--	--	116	116
9514	--	--	0	0

From February 2005 through September 2006, LADWP operated 24 sand catch sites within the MV area to support the Managed Vegetation Control Efficiency Study[1], as shown in Figure 3. The 2005 and 2006 sand catch masses for the LADWP sites are presented in Table 2. Each LADWP site employed an instrument pair. The resolution of the LADWP catches was 0.1 grams.

Table 2: LADWP sand catch sites with collected sand masses by year (largest and total). Yellow highlighted sites had a sand collection mass greater than 5 grams.

		2005		2006	
LADWP Site	Sensit Number	Largest Collection (grams)	Total Mass (grams)	Largest Collection (grams)	Total Mass (grams)
CS1001	20054	2.0	3.9	4.9	9.0
	20055	4.2	7.2	4.9	9.0
CS1002	20056	0.6	1.8	0.9	2.2
	20057	0.5	1.3	1.9	2.9
CS1003	20058	0.3	1.1	0.8	2.1
	20059	0.2	0.9	0.6	1.8
CS1004	20060	0.7	1.9	13.7	18.2
	20061	0.5	1.5	10.2	14.2
CS1005	20062	3.0	4.2	3.0	7.5
	20063	3.0	4.1	2.1	6.1
CS1006	20064	51.8	82.1	5.5	12
	20065	44.2	89.4	3.7	6.6
CS1007	20066	0.5	1.8	0.8	2.1
	20067	0.4	1.4	0.4	1.3
CS1008	20068	0.3	0.8	1.3	2.8
	20069	0.2	0.9	0.7	1.9
CS1009	20070	139.5	148.1	167	359.5
	20071	47.2	51.6	62.9	141.8
CS1010	20018	1.5	4.0	1.8	4.9
	20019	1.5	3.2	1.6	3.8
CS1011	20032	0.5	2.2	2.0	5.9
	20033	0.4	1.7	1.6	5.0
CS1012	20008	0.3	1.1	1.9	3.6
	20009	0.4	1.8	1.0	2.7
CS1013	20012	0.1	0.8	0.8	2.2
	20013	0.3	1.2	0.7	2.3
CS1014	20016	0.7	2.1	0.9	2.7
	20017	0.7	1.5	1.0	3.1

[1] Managed Vegetation Control Efficiency Study, Owens Dry Lake, California, Technical Memorandum prepared for Richard Harasick, Los Angeles Department of Water & Power by Air Sciences Inc., July 24, 2006.

Table 2 (continued): LADWP sand catch sites with collected sand masses by year (largest and total). Yellow highlighted sites had a sand collection mass greater than 5 grams.

		2005		2006	
LADWP Site	Sensit Number	Largest Collection (grams)	Total Mass (grams)	Largest Collection (grams)	Total Mass (grams)
CS1015	20040	1.2	3.4	1.1	3.8
	20041	2.1	4.6	1.1	3
CS1016	20038	0.7	3.1	209.8	481.6
	20039	0.8	3.2	271.2	543.7
CS1017	20028	2.5	5.8	77.2	155.4
	20029	1.8	3.7	58	107.3
CS1018	20026	3.9	13.3	61.6	115.4
	20027	2.5	5.6	30	62.3
CS1019	20024	2.6	6.7	49.5	91.5
	20025	2.5	6.2	49.1	91.5
CS1020	20036	8.3	13.5	46.8	84.5
	20037	5.3	11.4	47.2	82.4
CS1021	20046	3.7	5.9	3.8	6
	20047	1	3.3	3.4	5.8
CS1022	20048	0.8	1.7	1.5	2.4
	20049	1.6	2.3	1.2	2.8
CS1023	20050	1.2	3.2	3	6.8
	20051	1	2.6	2.8	6.5
CS1024	20052	0.2	0.7	0.6	1.6
	20053	0.3	0.8	0.5	1.5

Figure 1: District sand catch sites within the Managed Vegetation area. The green circles are District sand catch sites operating in 2005 and 2006. The red circles are District sites that were installed in mid-December 2006.

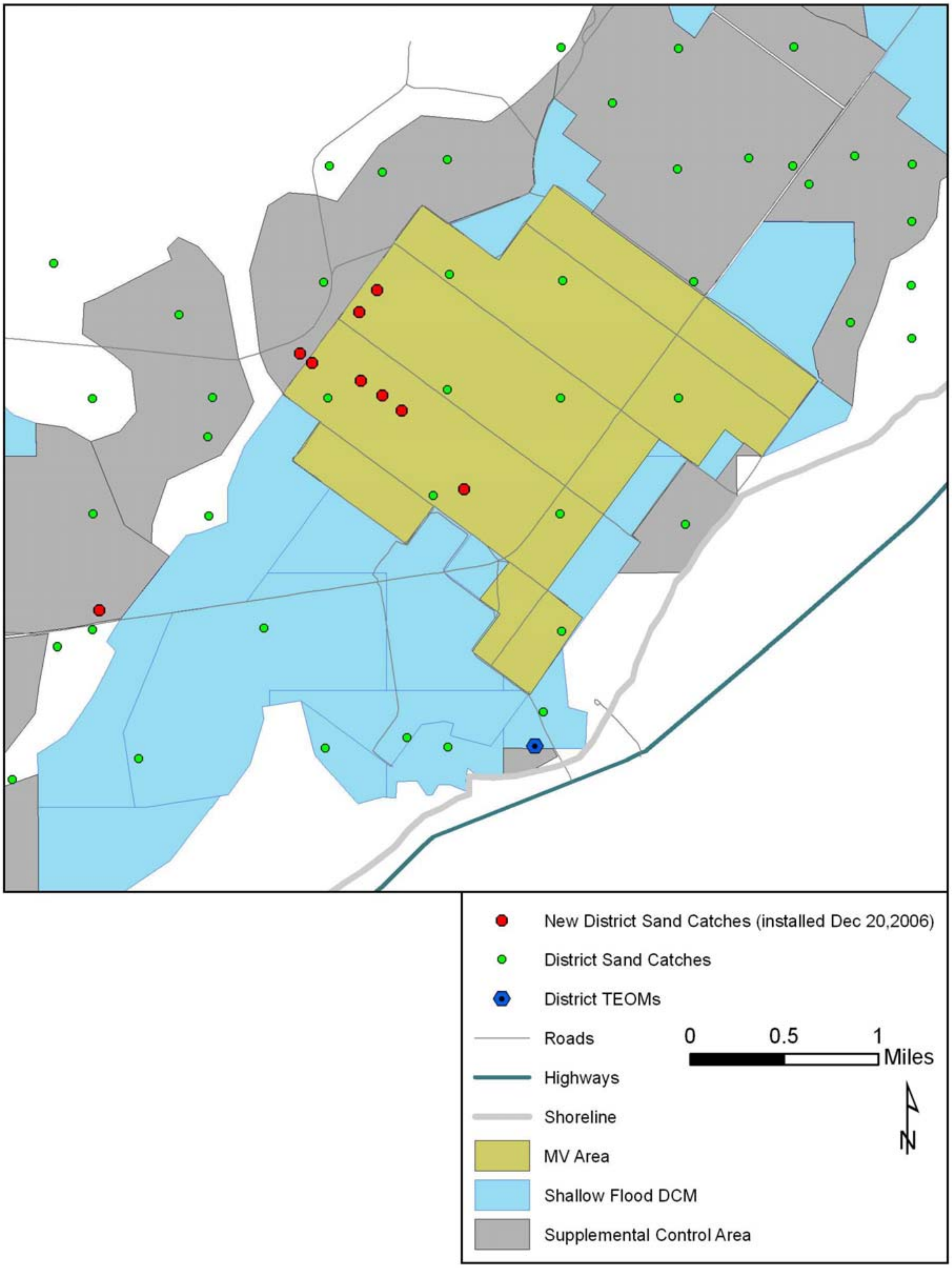


Figure 2: Closeup of District sand catches sites within the MV area.

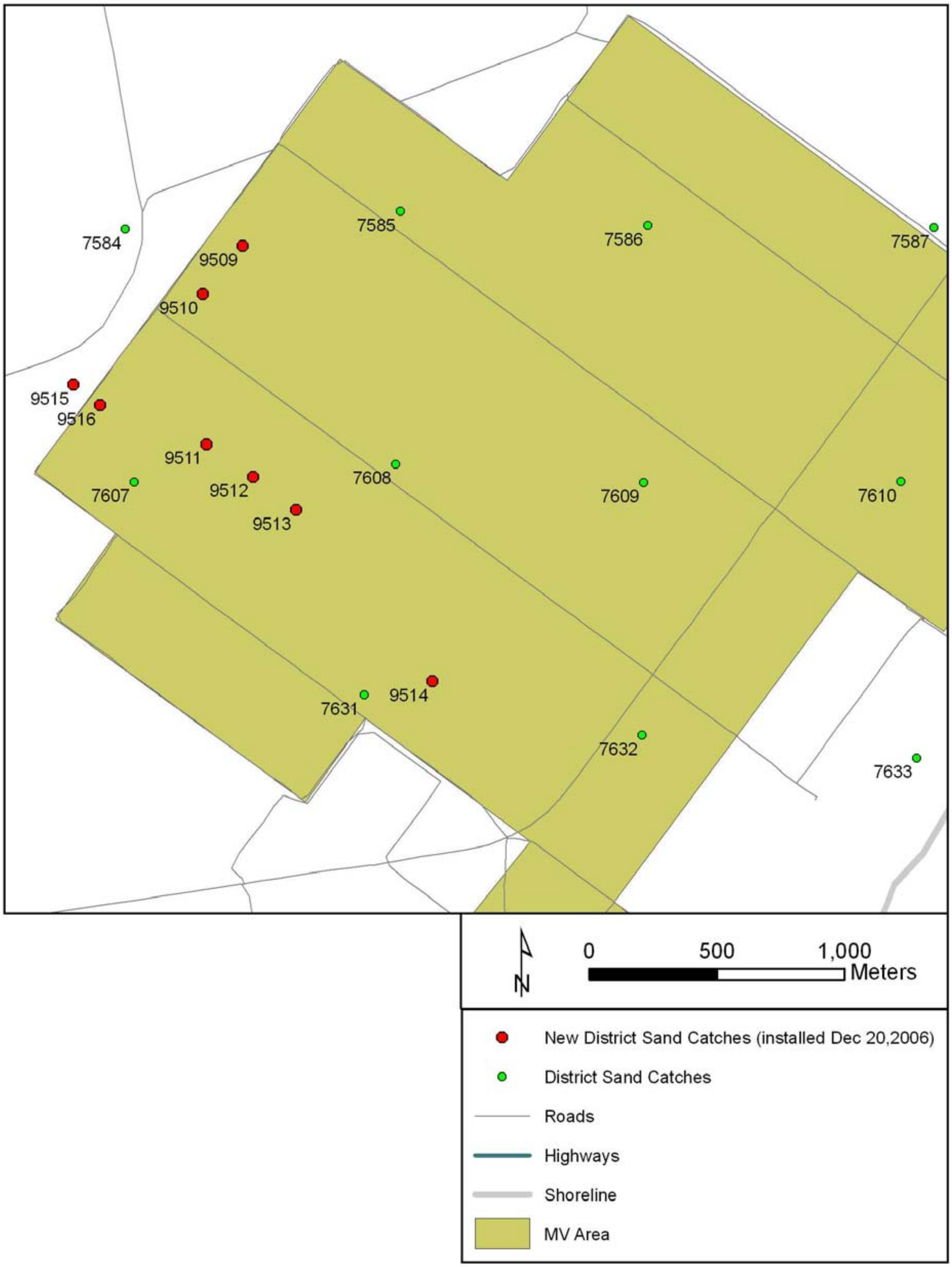
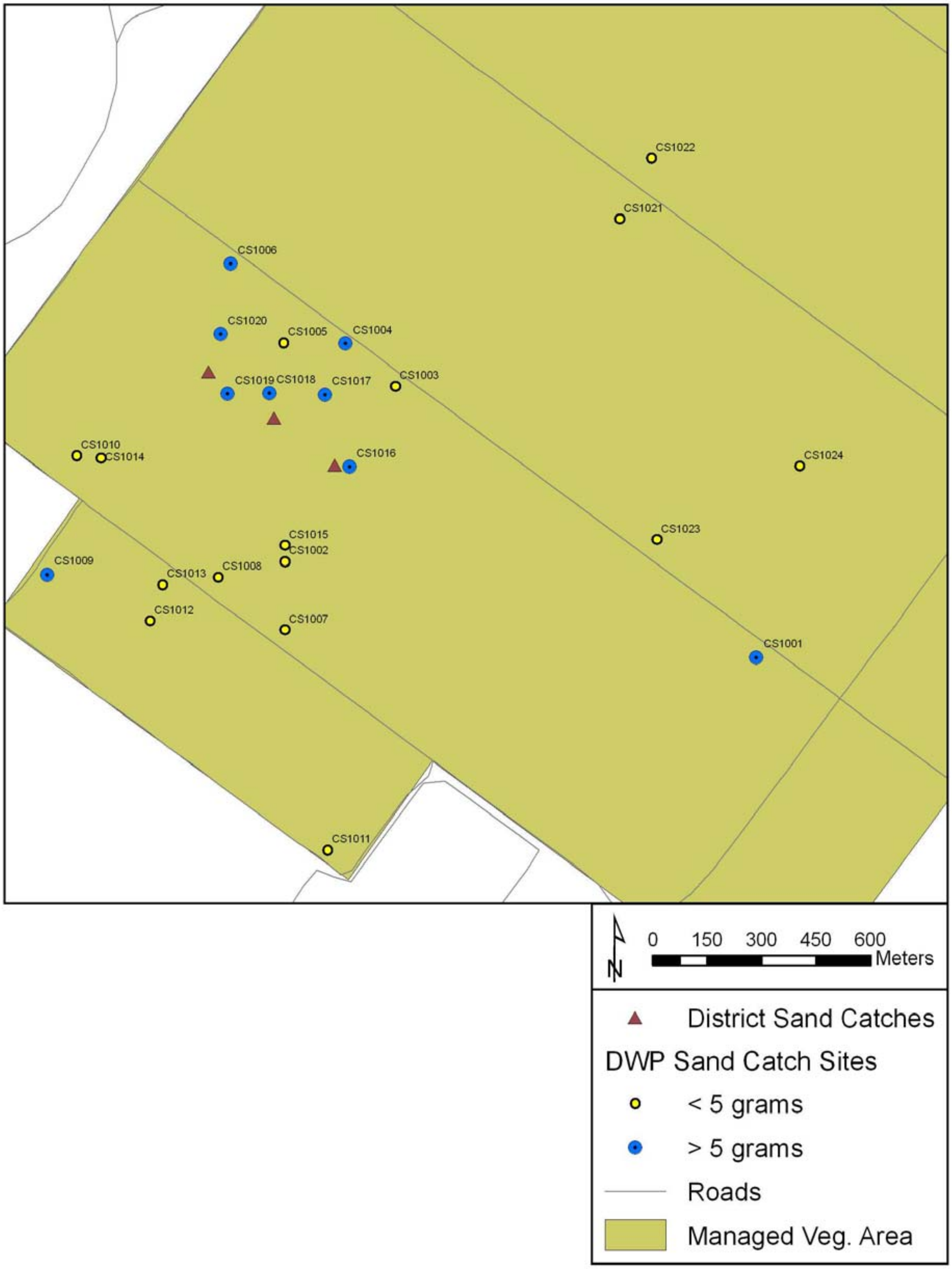


Figure 3: LADWP sand catch sites within the MV area.



Modeled Areas

For this analysis, two types of areas were considered. The first class were discrete areas associated with the higher mass sites, generally with a catch greater than 5 grams with a definable boundary. The second class was the remainder of the general MV area. The general area was represented by the scattered low mass catches which generally did not have a clearly identified emissive area associated with them.

The discrete areas with high sand masses are shown in Figure 4. Eight sand catch sites are associated with this source class: CS1004, CS1006, CS1009, CS1016, CS1017, CS1018, CS1019 and CS1020. Five of these, CS1016 through CS1020, were associated with the 34-acre area of drip tube shanking in late 2005. This area is also represented by District sites 9511, 9512, and 9513. CS1004 was associated with a 1.25-acre LADWP-delineated area. CS1009 was associated with sand intrusion coming onto the MV area from the bare playa just west of the MV area. This area encompasses approximately 4.39 acres. CS1006 was identified with a 7.5-acre area of poor subsurface drainage and sparse vegetation. The area extends to CS1005, but CS1005 was not included with this area because of its low 2006 sand masses.

These distinct areas were then characterized using the methodology from the Dust ID Program, i.e., they were modeled as rectangles with the same area as the source delineation. Because each site has two sets of instruments (one in-row and one between-row), the sand fluxes were calculated hourly and then averaged over both sets on an hour-by-hour basis to represent the site. Only collections when the sand catch was above 1 gram were considered.

The general MV area was characterized as a series of 250-meter by 250-meter squares, except around the distinct areas described above. Around these distinct areas, smaller squares or rectangles were used. For the sand flux, all of the non-distinct area catches were averaged and then time-resolved using an average flux based on a unit sand mass. This way, the modeled flux would be based on the area-wide average values and not biased toward any one site. If all of the distinct areas had sand masses less than 1 gram, then the area-wide MV emissions were assumed to be zero.

Note that the long-term District sites were not used in this analysis because the Dust ID files that Air Sciences had on hand were not resolved below 5 grams in 2005. It is Air Sciences' opinion that this omission does not have a significant impact on the results because these sites had zero or small sand catches (comparable to the LADWP set) during this time period.

K-factors

For this analysis, the South Area default K-factors were used.

Analysis and Results

Using the sand flux, source areas, and K-factors, the CALPUFF model was run for each source area to calculate the maximum 24-hour average shoreline PM_{10} concentration. Table 3 shows the maximum 24-hour concentrations for each individual area and for the overall cumulative contribution.

Table 3: Maximum 24-hour PM_{10} concentrations for 2005 and 2006.

LADWP Site Number	District Site Number	Maximum 24-hour Concentration (μg/m³) 2005	2006
1004		0	0.05
1006		0.71	0.04
1009		1.18	1.73
1016	9513	0.05	12.57
1017		0.03	0.95
1018		0.11	0.85
1019	9511	0.06	2.01
1020		0.09	0.21
Rest of MV Area		16.41	7.66
Cumulative Maximum		16.41	19.01

Because the source contributions are much smaller than the standard less the background concentration (130 μg/m³), it is assumed that these source areas are achieving the required 99-percent control efficiency.

Figure 4: Discrete source areas within the Managed Vegetation site.

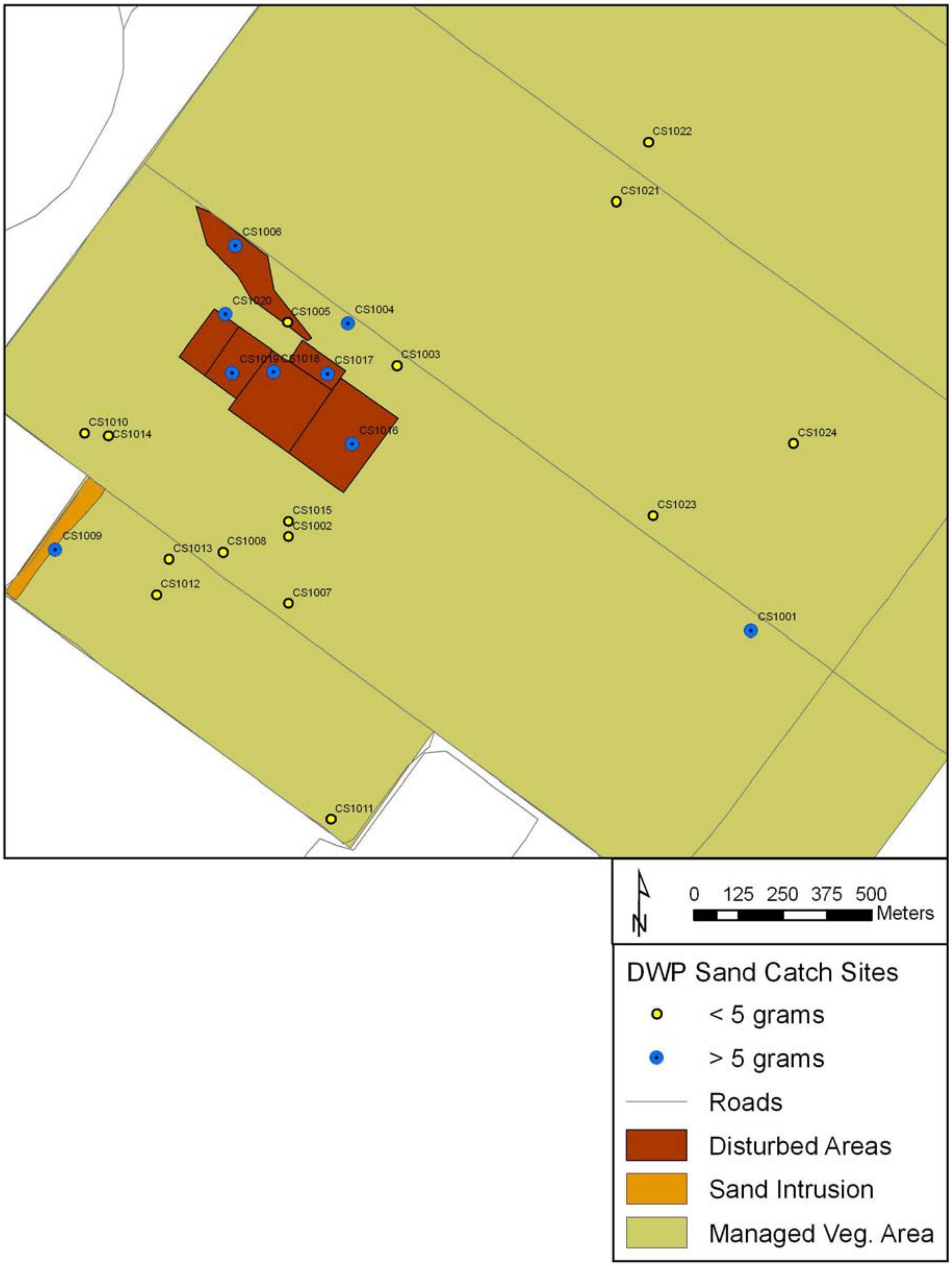
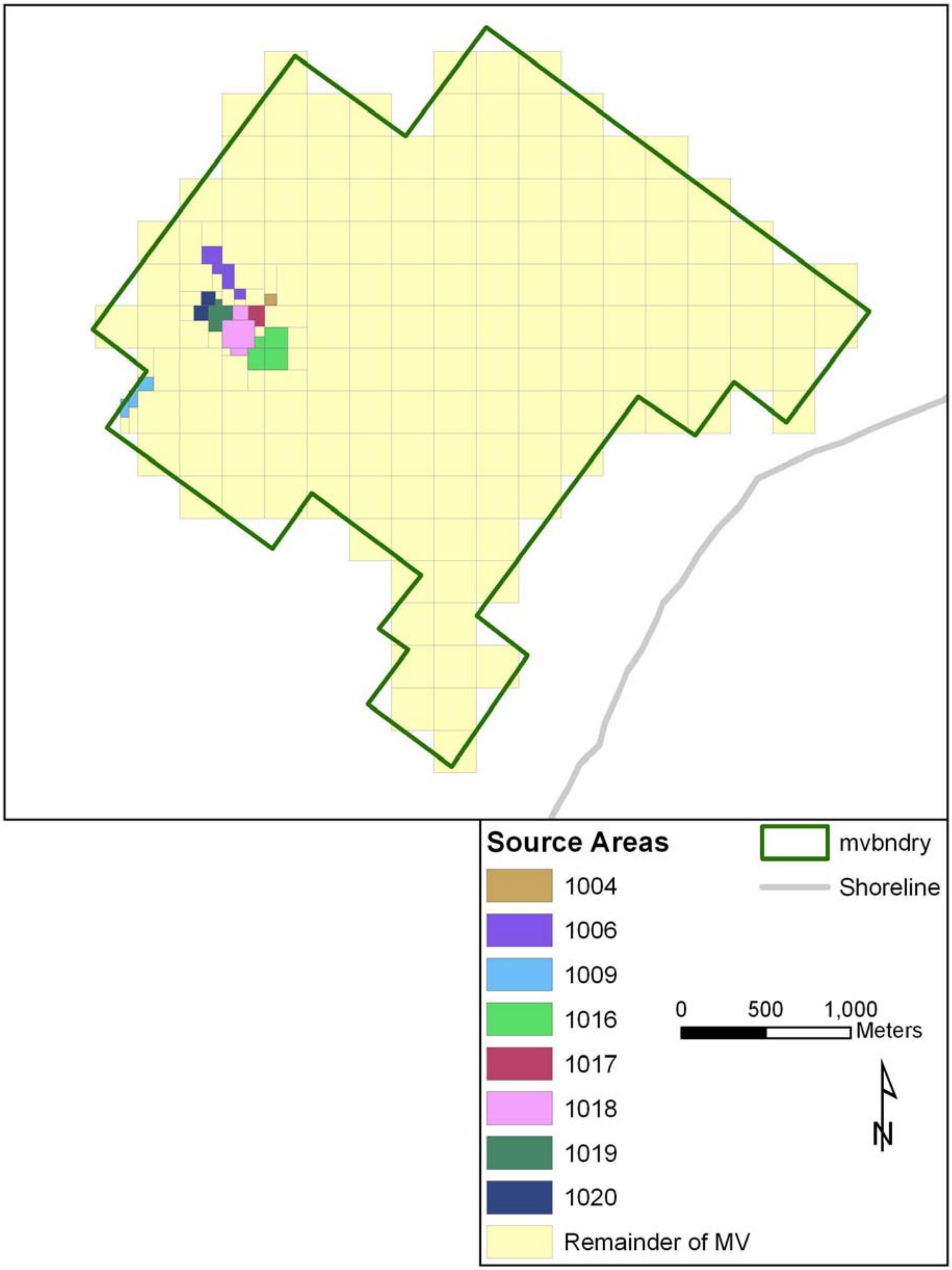


Figure 5: Modeled source areas for the LADWP sand catch sites (February 2005 to August 2006).



AIR SCIENCES INC.
DENVER • PORTLAND

TECHNICAL MEMORANDUM

CALCULATION OF MANAGED VEGETATION SAND FLUX CONTROL EFFICIENCY

PREPARED FOR: Duane Ono/GBUAPD
Mark Schaaf, Air Sciences

PREPARED BY: Kent Norville, Air Sciences

PROJECT NO.: 228-7-1

DATE: August 1, 2007

This memorandum outlines the methods, data, and assumptions for calculating the sand flux control efficiency in the Managed Vegetation (MV) area in order to demonstrate compliance with the required 99-percent control efficiency as defined under the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan 2003 Revision (RSIP).

Approach

The sand flux control efficiency is defined as

$$CE = \frac{\left[SF_{base}(w) - SF_{MV}(w)\right]}{SF_{base}(w)}$$

where SF_{MV} is the MV area averaged sand flux and SF_{base} is the uncontrolled pre-MV sand flux. Both sand fluxes are functions of wind speed. To estimate the uncontrolled sand fluxes, two years of pre-construction sand flux data from nine Sensit sites (7586, 7607, 7608, 7609, 7630, 7631, 7632, 7633 and 7654) in the MV area were used. First, for each Sensit, the cumulative daily sand flux was calculated. Since the pre-construction source areas were designated as square kilometers, the average daily sand flux was found by averaging the nine individual daily cumulative sand fluxes. Then for each day, the maximum wind speed, as measured at the Dirty Socks monitor, was determined. The sand flux was then binned into 1 m/s wind speed increments and the 98 percentile sand flux was determined. Figure 1 shows the binned sand flux values and the 98th percentile sand flux line. This line was set so that a bin's 98th percentile was never less than that found in a lower wind speed bin.

For the controlled MV area, the DWP MV Sensit data from January 2005 to June 2006 were used. DWP had 24 sites on the MV area operating during this period. Most of the sites had little sand activity; however, several sites (1004, 1006, 1009, 1016, 1017, 1018, 1019, and 1020) had higher sand activity and were thus assigned to delineated areas. These high activity sites were treated individually. For the low sand mass sites, the catches were averaged and then time-resolved using an average flux based on a unit sand mass. This way, the modeled flux was the area-wide average value and not biased toward any one site. Then the daily cumulative sand fluxes were calculated and then weighted based on the size of the area that was assigned using:

$$SF_{MV} = \frac{\sum_{site} SF_s A_s}{\sum_{site} A_s}$$

where SF_s is the daily cumulative sand flux for site s and A_s is the delineated area for site s. Then, the sand flux was then binned into 1 m/s wind speed increments, using the wind data from the Dirty Socks monitor, and the 98 percentile sand flux was determined. Figure 2 shows the binned sand flux values and the 98th percentile sand flux curve.

Results

Table 1 shows the CE for each wind speed bin. All of the CE's are greater than 99 percent control indicating compliance with the 99 percent control requirement.

Table 1. Calculate CE by wind speed bin

WS Bin (m/s)	SF_{MV} (g/cm²/day)	SF_{base} (g/cm²/day)	CE (%)
7	0.18	37.80	99.52
8	0.18	47.65	99.62
9	0.18	74.63	99.76
10	0.22	194.04	99.89
11	0.22	194.04	99.89
12	0.22	194.04	99.89
13	0.22	199.98	99.89
14	0.61	199.98	99.70
15	0.61	540.12	99.89
16	0.61	540.12	99.89
17	0.61	540.12	99.89
18	0.61	540.12	99.89
19	0.61	540.12	99.89
20	1.47	540.12	99.73
21	1.47	540.12	99.73
22	2.04	540.12	99.62
23	2.04	540.12	99.62

Figure 1. Binned uncontrolled sand flux (SF_{base}) and the 98th percentile line

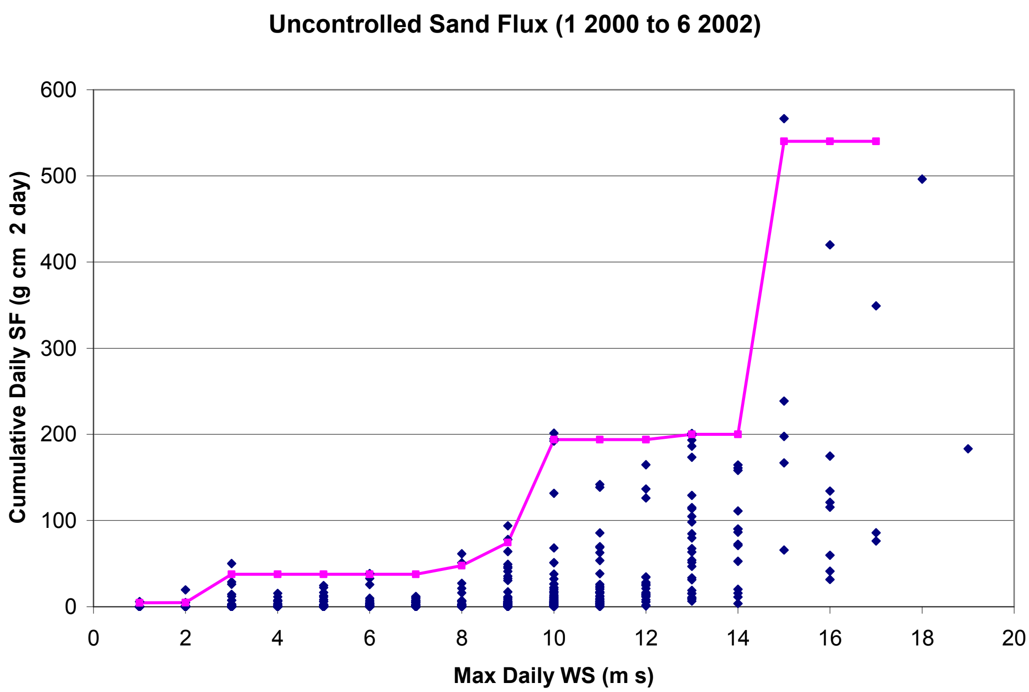
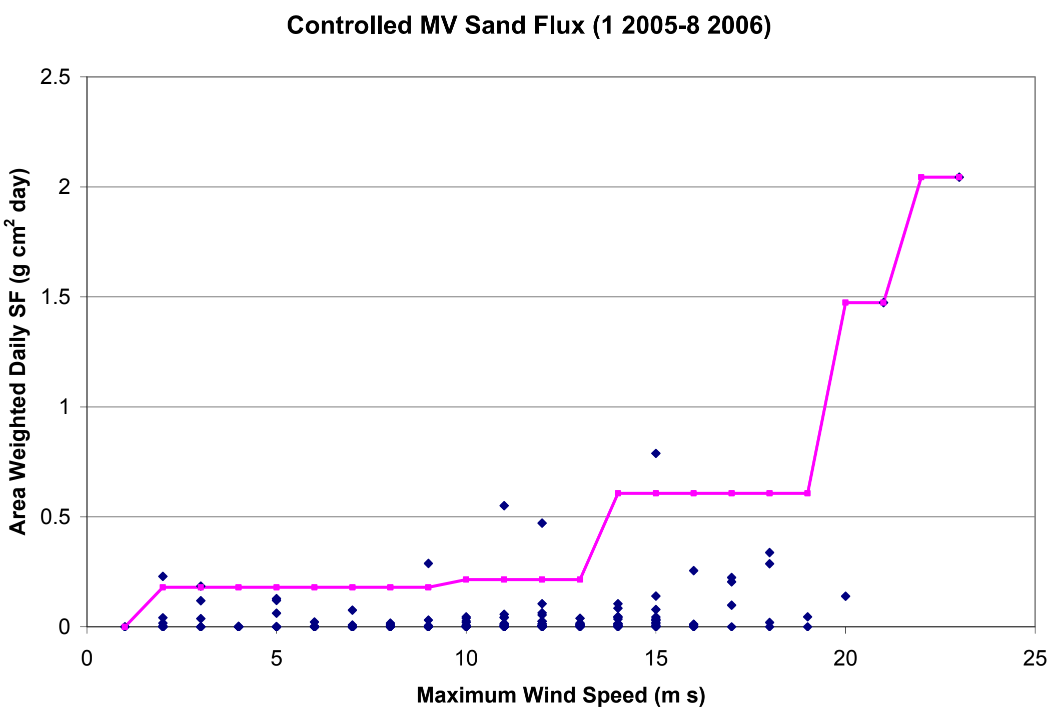


Figure 2. Binned controlled MV sand flux (SF_{MV}) and the 98th percentile line



APPENDIX 5.
NEWFIELDS, AIR SCIENCES, AND EARTHWORKS. 2008. APPROACH TO THE MANAGED VEGETATION OPERATION AND MANAGEMENT PLAN.

Report

Approach to the Managed Vegetation Operation and Management Plan

Prepared for

Los Angeles Department of Water and Power

May 2008

NewFields Agricultural and Environmental Resources

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Co-authored by

EARTHWORKS Restoration, Inc.

and

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ACRONYMS AND ABBREVIATIONS

AOC	area of concern
APCO	Air Pollution Control Officer
DCM	dust control measure
DMU	drainage management unit
DPF	digital point frame
GBUAPCD	Great Basin Unified Air Pollution Control District
LADWP	Los Angeles Department of Water and Power
MV	managed vegetation
Plan	Managed Vegetation Operation and Management Plan
PMP	Performance Monitoring Plan
Site	managed vegetation Site
SOP	standard operating procedure

INTRODUCTION

Item 6 of the November 2006 Settlement Agreement between Great Basin Unified Air Pollution Control District (GBUAPCD) and the Los Angeles Department of Water and Power (LADWP) contains a provision requiring the development of a *Managed Vegetation Operation and Management Plan* (Plan; NewFields et al., 2008), as follows:

6. *The Parties believe that the City's existing Managed Vegetation site may currently achieve a control efficiency of 99 percent. Therefore, the City shall continue to maintain and the District shall continue to monitor the site to ensure that it achieves 99 percent control efficiency. No later than July 1, 2007, the City shall submit to the District an operation and management plan for the City to maintain cover conditions that achieve 99 percent control efficiency in the Managed Vegetation areas. The plan shall be subject to written approval by the APCO, which approval shall not be unreasonably withheld. Prior to the time that the Managed Vegetation area is in compliance with an approved SIP, the District will not issue a Notice of Violation (NOV) for the existing Managed Vegetation area as long as:*

   A. *From January 1, 2007, to the earlier of July 1, 2007 or the date when the City's operation and management plan is approved by the APCO, the City maintains its current operation and management practices for its Managed Vegetation areas; and*

   B. *After the APCO's written approval of the operation and management plan, the City implements all provisions of its operation and management plan; and*

   C. *The City's Managed Vegetation area site does not cause an exceedance of the federal standard at the historic shoreline.*

During the 2003 through 2006 period, LADWP conducted the Managed Vegetation Effectiveness Monitoring Study (Study). Data gathered during this study forms the basis for assessments of dust control effectiveness at the existing managed vegetation site (Site). The study is described in greater detail in an evaluation of the control efficiency of the Site is provided in Air Sciences (2006). This explanation of the approach to the Plan (Approach) explains how the Site will be operated and managed in the future to meet or exceed the minimum cover requirements, and to address any areas that threaten to produce shoreline NAAQS exceedances. It is understood that if cover condition that achieved 99 percent control efficiency in the past are met or exceeded, then achievement of these goals will be very likely. The Plan itself (NewFields et al., 2008) describes how ongoing compliance with federal PM_{10} standards will be verified by GBUAPCD. The main elements of this approach are the following:

1. **Managing the Site.** The general Site management approach is described, but most of this section is devoted to areas that have required specific effort to establish and/or maintain. Over the past 5 years, the Site has been managed to maximize plant growth and cover, balancing the irrigation and drainage needs of diverse areas, often within a single, 40-acre block. The challenges encountered and successful management approaches developed, as well as the plant growth results achieved during this period are described.
2. **Verifying compliance with federal PM_{10} standards.** Aerometric and meteorological data will be collected at selected locations and analyzed to better focus operations and maintenance (O&M) activities. Areas with sparse vegetation have been reduced in number and scale since the first planting that covered about 80 percent of the Site with live saltgrass, and seasonal growth across the Site as a whole increases average vegetative cover. Risk of significant emissions is, therefore, declining. Nevertheless, remaining or newly sparse areas will be monitored and, if they pose a significant emissions risk, will be specially managed to reduce this risk.
3. **Verifying vegetative cover.** Cover will be measured annually on the Site. Results will be compared with specific criteria related to historical conditions that were related to 99 percent control efficiency for the Site. Criteria will be developed or applied with a margin of safety. This comparison and any new O&M actions to address problems will be submitted annually by

LADWP in the Performance Monitoring Plan, as provided for in Item 12 of the Settlement Agreement:

12. *The City, in consultation with the District, shall annually develop and provide to the District a Performance Monitoring Plan (PMP) to aid in its operation of the Owens Lake dust mitigation program on the Owens Lake bed.*

    A. *The PMP will describe the measurements and methods used to verify the performance of the constructed DCMs and Moat and Row test areas. The PMP will also describe the measurements and methods used to maximize information on dust emissions from areas of special interest.*

    B. *The City shall implement the PMP, and will use the results as a guide for making operational decisions about the type, location, timing, and level of dust control measures needed to prevent exceedances of the federal standard at the shoreline.*

    C. *The District may use information from the PMP to assist in determining the likely sources of dust emissions causing or contributing to exceedances (if any) of the federal standard at the shoreline.*

This version of the Plan has been developed in response to review of vegetative cover estimates. These reviews and their impact on the Plan are summarized in NewFields (2008).

APPROACH TO SITE MANAGEMENT

The Site will be managed to meet or exceed target cover conditions, and address any areas identified as a threat to produce shoreline violations (see *Air Sciences 2007a and 2007b)*.

1.1 Historical Management Strategy Experience

The first 5 years of Site operation included intensive monitoring, extensive investment in facilities improvements, numerous research test plots, and a considerable replanting of problem areas (areas of concern, or AOCs) in 2004. The following brief summary of the progression of Site management strategies provides a backdrop against which the current management strategy has developed. More details of the intensive monitoring, observations, and management responses are available in the multiple annual monitoring reports and special investigation reports prepared by LADWP during the 2002 – 2007 period.

Figure 1 shows the first 5, now transitioning into 6 years of Site O&M. A few of the O&M activities that have been implemented each year are shown. As more is learned about

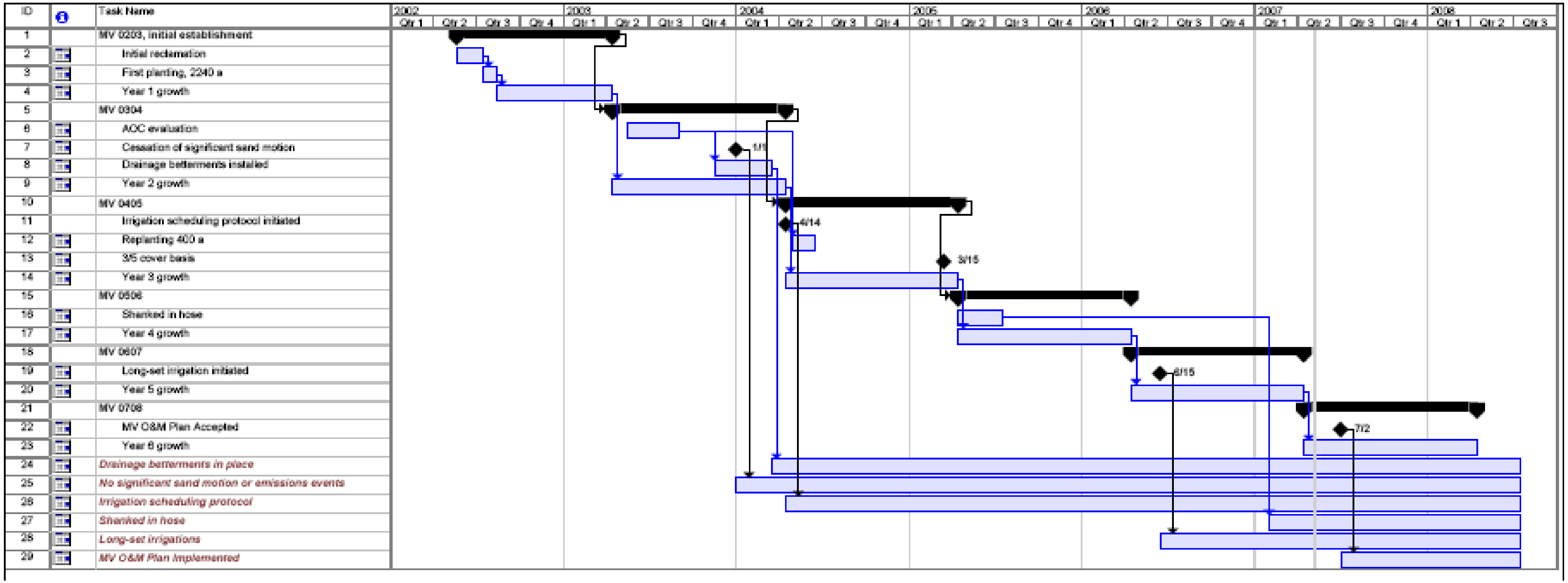

FIGURE 1
Managed Vegetation Site History. Tasks Shown in Maroon Coloring are Perpetual, Ongoing Benefits of One-time Facilities Betterments, Changes in Management, or Refined Regulatory Goals.

managed vegetation on Owens Lake in general, and about the Site in particular, O&M responses are developed to address specific challenges and to improve the Site's vegetative cover. Once implemented, benefits of improvements are generally there for the life of the Site. The accumulation of improvements (betterments and improved O&M) and the ongoing benefits generally improves the Site and reduces the risk that air quality violations will be caused by emissions from it. These ongoing benefits are shown in maroon font at the bottom of the schedule shown in Figure 1, beginning at the time that the improvement was first implemented, and continuing for as long as the Site is operated.

The following sections detail these and other improvements to Site facilities and O&M during past years of operation, again as an indication of the general approach to Site management that is anticipated for the future.

2002 – 2003 – Focus on Establishment and Growth

- After installing Site facilities and planting in the summer of 2002, management activities in 2002 and 2003 focused on irrigation for establishment and growth of as much area as possible.
- Management required irrigation within blocks to be balanced among drier and wetter areas, providing most of the young plants adequate, but not excessive, soil moisture to allow establishment.
- Growth and survivorship was compromised in multiple small areas (most of the AOCs, about 20 percent of the Site) in an effort to promote growth in the largest possible proportion of the Site.
- Initial mapping of AOCs was conducted primarily in areas that were too wet or too dry relative to the larger portions of blocks, and areas with localized problems related to drainage or offsite impacts (surface and subsurface flow into the area) were identified.
- Approximately 400 acres out of the 2,240-acre managed vegetation area were delineated as having poor establishment and targeted for replanting in the spring of 2004.
- Multiple management actions were taken to address facilities problems or other issues that were identified, including installation of 151 drainage system improvements to reduce site-specific drainage problems that led to many of the problem areas that required replanting.

2004 – Focus on Replant Establishment

- After the replanting effort in April 2004, the irrigation and drainage management strategy focused on careful attention to irrigation to support establishment of the plants in the replanted areas.
- Many of these replanted areas were the wetter portions of blocks within larger areas of established vegetation, again requiring a balance of wet areas with dry areas in the same blocks. However, now the established areas could tolerate more restricted irrigation because of their established root systems.
- Other replanted areas required high irrigation rates in generally dry blocks to establish replants.
- An irrigation scheduling protocol driven by field observations of the most sensitive areas, along with other irrigation system operating constraints, was developed and implemented. Generally, this led to more precise balancing of wetter and drier areas, taking advantage of the tolerance of more established vegetation to optimize irrigation management for more sensitive, newly replanted areas wherever possible.
- Close monitoring of the soil conditions in the DCA during 2004 further defined the need for focus of irrigation to coincide spring and fall saltgrass growing season.
- At the close of this season, all but about 11 of the initial 400 acres of AOCs had adequate plant populations from which to develop vegetative cover.

2005 – 2006 – Shift to Long-term Sustainability and Attention to Remaining Isolated Problem Areas

- With the bulk of the Site well established and expanding, and with most of the 2004 replanted areas established, operations in 2005 and 2006 shifted somewhat to more specific attention to smaller areas that continued to exhibit special needs.
- Continued careful monitoring of irrigation based on soil and historic wet areas in particular blocks served to refine generalized irrigation management strategies for particular blocks.
- The very wet winter preceding the 2005 growing season also provided an opportunity to observe how Site management must adjust to variable environmental factors such as high winter groundwater.
- An example of the diligent monitoring and adaptive management response during the 2005 growing season was the identification of discoloration and reduced vigor of vegetation in low areas of block T7-5A, a well-established block with greater than 50 percent cover. In response, an investigation was launched, and it was learned that the heavier-than-normal winter precipitation had raised the level of boron, chloride, and sulfate, as well as EC (bulk salinity) the root zone within low areas of block T7-5A. Irrigation applied at rates employed the previous season had not been adequate to re-reclaim the affected areas. However, when irrigation schedules were modified based on the results of the study, this block recovered by mid-season 2006.
- Other special project management actions taken in 2005 and 2006 in response to detailed monitoring observations included:
  - splitting irrigation control within blocks to better manage wet and dry portions
  - burying drip irrigation hoses in some blocks where the lines had been installed on the surface to respond to special establishment needs or installation challenges in those areas
  - implementing longer irrigation sets in 2006 to improve root zone leaching, especially in problem areas

1.2 Overall MV Operations Strategy

With this intensive effort and the knowledge gained from several years of operations, a reasonably stable protocol has been established for most of the Site. However, as expected for such a novel vegetated system in the unique, saline, and poorly drained lakebed environment, small areas within the Site still require special attention. In addition, new conditions may develop during ongoing operation (as occurs on any farm) that will require adaptive management. Accordingly, the Site O&M strategy requires:

1. Ongoing Site monitoring and O&M to support historical cover levels (applicable to the majority of the Site, see *Verification of Vegetative Cover* section)
2. Special monitoring and O&M actions to respond to problem areas and unusual conditions

The following sections detail the planned monitoring and management activities in these two categories (overall Site and problem areas).

1.3 Ongoing Management to Support Historical Cover Levels on the Overall Site

The majority of the Site will be managed to support adequate growth each year to maintain vegetative cover levels at target (historical) levels. Ongoing Site management encompasses a variety of activities to sustain the existing vegetation and grow new vegetation to replace the portion of previous years' growth that may have been decomposed or blown away. The management protocols for the well-established portions of the Site have been calibrated on a block-by-block basis to support continued health of the bulk of the vegetated areas within each block without negatively affecting areas within the block where cover needs to be increased.

Ongoing management activities will be conducted as described in the following sections, unless a specific condition requiring a different response is identified through the monitoring program. If a special condition is identified, the affected area will be delineated, and a special condition management response plan will be developed and implemented according to the protocol defined in the *Problem Area Management Response* section.

Ongoing Drainage System Operation

The drainage system for the Site will be operated year-round according to the standard protocols established during previous seasons. The Site's drainage system includes the drainage management units (DMUs) listed in Table 1.

The DMU pump stations are equipped with automatic level switches that cycle the DMU pumps on and off at set water levels. The appropriate level settings for each DMU have been identified over time to balance the need for low drainwater levels in the sump with pump cycling frequency. Operation of the drainage system will continue according to the following general guidance and in compliance with the established equipment-specific standard operating procedures (SOPs):

- DMUs will be operated year-round.
- DMU pump station levels will be kept at a level necessary to ensure DMU drainage function is not compromised by pump station water levels. Levels may be adjusted upward or downward according to other management needs, as long as such settings do not compromise DMU function.
- In the event of damaged or malfunctioning DMU pumps and supporting facilities, repairs will be made as quickly as practicable to restore proper function.
- DMUs will be periodically monitored for evidence of drain line or lateral clogging. Evidence of an impediment to flow will result in investigation and appropriate response to correct the problem.

TABLE 1
Drainage Management Units Serving the Managed Vegetation Area
Approach to the Managed Vegetation Operation and Management Plan

DMU	MV Blocks Served
41	T5-3B, 3C, 4B, 4C
42A	T5,-6B, 6C, 7B
51	T5-4D T6-4C
52	T5-5A, 5D, 6A, 6D T6-5B, 5C, 6B, 6C
53	T5-7A, 7D T6-7B, 7C
61	T6-4D T7-4C
62	T6-5A, 5Dn, 5Ds, 6A, 6D T7-5B, 5C, 6B, 6C
63	T6-7A, 7Dn, 7Ds T7-7B, 7C
71	T7-4An, 4As, 4D T8-3B, 4Bn, 4Bs
72	T7-5A, 5D, 6A

TABLE 1
Drainage Management Units Serving the Managed Vegetation Area
Approach to the Managed Vegetation Operation and Management Plan

DMU	MV Blocks Served
41	T5-3B, 3C, 4B, 4C
42A	T5,-6B, 6C, 7B T8-5B, 5C, 6B, 6C
73A	T7-6D, 6A, 7D T8-6CT7-6D, 6A, 7D
81A	T8-3A, 4A, 4D
82	T8-5A, 5D, 6A, 6D

Other factors that cannot be controlled by DMUs, such as soil hydraulic properties, may limit drainage function. These problems are discussed elsewhere.

Ongoing Irrigation Operation

The Site irrigation system will be operated during the growing season according to the standard protocols established over the previous operating seasons. Operation of the irrigation system will continue according to the following general guidance and in compliance with the established equipment-specific SOPs:

- The Site will be irrigated on a schedule balancing plant needs with field drainage capacity during the growing season, approximately April through October each year.
- Annual start-up and end-of-the-year shut-down times will be adjusted annually to account for temperature and precipitation conditions during the preceding year.
- At the beginning of each year, an anticipated irrigation schedule will be established for each block based on block-by-block experience of irrigation needs during previous years. This schedule will serve as a starting point for irrigation during the coming year, but will also be adjusted during the year based on field observation of plant growth and soil salinity, and on actual weather conditions (e.g., temperature, wind, and precipitation.).
- Routine operations and regular maintenance functions will be performed according to appropriate SOPs developed by LADWP based on manufacturer's guidelines and/or LADWP operations experience. These functions include:
- Automatic primary filter backflush as determined by filter pressure differential
- Manual secondary filter cleaning
- Repair of irrigation system leaks as observed
- The need for soil amendments, such as fertilizers, will be determined on an approximately annual basis. *Routine MV Site Condition Monitoring* (see below) or focused investigations form the basis to establish amendment needs.
- Protocol may be altered when and where necessary to support operational research.
- LADWP will inform GBUAPCD within 48 hours of any significant breach of this O&M protocol.

Routine MV Site Condition Monitoring

Irrigation operations staff will observe conditions in the field and take corrective action as part of normal duties. Observations to be noted include:

- Irrigation leaks or plugging, as evidenced by spraying water, standing water, or altered system flow rates.
- Areas of abnormal surface saturation or dry conditions that may indicate irrigation leaks or drip-tube clogging, or that may indicate a need for irrigation adjustment.
- Notable vegetation variation such as discoloration or unexpected levels of die-back.
- DMU and/or other drainage system malfunction as evidenced by conditions in sumps and fields.
- Turnout or control system malfunction, as evidenced by water quality or timing of irrigation.

Corrective actions may include making necessary repairs and/or notifying supervisor or Site manager. If immediate solutions or corrective actions are not obvious or routine, the supervisor or Site manager may initiate a special investigation, consult with off-site (vendor or specialist) personnel.

In addition to routine observations by field operations staff, regular dedicated monitoring will be conducted by one or more plant biology and/or agricultural specialist at approximately monthly intervals during the growing season. These monitoring observations will include assessment of:

- Plant health indicators, including discolorations, leaf curling, wilting, etc.
- General soil conditions such as moisture and salt crust
- Soil salinity monitoring at select locations to verify salinity levels in the acceptable range
- Other general site conditions such as:
  - Significant pest damage or populations
  - Exotic plant species
  - Recruitment of other native plant species

More detailed soil monitoring to track Site-wide soil conditions and to identify changes or trends in chemical and physical characteristics that are significant for plant growth. This more detailed monitoring will be conducted annually during the growing season and will include:

- Site-wide composite soil chemistry sampling to track levels of agronomic constituents
- Characterization of soils at select locations by description and sampling in test-pits to track soil physical conditions, root development and soil reclamation profiles in the upper 4 feet of soil. Test pit locations will be selected in consultation with the Site Manager to investigate areas that represent conditions of special operational interest.
- As directed by other monitoring efforts and LADWP operations staff, specific soil investigations or monitoring may be conducted to monitor operational trials or to investigate specific conditions or areas of concern.

Monitoring specialists will make recommendations regarding irrigation schedule, blending, fertilizer, amendment, drainage, or other appropriate adjustments, and will report to the designated LADWP operations staff before and after each visit. An annual report, summarizing field observations, block irrigation, soil monitoring, and associated recommendations will be prepared each of the next five years (2007 – 2011). Pertinent aspects of these reports will be cited in the PMP.

Problem Area Management Response

The general process for identification of and response to problem areas, and several examples of types of problem areas and responses, are described in this section. If a specific type of problem is not described here, but actually disrupts the Site in a manner that may threaten cover levels that provide needed levels of performance, then the general process will be applied to resolve the problem. The Site history (previous section) demonstrates how this has been done during the past 5 years to resolve the diverse issues that have already arisen for saltgrass trying to grow on Owens Lake.

Problem Area Identification and Response Process

If field monitoring of vegetation or soil identifies signs of possible problems, and a solution can be readily established, the solution will be applied. If the nature of the problem or an appropriate solution are not evident, then a **Problem Area Special Investigation** will be initiated to investigate the problem, identify likely causal factors, and develop a responsive action plan to correct the problem.

Signs of possible vegetation problems may include, but are not limited to unexpected:

- Downward trends in vegetative cover
- Expansion of a previously existing areas of sparse growth or plant stress
- Development of unique plant coloration
- Ponding in new areas or expansion of previously identified ponded areas
- General signs of reduced plant vigor

Upon identification of possible problems, the monitoring personnel noting the problem will notify the LADWP Operations Engineer. The Operation Engineer will assign a staff member (or team) to:

- Define and document the general nature and spatial extent of the suspected problem
- Assemble and review basic supporting information from operations (SCADA), performance monitoring, and field monitoring teams

If review of supporting information suggests that further study is needed, the Operations Engineer will:

- Identify additional specialized expertise needed to clarify the condition
- Assign a team to:
  - Define and conduct additional investigations, if needed
  - Develop corrective action plan options
  - Direct the Site Manager to implement corrective actions

In actual practice, the Site Manager and field staff understands the Site very well and may at times either investigate and solve problems, or seek outside consultation, informing the Operations Engineer of their activities. This type of initiative and ownership is one of the reasons that the Site is successful.

Possible Problems and Example Responses

A number of problems that can be associated with this Site, and with vegetating Owens Lake in general, have already been encountered, or may be anticipated given experience on and knowledge of existing Site conditions and facilities. A brief description of some of the more likely problems and example responses are provided here for illustrative purposes. These examples illustrate a general process: problem identification, investigation of causes, development of appropriate management response(s), implementation of management responses, monitoring of Site response to changed management, and feedback from monitoring if further refinement of management is indicated. This general approach notwithstanding, problems will be dealt with on a case-by-case basis, considering the actual symptoms and conditions, so that future responses may differ somewhat from these examples.

Intrusion of High-EC Groundwater into Plant Root Zone.

Periods of high precipitation, over irrigation, or poor drainage performance can lead to a rise of shallow groundwater into the plant root zone. Evidence suggests that this saline groundwater intrusion can be tolerated by saltgrass for short periods without long-term impacts, although plant growth and health may be temporally affected by even short-term exposure.

This is the suspected cause of a notable decline in plant health and cover in block T7-5A in 2005 compared to the previous year. In response, LADWP analyzed groundwater levels, irrigation history, and soil conditions (see Schmid/Inman TM, April 2006). The results of that investigation suggested that elevated shallow groundwater levels resulting from abnormally high rainfall in the winter of 2004-2005 had increased the salinity in the plant root zone of the block and immediately adjacent areas of some surrounding blocks. In response to recommendations from the investigation, irrigation amounts and durations to T7-5A and surrounding blocks were increased in 2006, and the block experienced a rebound in cover of approximately 10 percent in 2006. In this case, cover decline was identified and corrective action was successful in reversing the trend without cover levels dropping below 50 percent in the affected blocks (according to LADWP cover measurement estimates).

Surface Ponding.

As noted above and in supporting documents, variations in topography and soil hydraulic conductivity within single blocks requires balancing the irrigation supply to the block to adequately wet the higher or better draining areas without over irrigating or inundating the lower or poorer draining areas within the block. This is often a precarious balance, and rather small changes in root zone hydrologic balance caused by irrigation or precipitation events can cause surface ponding to develop. This surface ponding can lead to redistribution of resident salts, which can quickly affect plant health when salts move into previously reclaimed soil where plant roots reside and extract water and nutrients to support metabolism and growth.

Surface ponding has occurred in limited areas across the Site since start-up in 2002. Ponding was particularly pronounced in 2002 and 2003, when the management emphasis was on achieving rapid increases in cover over most of the Site. The extent of surface ponding has dropped dramatically during subsequent years as irrigation strategy has shifted away from quick establishment of the driest areas to ongoing maintenance of cover on the whole Site, with special attention to problem areas. This shift in strategy recognizes the ability of well-established vegetation to survive and expand with less-than-optimum water supply.

Multiple strategies have been implemented to respond to surface ponding conditions including:

- Installation of supplemental surface and “French drains” in 151 locations between 2003 and 2004 (in advance of the April 2004 replanting effort) to improve drainage in frequently ponded areas.
- Reduction of irrigation frequency or set lengths in numerous blocks to manage to the problem areas after vegetation was well established in drier areas of the block

Build-up of Salts.

Salt buildup could occur in areas where irrigation applications do not adequately leach salts from a reclaimed portion of the root zone. Causes of salt buildup could include inadequate local drainage, or low or excessive irrigation application rates, or sporadic irrigation. Any of these can cause water accumulation and evapo-concentration in the root zone. Ultimate sources of salts can be irrigation water and/or shallow groundwater. Subsurface drip irrigation is meant to provide adequate leaching in a zone along the drip line, while leaching native and applied salts outward to inter-row areas and downward to drains.

The reclaimed soil zone varies across the Site according to local soil/drainage conditions and the influence of block-wise irrigation strategies. Saltgrass roots and rhizomes are observed surviving in a wide range of soil salinity and physical conditions. Other native, salt-tolerant vegetation that might occur at the Site should behave in a similar manner, tolerating a wide range of Site conditions.

Regular and annual soil monitoring along drip irrigated rows provides information on areas that may exceed salinity thresholds and therefore may be experiencing salt accumulations. Likewise, annual soil test-pit salinity sampling helps to better understand the profile of salinity in the irrigated zone for different soil types.

When high salinity areas are detected, potential causes are assessed by reviewing irrigation rates, precipitation records, and block observations of ponding or drainage issues. Appropriate management actions are then selected and may include

- Altered irrigation rates
- Actions to improve local drainage (see “surface ponding” above), or
- Modification to irrigation durations (i.e. long sets as opposed to more frequent, short sets)
- Re-testing areas that do not show vegetative stress indicators or signs of plant die-back

These management actions have been successful in correcting or reducing high salinity areas in widely ranging soil conditions across the Site.

Onsite Sand Deposition

Where sand blown offsite is determined to cause permanent vegetative cover reduction or net decline in vegetative cover over time, corrective actions may be taken. Where the plant stand is irreversibly damaged (and this is rare), some replanting may be needed. Otherwise, conditions for plant stand regrowth and restoration of cover are optimized to the extent practicable. Where perimeter control of sand motion is pending implementation of a planned, adjacent dust control measure, this will be taken into account.

1.4 Approach to Verifying Vegetative Cover

This section discusses methods of vegetative cover measurement and develops baseline cover criteria against which Site conditions can be judged in the future. The intent is to employ actual Site conditions associated with successful control of sand motion in the past as a reference for judging whether the Site can successfully control sand motion in the future. No implementable cover criteria could guarantee that every portion of the Site would perform adequately under all imaginable future conditions. For this reason, forgoing sections of the Plan focused mainly on identification and management of “problem areas.” This section, on the other hand, is intended to provide criteria for judging the adequacy of vegetative cover across *the entire Site.* However, in recognition of the still-developing understanding of how spatially variable vegetative cover works to control dust emissions, an extremely detailed spatial analysis of historical patterns of vegetative distribution have been employed and incorporated into cover criteria. This effectively prevents Site cover from degrading in a manner that could cause it to become much more emissive than it has been during past years.

Implementing either this portion, or the preceding sections of the Plan, could by themselves provide a Site that prevents significant PM_{10} emissions from the Site in the future. When all parts of the Plan are implemented together, they provide a robust, redundant program with a very substantial and desirable margin of safety.

An additional factor of safety is the accumulation of knowledge and gradual improvement in Site cover and management. As noted previously, the benefits of most improvements begin when the improvement is implemented, and continue thereafter, so that the benefits of all previously accumulated improvements are active at the Site at any time. This has the effect of gradually increasing Site reliability in controlling emissions.

Measuring and Reporting Management and Cover

Measurement of vegetative cover on the Site has been undertaken by GBUAPCD and LADWP using a variety of methods. Future cover measurement methods are discussed in NewFields (2007). It is the intent of this Plan that the method of cover measurement employed for judging compliance with the Plan should be identical to the method employed to develop criteria in the Plan, or should contain adjustments that adequately compensate for differences in methodology. This avoids confusion and challenges associated with comparison among existing cover standards and contemporary cover estimates based on different methods.

Vegetative Cover Thresholds

Cover on the Site developed over its five years of operation. Vegetation maps were developed from calibrated Quickbird images. Ground truthing for these calibrations, performed as part of the Study, was done by capturing low-altitude (6 feet high) digital images of the land surface (digital point frame, or DPF images), and then assessing vegetation cover by spectral analysis of each image. The consistent methodology was necessary to capture trends over time during the study.

After the Study was completed, GBUAPCD agreed to the use of DPF images analyzed by observing grid points on each image and taking the percentage of these points at which vegetation is observed as the percent cover (NewFields, 2008). To establish a reference cover measurement, areas that were not intended to be vegetated were identified and removed from consideration. These areas include primary roads and turnout facilities. Shifting of image registration among image capture events was taken into consideration so that, for example, roads will never be treated as vegetated areas, or vice-versa.

The vegetation map used to represent the Site reference cover was developed by calibrating the satellite image against ground truth results developed by the method agreed to with GBUAPCD, that is, counting of pins (grid points) on DPF images. The average vegetative cover levels in these calibrated images is somewhat higher than resulted from previous calibrations. The reasons for this difference, and the rationale supporting use of the agreed ground truth method, are explained in NewFields (2008). Cover distributions and criteria presented in this document are based on this agreed ground truth and calibration approach.

Figure 3 shows average vegetative cover results on site vegetation maps calibrated and validated with grid-point analyzed DPF images.

Cover level increased annually during the growing season, and declined annually by about 20 percentage points during the winter dormancy period. Fall cover levels increased from about 42 to 55% cover from fall 2004 to fall 2006, and then remained constant during the following year.

The observed levels of cover coincided with an extinction of significant sand motion by the beginning of 2004. Additional detail regarding Site performance in arresting sand motion and PM_{10} emissions is provided in Air Sciences (2006).

The baseline reference for cover criteria in this Plan are based on observations of the Site in November 2004, after a season during which no significant sand motion was observed on the Site, but during which the average level and distribution of cover on the Site gradually improved because of the Site's age and aggressive management of both overall and site-specific vegetative cover (see *Approach to Site Management* section). Also, total cover measurements are most accurate during the November period, and at the beginning of the season during which cover is actually called upon to control emissions during the least stable season when most significant PM_{10} emissions events occur. The choice of this point in time as reference cover, then, incorporates a margin of safety, since inferior cover conditions during the 2003-2004 season had resulted in adequate performance.

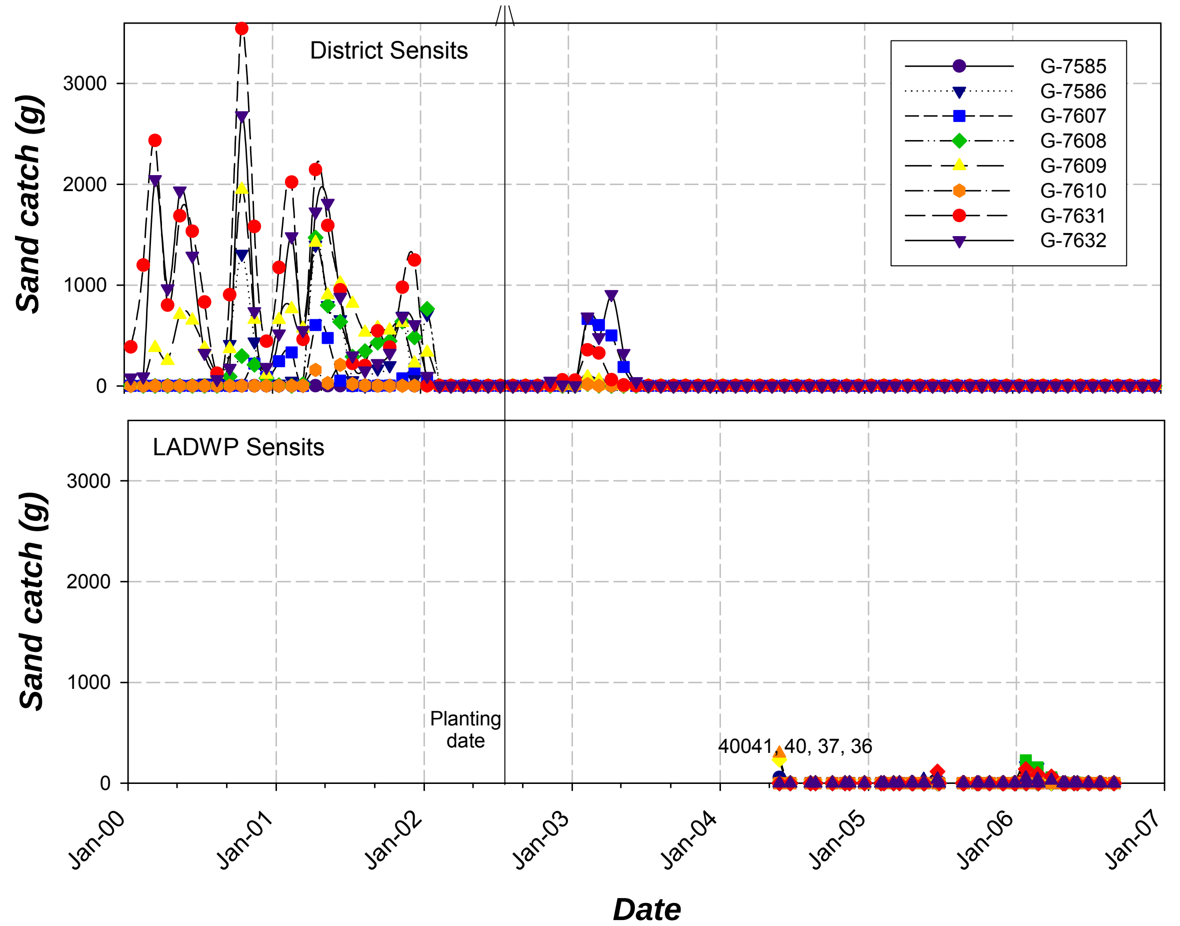

FIGURE 2
History of Sand Motion at the Site.

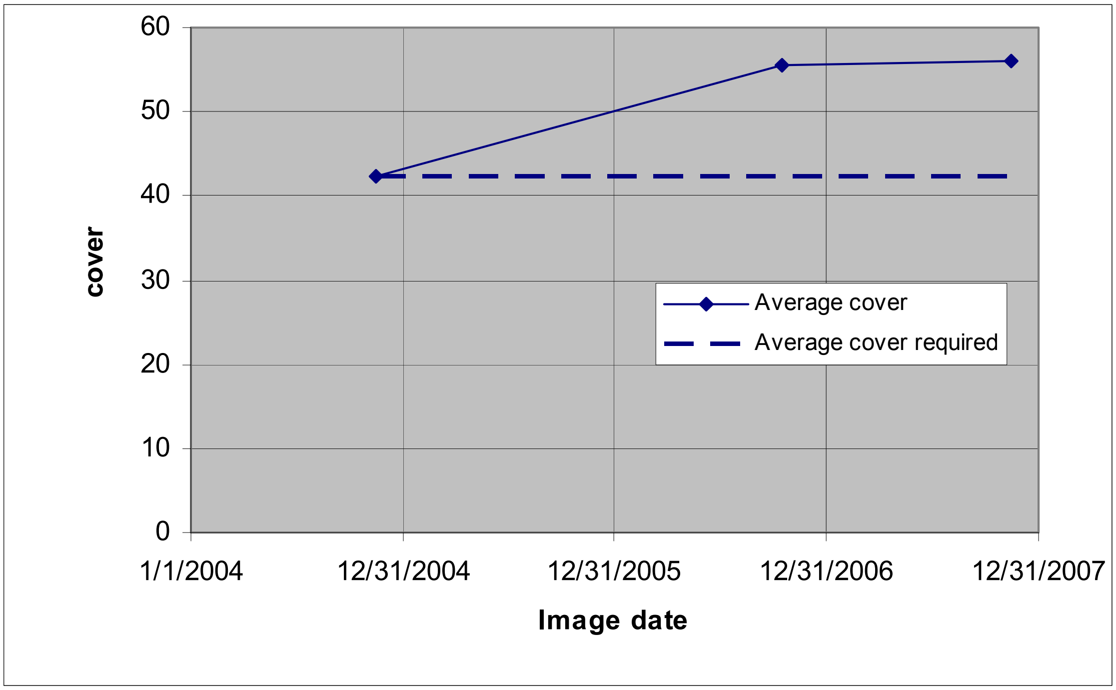

FIGURE 3
Fall cover for 2004, 2006, and 2007.

In Air Sciences (2006), it was shown that 99% control efficiency was achieved at between 11 and 20 percent vegetative cover on DPF images assessed by the spectral method. The average cover on the Site in November 2004 (according to a calibrated vegetation map based on spectrally interpreted DPF) was about 42%. However, several observations should be made to place the relationship between the control efficiency finding and average November 2004 cover:

- The control efficiency study (Air Sciences, 2006) employed spectral analysis of DPF images, while the proposed reference cover for the Managed Vegetation O&M Plan employs grid point observations of DPF. Where similar images have been calibrated by the two methods, average site-wide cover results were about 9 percentage points higher for calibration employing the grid-point observations.
- Air Sciences (2006) relates control efficiency to cover measured during each month. In the Managed Vegetation O&M Plan, fall cover will be evaluated as an indicator of site conditions during the following year, particularly during the ensuing winter and spring. Fall cover is about 10 percentage points higher than cover later in the potentially emissive winter-spring season
- The conservative (high) end of the control efficiency cover range is 20%, as indicated by spectral DPF. The ground truthing method now employed would likely attribute about 29% cover to such an area. Since measurements are to be taken in the fall, cover levels could fluctuate downward by up to 10 percentage points by springtime. Therefore, of 39% fall vegetative cover should result in maintenance of 29% or more cover throughout the winter season, which would approximate the highest level of cover that could be required for 99% control efficiency.
- This is another indication that a 42% site-wide average October-November cover requirement is appropriate, and perhaps conservative.

The Site is currently understood to control dust emissions as a unit. That is, a particular point within the Site, placed on open playa, might not achieve desired levels of control if pelted by saltating sand produced by surrounding uncontrolled playa. However, each point in the Site functions adequately within its actual context, surrounded as it is by other vegetated areas. The critical aspect of its surroundings (in terms a mathematically specific parameter describing distribution of cover) that allows each interdependent part to perform is currently unknown. However, this interdependence must be captured in these criteria. This is achieved by characterizing the actual spatial distribution of the successful Site, without preconception as to the specific aspects of the distribution that confer effectiveness.

The Site was subdivided by grids imposed at four scales, beginning at 0.1 acre, and increasing tenfold in area for the three subsequent grids (to 1, 10, and 100 acres). Cover distributions among these grid cells (average cover in each cell, and the distribution of those average values for each grid scale) were characterized. These distributions are shown in Figure 4.

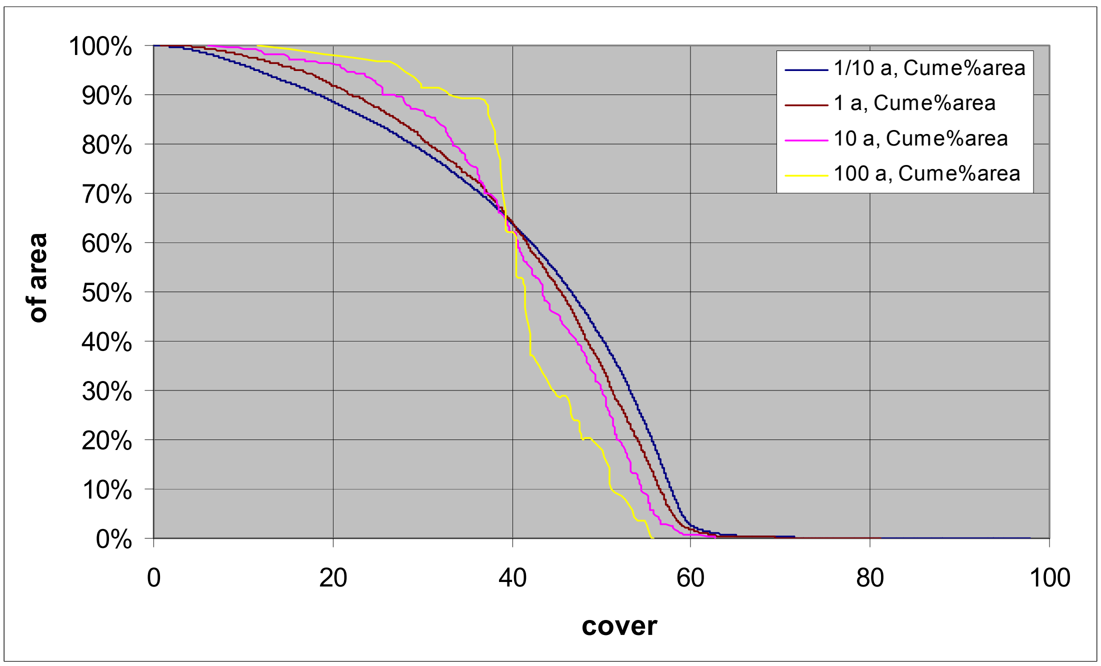

FIGURE 3
November 2004 Vegetative Cover Distributions in Grids at Four Scales Spanning Four Orders of Magnitude in Spatial Resolution.

A variance was then applied to each distribution to account for the fact that no future condition would likely match every point on a historical distribution perfectly. The lowest variances were applied to the lowest cover classes. The resulting criteria are shown relative to each of the four distributions in Table 2.

Vegetative cover at the Site is to be measured as described in NewFields (2007). As previously described, the Site has been subdivided by grids imposed at four scales, beginning at 0.1 acre, and increasing tenfold in area for the three subsequent grids (to 1, 10, and 100 acres). Cover distributions among these grid cells (average cover in each cell, and the distribution of those average values for each grid scale) will be characterized at any point in time. Cover thresholds in Table 2 will be adjusted for uncertainty of the vegetation map for that particular date (see discussion of map validation in NewFields [2007]), based on the cover map validation results. Adjustment of each threshold will be made as follows:

$$Threshold_{adj} = Threshold*(1-AFB)/5) \qquad \textbf{\textit{(1)}}$$

where *AFB* = half of the Absolute Fractional Bias (ranging from 0 to 1, with 1 indicating no error in the calibrated model prediction of vegetative cover at independent validation points), *Threshold* = any threshold from Table 2, and $Threshold_{adj}$ is the adjusted criterion against which vegetation measurements for the date and parameter in question would be evaluated.

TABLE 2
Site cover levels and thresholds. Percent cover was assessed according to NewFields (2007), with imaged calibrated to ground truth measurements per NewFields (2007 and 2008). The vegetation map from the November 2004 Quickbird image of the site was employed.
Approach to the Managed Vegetation Operation and Management Plan

Grid Scale	n	Average (cover)	5	10	20
			(of Site area)		
Measured Reference					
0.1	22,938	42	99	96	89
1	2,414	42	100	98	92
10	277	42	100	100	96
100	40	42	100	100	100
Minimum Thresholds[a]					
0.1		42	94	86	71
1		42	95	88	73
10		42	95	90	77
100		42	95	90	80
Thresholds Reference			**(of measured reference)**		
		100	95	90	80

[a]Note that in the measured reference condition, no 1- to 100-acre grid cells had <5 percent cover. The associated criteria are not intended to imply or to allow whole 10-acre or 100-acre grid cells to have < 5 percent cover. Rather, they are intended to allow for smaller grid cell fragments (e.g., at the site's edges) with this level of cover.

In future years, the Site will be evaluated relative to adjusted threshold cover levels. The status of the Site along with indicated management responses will be reported in the PMP.

CONCLUSION

The Plan contains the following assurances that Site effectiveness will be adequate in the future:

1. Site management is an active program to promote a general increase in cover and to further restrict areas of sparse coverage. Benefits of improved management and greater maturity to the Site are cumulative.
2. The Plan itself is an improvement to Site management, committing LADWP to actively manage problem areas.
3. Verification of compliance with federal PM_{10} standards actively identifies areas that could cause violations.
4. Cover thresholds are based on the end of the second season during which no significant sand motion was measured, and future cover levels must meet or exceed these thresholds.
5. The Site was effective while surrounded by uncontrolled playa. New control along the margins of the Site reduces the sand mass moving into Site margins.
6. This Plan is based on five years of Site management experience, the firmest foundation yet for a set of DCM performance specifications.

By all of these means, this Approach provides amply for maintenance of Site performance and the protection of human health.

ACKNOWLEDGEMENTS

Previous drafts and a final version of this document were prepared by CH2M HILL, Air Sciences, and Earthworks Restoration. This version is based largely on that work, and includes changes based on comments and suggestions from GBUAPCD and their consultants. The contributions of all team members are appreciated by the authors and LADWP, and were essential to the completion of this work.

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GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

EXHIBIT 7

CONCEPTUAL TRANSITION AREA DUST CONTROL PLAN

Great Basin Unified Air Pollution Control District
Abatement Order 110317-01

EXHIBIT 7

Conceptual Dust Control Plan

The following Reasonable Precautions have been approved by the APCO pursuant to Rule 401A and shall be implemented by Respondent as reasonably necessary and feasible to mitigate PM10 emissions from the Transition Areas during construction:

1. Temporary sand fences shall be installed where feasible as soon as practicable without delaying project completion and shall be maintained as necessary until areas of Managed Vegetation have been established;
2. Water trucks shall be used as necessary and feasible during construction;
3. Tillage shall be implemented where soil conditions allow.
4. Construction activities shall cease during high wind events.

The Dust Control Plan shall be similar to the following plans previously approved by the APCO:

a. T1A-1 Sand Fence and Tillage Construction Dust Control Plan – September 23, 2010 from Clarence E. Martin to Ted Schade and Susan Young
b. Owens Lake Phase VII Construction Dust Control Plan – November 3, 2008 from William T. Van Wagoner to Theodore Schade