Volume III: Appendices A-G

BLM

United States Department of the Interior
Bureau of Land Management

# Desert Sunlight Solar Farm Project
# California Desert Conservation Area Plan Amendment and Final Environmental Impact Statement

For the
**Palm Springs – South Coast Field Office**
Palm Springs, California

April 2011
CACA #48649

# Appendix A

# Public Scoping

Plan require that the NPS develop goals to improve program effectiveness and public accountability. This collection will encourage the public to collect data relevant to goal 1b: "The National Park Service contributes to knowledge about natural and cultural resources and associated values; management decisions about resources and visitors are based on adequate scholarly and scientific information". This collection is also consistent with the NPS Management Policies (2006), which emphasize the "use of qualitative and quantitative techniques to monitor key aspects of resources and processes at regular intervals" and furthermore state that "studies, research, and collection activities by non-NPS personnel involving natural and cultural resources will be encouraged and facilitated when they otherwise comport with NPS policies." More specifically, the goal of this collection is to engage the public in documenting the timing of biological events ("phenology") for a variety of species at numerous different locations. The data collected will help the NPS document how climate change is affecting the timing of biological events such as migration, flowering, and autumn foliage.

The proposed Internet- and paper-based surveys will ask the public to participate in the collection of these data on NPS lands. With sufficient participation, NPS will obtain critical information for determining trends in the timing of biological events for many species. In addition to documenting changes in timing of events, the data set will facilitate the identification of species most at risk from climate change and anthropogenic influences. Survey participants will provide their contact information and multiple observations of species at one or more sites. The contact information will be used for quality control and (at the request of the participant) to provide data summaries or reports and information about additional opportunities for assisting with NPS research and monitoring activities. The obligation to respond is voluntary.

*Automated Data Collection:* The information will be collected through an Internet site, as well as through paper forms available at public locations.

*Description of respondents:* Respondents are members of the public with an interest in contributing to climate change research in the National Parks.

*Estimated average number of responses:* 1,000 per year.

*Frequency of Response:* 5 per respondent.

*Estimated average time burden per respondent:* 30 minutes.

*Estimated total annual reporting burden:* 100 hours per year.

*Comments are invited on:* (1) The practical utility of the information being gathered; (2) the accuracy of the burden hour estimate; (3) ways to enhance the quality, utility, and clarity of the information being collected; and (4) ways to minimize the burden to respondents, including use of automated information collection techniques or other forms of information technology. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

December 23, 2009.

**Cartina A. Miller,**

*Information Collection Clearance Officer, National Park Service.*

[FR Doc. 2010–446 Filed 1–12–10; 8:45 am]

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## DEPARTMENT OF THE INTERIOR

### Bureau of Land Management

**[F–14909–B, F–14909–B2, F–19148–38; LLAK964000–L14100000–KC0000–P]**

### Alaska Native Claims Selection

**AGENCY:** Bureau of Land Management, Interior.

**ACTION:** Notice of decision approving lands for conveyance.

**SUMMARY:** As required by 43 CFR 2650.7(d), notice is hereby given that an appealable decision approving the surface estate in certain lands for conveyance pursuant to the Alaska Native Claims Settlement Act will be issued to Kuukpik Corporation. The lands are in the vicinity of Nuiqsut, Alaska, and are located in:

**Umiat Meridian, Alaska**

T. 10 N., R. 2 E.,
Secs. 1, 2, and 3;
Secs. 5 to 10, inclusive;
Secs. 16, 17, and 18;
Secs. 20, 21, and 29.

Containing approximately 8,751 acres.

T. 11 N., R. 2 E.,
Secs. 24, 25, and 26;
Secs. 34, 35, and 36.

Containing approximately 3,545 acres.

T. 11 N., R. 3 E.,
Secs. 7, 11, 13, and 18;
Secs. 19, 24, and 25.

Containing approximately 3,616 acres.

T. 11 N., R. 4 E.,
Secs. 19, 20, and 30.

Containing approximately 1,376 acres.
Aggregating approximately 17,288 acres.

The subsurface estate in these lands will be conveyed to Arctic Slope Regional Corporation when the surface estate is conveyed to Kuukpik Corporation. Notice of the decision will also be published four times in the Arctic Sounder.

**DATES:** The time limits for filing an appeal are:

1. Any party claiming a property interest which is adversely affected by the decision shall have until February 12, 2010 to file an appeal.
2. Parties receiving service of the decision by certified mail shall have 30 days from the date of receipt to file an appeal.

Parties who do not file an appeal in accordance with the requirements of 43 CFR part 4, Subpart E, shall be deemed to have waived their rights.

**ADDRESSES:** A copy of the decision may be obtained from: Bureau of Land Management, Alaska State Office, 222 West Seventh Avenue, #13, Anchorage, Alaska 99513–7504.

**FOR FURTHER INFORMATION CONTACT:** The Bureau of Land Management by phone at 907–271–5960, or by e-mail at *ak.blm.conveyance@ak.blm.gov.* Persons who use a telecommunication device (TTD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8339, 24 hours a day, seven days a week, to contact the Bureau of Land Management.

**Michael Bilancione,**

*Land Transfer Resolution Specialist, Land Transfer Adjudication I Branch.*

[FR Doc. 2010–449 Filed 1–12–10; 8:45 am]

BILLING CODE 4310–JA–P

## DEPARTMENT OF THE INTERIOR

### Bureau of Land Management

**[CACA 048649, LLCAD06000 L51010000 FX0000 LVRWB09B2520]**

### Notice of Intent To Prepare an Environmental Impact Statement for the Proposed First Solar Desert Sunlight Solar Farm Project, Riverside County, CA and Possible Land Use Plan Amendment

**AGENCY:** Bureau of Land Management, Interior.

**ACTION:** Notice of intent.

**SUMMARY:** In compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, and the Federal Land Policy and Management Act of 1976, as amended, the Bureau of Land Management (BLM) Palm Springs South Coast Field Office, Palm Springs, California, intends to prepare an Environmental Impact Statement (EIS) for First Solar Inc.'s application for a right-of-way authorization to develop a solar photovoltaic generating facility. The EIS may also support an amendment to the California Desert Conservation Area (CDCA) Plan (1980), as amended; by this notice the BLM is announcing the beginning of the scoping process to solicit public comments and identify issues.

**DATES:** This notice initiates the public scoping process for the EIS and possible plan amendment. Comments on issues may be submitted in writing until February 12, 2010. The date(s) and location(s) of any scoping meetings will be announced at least 15 days in advance through the local media, and the BLM Web site at: *http://www.blm.gov/ca/st/en/fo/palmsprings.html.* In order to be considered in the Draft EIS, all comments must be received prior to the close of the scoping period or 15 days after the last public meeting, whichever is later. The BLM will provide additional opportunities for public participation upon publication of the Draft EIS.

**ADDRESSES:** You may submit comments on issues and planning criteria related to the First Solar Desert Sunlight Solar Farm Draft EIS/Plan Amendment by any of the following methods:

- Web site: *http://www.blm.gov/ca/st/en/fo/palmsprings.html;*
- E-mail: *CAPSSolarFirstSolarDesertSunlight@blm.gov;*
- Fax: (760) 833–7199; or
- Mail: Allison Shaffer, Project Manager, Palm Springs South Coast Field Office, BLM, 1201 Bird Center Drive, Palm Springs, California 92262.

Documents pertinent to this proposal may be examined at the Palm Springs South Coast Field Office.

**FOR FURTHER INFORMATION CONTACT:** For further information or to have your name added to our mailing list, contact Allison Shaffer, BLM Project Manager, telephone (760) 833–7100; address Palm Springs South Coast Field Office, BLM, 1201 Bird Center Drive, Palm Springs, California 92262; e-mail *CAPSSolarFirstSolarDesertSunlight@blm.gov.*

**SUPPLEMENTARY INFORMATION:** The applicant, First Solar Inc., has requested a right-of-way authorization to develop a solar photovoltaic generating facility with a proposed output of 550 megawatts and a project footprint of approximately 4,410 acres. The proposed project would be located on BLM-administered lands in Riverside County approximately 6 miles north of the rural community of Desert Center, California. The overall site layout and generalized land uses would include a substation, an administration building, operations and maintenance facilities, a transmission line, and temporary construction lay down areas. The project's 230-kilovolt (kV) generation interconnection transmission line also would be located on BLM-administered lands and would utilize a planned 230- to 500-kV substation (referred to as the Red Bluff substation). The Red Bluff substation would connect the project to the Southern California Edison regional transmission grid. Should the project be approved, the interconnection transmission line would be about 9 miles to about 13 miles long, depending on the alternative selected. If approved, construction would begin in late 2010 and would take approximately 41 months to complete.

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including alternatives, and guide the process for developing the EIS. At present, the BLM has identified the following preliminary issues: Air quality, biological resources, recreation, cultural resources, water resources, geological resources, special management areas, land use, noise, paleontological resources, public health, socioeconomic, soils, traffic and transportation, visual resources, and other issues. Authorization of this proposal may require amendment of the CDCA Plan. By this notice, the BLM is complying with requirements in 43 CFR 1610.2(c) to notify the public of potential amendments to land use plans, based on the findings of the EIS. If a land use plan amendment is necessary, the BLM will integrate the land use planning process with the NEPA process for this project.

The BLM will use and coordinate the NEPA commenting process to satisfy the public involvement process for Section 106 of the National Historic Preservation Act (16 U.S.C. 470f) as provided for in 36 CFR 800.2(d)(3). Native American tribal consultations will be conducted and tribal concerns, including impacts on Indian trust assets, will be given appropriate consideration. Federal, State, and local agencies—along with other stakeholders who may be interested or affected by the BLM's decision on this project—are invited to participate in the scoping process and, if eligible, may request or be requested by the BLM to participate as a cooperating agency.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

**Thomas Pogacnik,**

*Deputy State Director, California.*

**Authority:** 40 CFR 1501.7 and 43 CFR 1610.2.

[FR Doc. 2010–403 Filed 1–12–10; 8:45 am]

BILLING CODE 4310–40–P

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## DEPARTMENT OF THE INTERIOR

## National Park Service

## Termination of the Environmental Impact Statement for the General Management Plan, Gila Cliff Dwellings National Monument

**AGENCY:** National Park Service, Department of the Interior.

**ACTION:** Notice of termination of the Environmental Impact Statement for the General Management Plan, Gila Cliff Dwellings National Monument, New Mexico.

**SUMMARY:** The National Park Service (NPS) is terminating the Environmental Impact Statement (EIS) for the Gila Cliff Dwellings General Management Plan because it has determined that an Environmental Assessment (EA) is the more appropriate National Environmental Policy Act compliance document. A Notice of Intent to prepare the EIS for the Gila Cliff Dwellings General Management Plan was published on April 16, 2008 (**Federal Register** Vol. 73, No. 74). Scoping conducted for the plan indicated that there were no significant impacts or controversy identified by the public. A preliminary impact analysis indicated that the alternatives have limited potential to result in significant/major effects on the human environment as they focus on different ways of protecting resources, providing appropriate visitor experiences, and addressing joint NPS/Forest Service operations. For these reasons the NPS determined the proposal would not require an EIS.

# Notice of BLM's Intent to Prepare an Environmental Impact Statement

| | |
|---|---|
| Date: | January 20, 2010 |
| To: | Responsible and Trustee Agencies<br>Interested Parties |
| Subject: | Notice of BLM's Intent to Prepare an Environmental Impact Statement for the First Solar Desert Sunlight Solar Farm Project |

The Bureau of Land Management (BLM) Palm Springs South Coast Field Office, Palm Springs, California, intends to prepare an Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended, for First Solar Inc.'s application for a right-of-way authorization to develop a solar photovoltaic generating facility. The EIS may also support an amendment to the California Desert Conservation Area Plan (1980), as amended. The BLM published a Notice of Intent for the First Solar Desert Sunlight Solar Farm Project in the Federal Register Volume 75, Number 8, on January 13, 2010.

The Council on Environmental Quality (CEQ) regulations (40 CFR 1506.2) direct federal agencies to cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements, including joint planning processes, environmental research and studies, public hearings, and environmental documents. In addition, the California Environmental Quality Act (CEQA) Guidelines, Sections 15221 and 15226 encourage similar cooperation by State and local agencies with federal agencies when environmental review is required under both CEQA and NEPA.

The California Public Utilities Commission (CPUC) intends to use the EIS prepared by the BLM in making a discretionary decision to determine if Southern California Edison (SCE) can construct a 500/230 kV interconnection substation, in accordance with CEQA. The CPUC will work as a cooperating agency with the BLM to provide information within the CPUC's area of expertise. Following preparation of the EIS by BLM, the CPUC will determine whether the EIS meets the requirements of CEQA and will comply with CEQA prior to making any discretionary decision on the aforementioned substation.

If you wish to comment on the scope and content of BLM's Draft EIS, including the portion related to the SCE interconnection substation under CPUC's jurisdiction, please review the BLM's Notice of Intent, available in the Federal Register Volume 75, Number 8 at the website listed below and provide comments to the following address no later than **February 12, 2010**:

| | |
|---|---|
| Address: | Allison Shaffer, Project Manager<br>Palm Springs South Coast Field Office<br>Bureau of Land Management<br>1201 Bird Center Drive<br>Palm Springs, California 92262 |
| Telephone: | 760-833-7100 |
| E-mail: | CAPSSolarFirstSolarDesertSunlight@blm.gov |

Information on the project can be found at: **http://www.blm.gov/ca/st/en/fo/palmsprings.html**
Federal Register homepage: **http://www.gpoaccess.gov/fr/**

When and if the CPUC decides to use the EIS prepared by the BLM in making a discretionary decision to determine if Southern California Edison can construct a 500/230 kV interconnection substation, it will provide additional notice and opportunity for public comment in accordance with CEQA.

**PUBLIC INFORMATION / SCOPING MEETING**

A public information/scoping meeting will be held at the following time and location:

**January 28, 2010 from 5 p.m. to 9 p.m.**
University of California Riverside-Palm Desert Campus
75080 Frank Sinatra Drive
Palm Desert, CA 92211

The public is invited to learn about the project, and comment on issues of concern, potential impacts, alternatives, and mitigation measures that should be considered in the analysis of the proposed action. The BLM and CPUC will use public scoping comments to prepare the draft environmental documents that will be available for public review.

**SUPPLEMENTAL INFORMATION**

**A. Project Description**

The applicant, First Solar Inc., has requested authorization to develop a solar photovoltaic generating facility with a proposed output of 550 megawatts and a preferred project footprint of 4,410 acres. The proposed project would be located on BLM-administered lands in Riverside County, approximately six miles north of the rural community of Desert Center, California (see location map). The overall site layout and generalized land uses would include a solar farm and on-site substation, a 230 kV interconnection transmission line, a 500/230 kV substation (referred to as the Red Bluff Substation), an administration building, operations and maintenance facilities, and temporary construction staging areas. The interconnection transmission line would be nine to 12 miles long, depending on the alternative selected. The Red Bluff Substation would connect the project to the Southern California Edison regional transmission grid. If approved, construction is estimated to begin in late 2010 and would take approximately 41 months to complete.

**B. Potential Environmental Effects of the Project**

A project level EIS will be prepared and would address a full range of environmental issues associated with the construction and operation of the proposed project. Key issues are anticipated to be air quality, biological resources, recreation, cultural resources, hydrology/water quality, geology and soils, land use and special management areas, noise, public health, socioeconomic, traffic and transportation, and visual resources. Potential impacts to these issues would be examined in the EIS. In addition, the EIS would include a discussion of reasonable alternatives to the proposed project.

<u>Air Quality</u>. Construction and operation of the proposed project may generate emissions from construction equipment exhaust, earth movement, construction workers' commute, material hauling, and maintenance activities. The EIS would evaluate the effects of construction and operation on air quality.

<u>Biological Resources</u>. The proposed project has the potential to impact sensitive wildlife species such as desert tortoise, Palm Spring round-tailed ground squirrel, burrowing owl, migratory birds, Coachella Valley milk-vetch, and foxtail cactus. The EIS would evaluate any potential impacts to biological resources.

<u>Recreation</u>. The EIS would evaluate any impacts of the proposed project on Off-Highway vehicle facilities and BLM-designated "open" off-highway routes.

<u>Cultural</u>. Grading and construction activities may have the potential to impact known or previously unknown archaeological, paleontological, or historic resources. The EIS would evaluate the proposed project's impact on these resources.

<u>Hydrology/Water Quality</u>. Flood hazards may exist within the boundaries of the proposed project that could impact structural elements of the proposed project. Use of groundwater or trucked water may be used to meet water needs during construction for dust control, soil compaction, sanitary uses, etc. Also, grading activities may have an effect on desert washes or other surface water features. The EIS would evaluate all potential impacts on water resources.

<u>Geology and Soils</u>. The proposed project may be subject to seismic activity including ground shaking and surface rupture. Soils would be disturbed during site construction and along access ways which may result in potential impacts to air quality. The EIS would evaluate geologic hazards and soil disturbance impacts.

<u>Land Use and Special Management Areas</u>. Specially designated areas such as Desert Wildlife Management Areas and the Chuckwalla Critical Habitat Unit exist in the vicinity of the proposed project. The EIS would evaluate impacts to any specially designated areas.

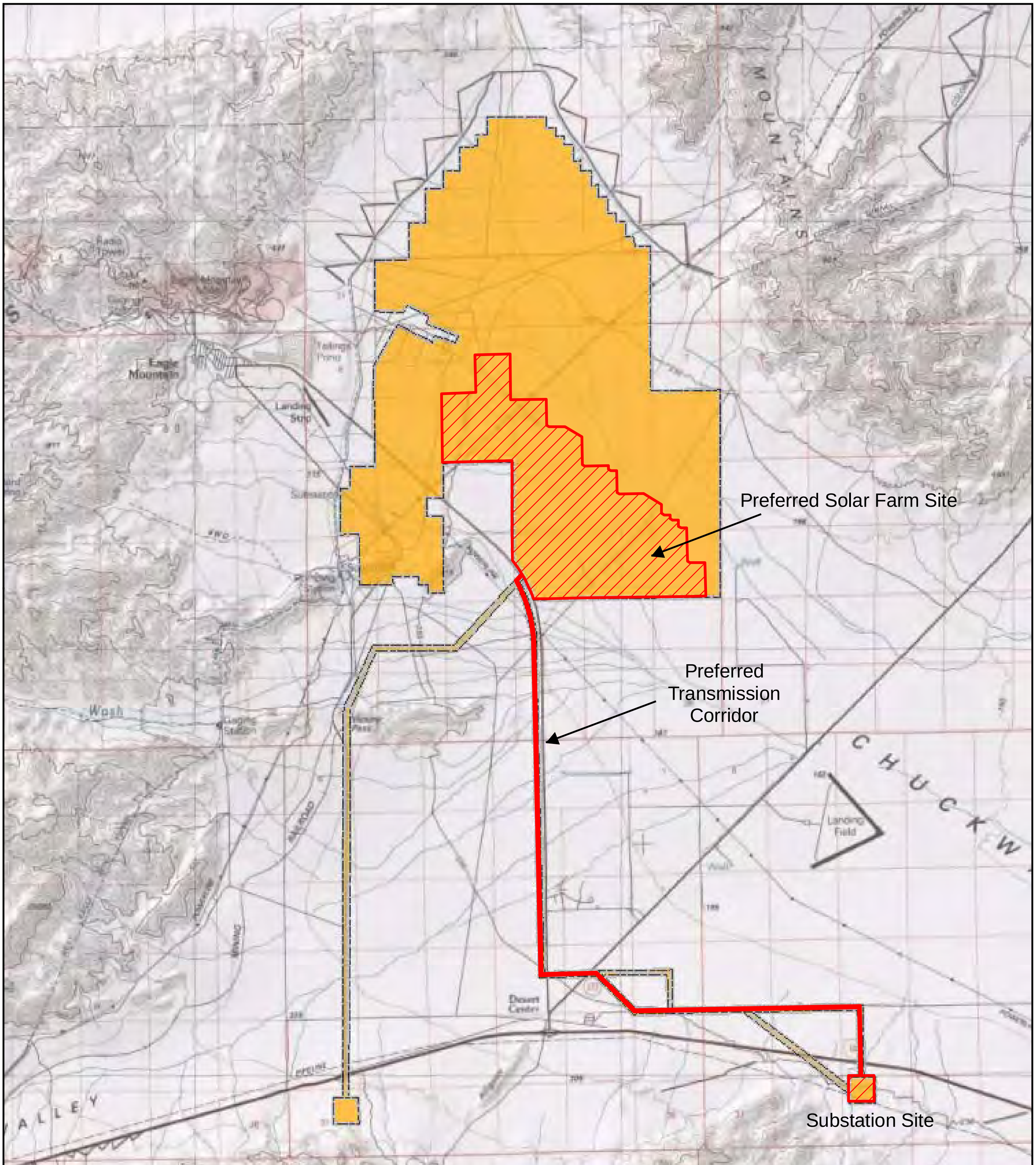
<u>Noise</u>. Scattered residences exist in the vicinity of the proposed project. Construction activities may generate noise that could impact these residences. The EIS will evaluate any noise impacts on sensitive receptors in the area.

<u>Public Health</u>. Hazardous substances may be stored on the project site. The EIS would evaluate the potential for encountering any hazardous materials or waste associated the proposed project.

<u>Socioeconomic</u>. It has been estimated that during construction, the number of on-site employees would average about 255, with a peak on-site workforce of 430 employees. Construction would take place over 41 months. During the operational phase, it has been estimated that 15 workers would be on-site. The EIS would evaluate the impacts to local businesses, employment opportunities, demand for housing, and minority and disadvantaged populations that may be living in the vicinity.

<u>Traffic and Transportation</u>. The proposed project would increase traffic levels to and from the project site. The EIS would discuss potential transportation, circulation and parking impacts.

<u>Visual Resources</u>. The proposed project would require lighting during periods of construction and maintenance operations. In addition, the reflectivity and color of the photovoltaic (PV) panels may have a potential visual impact. The EIS would evaluate the potential impacts from the PV panels and any lighting source.




Map Location


Legend

Study Area Boundary

Preferred Project Site

1 in = 2 miles

0 2 4 Miles

**Desert Sunlight Solar Farm Project**

**LOCATION MAP**

Date: November 2009

Source: Desert Sunlight Solar Farm Plan of Development, November 2009

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United States Department of the Interior
Bureau of Land Management
Palm Springs-South Coast Field Office

# Desert Sunlight Solar Farm Project

## BLM Land Use Application
## File # CACA-48649

# SCOPING REPORT

# RESULTS OF SCOPING

## February 2010

Palm Springs-South Coast Field Office
1201 Bird Center Drive
Palm Springs, CA 92262

Approved by: ______________________________ _______________
John R. Kalish Date
Field Manager

# Desert Sunlight Solar Farm Project

## I. Introduction

### A. Brief Description of the Project

First Solar Development, Inc. proposes the Desert Sunlight Solar Farm Project (DSSF), an alternating current solar photovoltaic (PV) energy generating facility of approximately 550 megawatts (MW). If approved, the DSSF would be located on Bureau of Land Management (BLM) administered land approximately 6 miles north of the rural community of Desert Center, in eastern Riverside County (See Project Location Map below). The project would include a new 230 kV transmission line that would interconnect with Southern California Edison's regional transmission at the planned Red Bluff substation. The project would include approximately 8.4 million PV solar modules; direct conversion of sunlight to electricity; and low-profile, uniform PV arrays approximately five feet tall.

### B. Potential Land Use Plan Amendment to the California Desert Conservation Area Plan

The project would be located on land that is subject to the BLM's California Desert Conservation Area (CDCA) Plan. All of the public lands in the CDCA under BLM management, except for a few small and scattered parcels, have been designated geographically as a Multiple Use Class (MUC) as follows: Controlled Use (C), Limited Use (L), Moderate Use (M), and Intensive Use (I). The Project is mostly located in BLM designated M lands. For M lands, wind and solar electric generation facilities may be allowed after National Environmental Policy Act (NEPA) requirements are met. The transmission corridor is located within (L) lands, which are lands managed to provide lower-intensity, carefully controlled multiple use of resources while ensuring that sensitive values are not significantly diminished. The CDCA also states that sites associated with power generation or transmission not identified in the CDCA will be considered through the Plan Amendment process. The project site is currently not identified in the CDCA. Therefore, prior to right-of-way (ROW) grant issuance, the project would require a Land Use Plan Amendment to the CDCA.

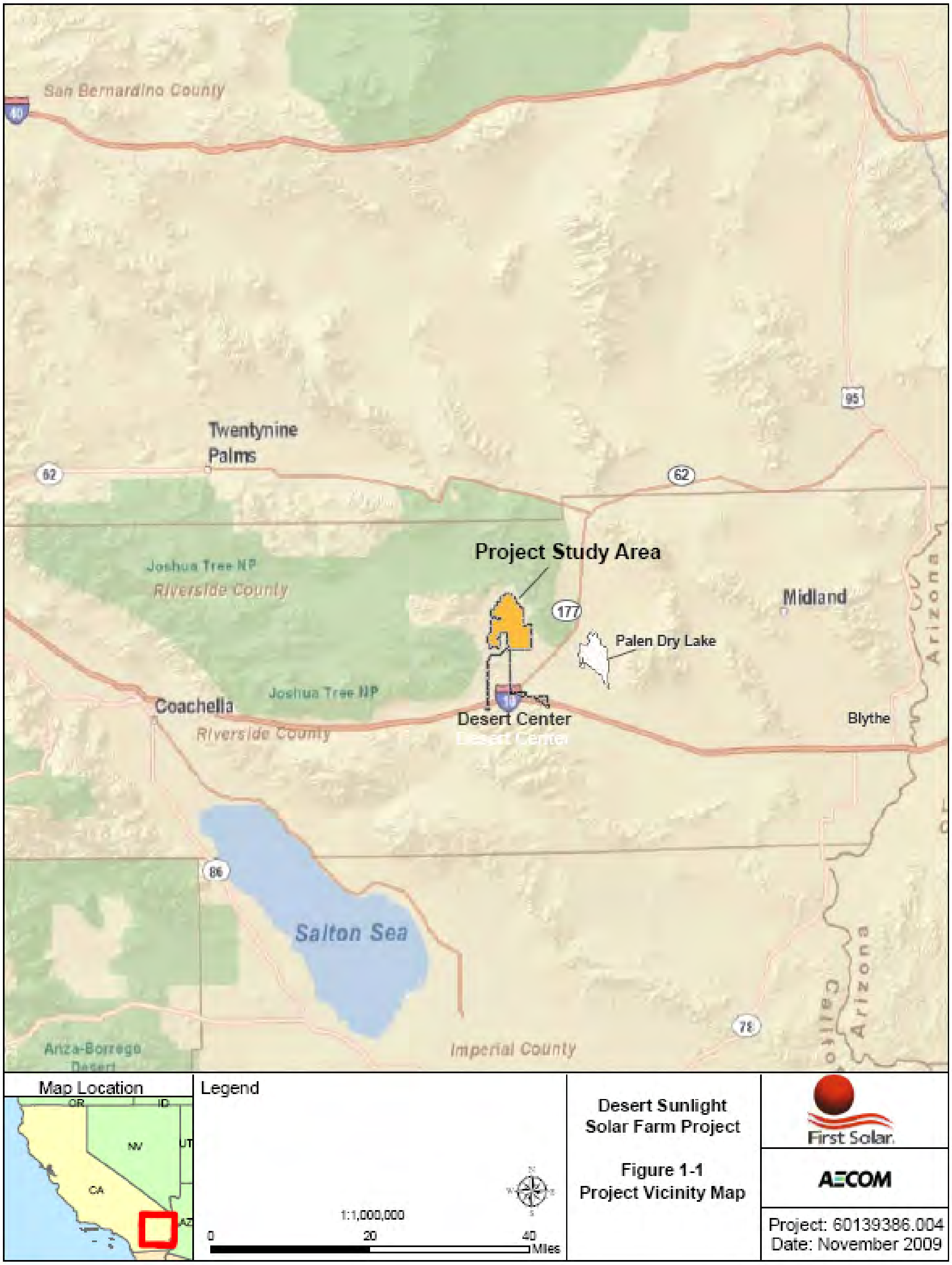



Figure 1: Project Location

## C. Purpose and Need for the Project

The proponent proposes to assist the State of California in meeting the State of California Renewable Portfolio Standard Program goals and reduce greenhouse gases by developing an alternating current solar photovoltaic (PV) energy generating facility of approximately 550 MW and related facilities in Riverside County, California on BLM administered lands.

BLM's purpose and need for the solar project is to respond to the proponent's application under Title V of the Federal Land Policy and Management Act of 1976 (43 USC 1761) for a ROW grant to construct, operate and decommission a solar PV facility on BLM lands. BLM will consider alternatives to the proponent's proposed action and will include terms and conditions, as deemed necessary. If BLM decides to approve issuance of a ROW grant to the proponent, BLM's actions would include amending the CDCA, concurrently. BLM will take into consideration the provisions of the Energy Policy Act of 2005 in responding to the proponent's application.

## D. Agency Coordination

### D.1 Lead Agency

The BLM, acting as federal lead agency, intends to prepare an Environmental Impact Statement (EIS) in compliance with NEPA and the Federal Land Policy and management Act of 1976.

### D.2 Cooperating Agency

The Council on Environmental Quality (CEQ) regulations (40 CFR 1506.2) direct federal agencies to cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements, including joint planning processes, environmental research and studies, public hearings, and environmental documents. In addition, the California Environmental Quality Act (CEQA) Guidelines, Sections 15221 and 15226 encourage similar cooperation by State and local agencies with federal agencies when environmental review is required under both CEQA and NEPA.

The California Public Utilities Commission (CPUC), intends to use the EIS prepared by the BLM in making a discretionary decision to determine if Southern California Edison (SCE) can construct a 500/230 kV interconnection substation, in accordance with CEQA. The CPUC will work as a cooperating agency with the BLM to provide information within the CPUC's area of expertise. Following preparation of the EIS by BLM, the CPUC will determine whether the EIS meets the requirements of CEQA and will comply with CEQA prior to making any discretionary decision on the aforementioned substation. There is a Memorandum of Understanding between the BLM and the CPUC to this outlining this cooperation.

# II. Scoping Process Summary

## A. Notice of Intent

The BLM published a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) on January 13, 2010 in the Federal Register Volume 75, Number 8. Publication of the NOI began a 30-day comment period which ended on February 12, 2010. BLM provided a website with Project information that also described the various methods of providing public comment on the Project including an e-mail address where comments could be sent electronically.

## B. Public Notification

Notification for a public Scoping Meeting held on January 28, 2010 was posted on BLM's website and sent via email to the local newspaper, the Desert Sun, on January 13, 2010. In addition, notices were sent certified mail to Responsible and Trustee Agencies under CEQA, all landowners within 300 feet of the project boundary, and other interested parties.

## C. Public Scoping Meeting

A public Scoping Meeting was held on January 28, 2010 at the University of Riverside Palm Desert Graduate Center located at 75-080 Frank Sinatra Drive in Palm Desert, California. A presentation describing the project was made by First Solar Development, Inc. with presentations describing the environmental review process presented by members of the BLM. Twenty-two attendees were documented by signing in on a voluntary sign-in sheet.

## D. Written Comments

Fourteen comment letters were received within the comment period ending on February 12, 2010.

# III. Comment Summary and Analysis

Issues were identified by reviewing the comment documents received. Many of the comments identified similar issues. The following section provides a summary of the issues, concerns, and/or questions raised. For this report, the issues have been grouped into one of the three following categories:

- Issues or concerns that could be addressed by effects analysis;
- Issues or concerns that could develop an alternative and/or a better description or qualification of the alternatives;
- Issues or concerns outside the scope of the EIS.

The comments discussed below are paraphrased from the original comment letters. To a minor degree, some level of interpretation was needed to identify the specific concern to be addressed. Many of the comments identified similar issues; to avoid duplication and redundancy similar comments were grouped together and then summarized. Original comment letters may be reviewed up on request at the BLM Palm Springs-South Coast Field Office at 1201 Bird Center Drive, Palm Springs, California, 92262, during normal business hours, from 8:00 am to 4:30 pm.

## A. Effects Analysis

Comments in this category will be described in detail in the affected environment section of the EIS or addressed in the effects analysis for each alternative.

**Purpose and Need**

- Project description should not be narrowly defined to rule out feasible alternatives
- Project should be discussed in the context of the larger energy market; identify potential purchasers of the power produced; discuss how project will assist in meeting its renewable energy portfolio standards and goals

**Air Resources (Air sheds)**

- Impacts during construction and operation
- Quantify PM2.5 emissions
- Calculate localized air quality impacts in addition to regional impacts, incorporating dispersion modeling if necessary
- Perform a mobile source health risk assessment if diesel-fueled vehicles are used
- Refer to South Coast Air Quality Management District's CEQA Air Quality Handbook for sample air quality mitigation measures
- Impacts to fine particulate soils below desert pavements and fugitive dust
- Impacts related to ozone concentration near high voltage power lines
- Designated Utility Corridor identified on BLM maps within Joshua Tree National Park boundaries—NPS requests this area continue to be excluded from consideration as a transmission corridor
- Greenhouse gas emissions/climate change impacts on plants, wildlife, and habitat
- Evaluate impact of GHG SF6 used in electricity transmission lines
- Planning for species adaptation due to climate change
- Discussion of how projected impacts could be exacerbated by climate change
- Quantify and disclose anticipated climate change benefits of solar energy
- Discussion of trenching/grading/filling and effects on carbon sequestration of the natural desert

**Soils Resources**

- Impacts to desert soils
- Increased siltation during flooding and dust
- Impacts to crypto-biotic crust
- Impacts resulting from disturbance of naturally-occurring arsenic in desert soils
- Preparation of a drainage, erosion, and sediment control plan

**Water Resources (Surface and Groundwater)**

- Identify impacts to jurisdictional waters of the US and California
- Effects of additional groundwater pumping in conjunction with other groundwater issues
- Groundwater and surface water impacts
- Identify water use quantities and sources
- Grading impacts on normal fluvial processes
- Concentrated sheetflow from graded areas may unevenly redistribute water causing erosion, sediment transport and deposition in unintended areas
- Identify potentially-affected groundwater basin and potential for subsidence
- Impacts to down-gradient groundwater, surface water, and wetlands
- Describe basin recharge rates
- Describe water right permitting process and status of water rights within the basin
- Feasibility of using other sources of water, including potable water, wastewater, or deep-aquifer water
- Impacts of project discharges on surface and groundwater quality
- Impacts resulting from septic systems
- Effects of diversion of water from ephemeral streams
- Description of water conservation measures to reduce water demands
- Effects of climate change on water supply
- Determination if project requires a Section 404 permit under the Clean Water Act
- Include a jurisdictional delineation for all Waters of the US, including ephemeral drainages
- Description of natural drainage patterns, project operations, identify whether any component of project is within 50 or 100-year floodplain
- Provide information on CWA Section 303(d) impaired waters, if any, and efforts to develop and revise TMDLs

**Biological Resources**

- Impacts to plants and animals in Joshua Tree National Park (JTNP)
- If there are threatened or endangered species present, recommend BLM consult with USFWS and prepare a Biological Opinion under Section 7 of the ESA
- Impacts to all known species, not just special status, should be analyzed to assure ecosystem level protection

- Maximize options to protect habitat and minimize habitat loss and fragmentation
- Impacts associated with construction, installation, and maintenance activities (deep trenching, grading, filling, fencing)
- Impacts due to increase of shade from PV panels in the desert environment
- Seasonal surveys should be performed for sensitive plant and animal species
- Impacts to all known species, not just special status, should be analyzed to assure ecosystem level protection
- Acquisition of lands for conservation should be part of mitigation strategy
- Impacts to Desert Dry Wash Woodland and Blue Palo Verde-Ironwood-Smoke Tree habitat

**Vegetation Resources (Vegetative communities, priority and special status species)**

- Seasonal surveys should be performed for sensitive plant species
- Vegetation maps should be at scale that is useful for evaluating impacts
- Impacts due to non-native invasive species
- Inclusion of an invasive plant management plan
- Avoidance of rare plants preferable due to transplanting issues
- Impacts to the following (but not limited to) species:
  - Las Animas colubrine
  - Harwood's milkvetch
  - Coves' cassia
  - Coachella Valley milkvetch
  - California ayenia
  - Alverson's foxtail cactus
  - California ditaxis
  - California barrel cactus

**Wildlife Resources (Priority species, special status species)**

- Desert tortoise; especially impacts to existing movement corridor connection from the Chuckwalla DWMA to Joshua Tree National Park; translocation results in high mortality; include an aggressive raven prevention plan
- Impacts to the following (but not limited to) species:
  - Burrowing owl
  - Desert bighorn sheep
  - Mojave fringe-toed lizard
  - LeConte's thrasher
  - Bendire's thrasher
  - Loggerhead shrike
  - Prairie falcon
  - Migratory birds
- Impacts to wildlife movement corridors

**Cultural Resources**

- Recommends a Class III inventory for cultural resources
- Determinations of Eligibility for the National Register of Historic Places should be conducted prior to project design and implementation

- Discussion of prehistoric and historic transportation corridors that might lead into Joshua Tree National Park (JTNP); information on prehistoric lithic quarries; information on rock art; habitation sites with midden deposits; early Holocene Pinto sites; Patton WWII training sites; California Aqueduct related sites
- Archaeological monitoring in high sensitivity areas during ground disturbing activities
- Impact on paleontological deposits in JTNP
- Describe Native American consultation
- Address existence of sacred sites and Executive Order 13007, distinguished from Section 106 of the NHPA

**Visual Resources**

- Visibility issues related to fugitive dust
- Impacts to wilderness area of JTNP by adding human activity within landscape view
- Cumulative impacts due to other projects in the vicinity
- Affect of artificial lighting due to security, maintenance on night sky viewing
- Impact on wildlife due to new light sources
- Nighttime lighting views from JTNP and Chuckwalla Wilderness Area
- Impacts resulting from building/facility color
- Undergrounding of transmission lines recommended

**Land Use/Special Designations (ACECs, WAs, WSAs, etc.)**

- Discuss how project would support or conflict with objectives of federal, state, tribal, or local land use plans, policies, and controls
- Project site located within Eastern Colorado Desert Tortoise Recovery Unit and classified as BLM Category III desert tortoise habitat
- Discuss whether land is classified as disturbed
- Utilize the Renewable Energy Interactive Mapping Tool to locate disturbed sites in proximity to the project that might also be utilized
- Preferred Transmission Corridor follows Kaiser Road and affects 192 acres of the Chuckwalla DWMA

**Public Health and Safety**

- Identify projected hazardous waste types and volumes, and expected storage, disposal, and management plans
- Address full product life cycle of PV components
- Identify fire prevention BMP
- Evaluate potential risk from cadmium telluride resulting from degradation/breakage of PV panels
- Hazards related to landing strip near project site

- Electromagnetic field impacts

**Noise/Vibration**

- Impacts of heavy grading equipment and machinery on the natural soundscape environment
- Consider wildlife as sensitive receptors and identify impacts
- Impacts from operation of project buildings

**Recreation**

- Impacts to local tourism economies
- Will the project have public access corridors to other public lands?

**Socioeconomic**

- Consider proximity to residences, state parks and federal parks
- Impacts to nearby farming operations

**Environmental Justice (minority and low-income communities)**

- Evaluate potential for disproportionate adverse impacts to minority and low-income populations and approaches used to foster public participation by these populations

**Cumulative Impacts**

- Identify impacts from other projects occurring in the vicinity, including solar, wind, geothermal, Eagle Crest Hydro-Pumped Electric Facility, Eagle Mountain Landfill, Eagle Mountain Mine, Shaver's Valley new town, roads, transit, housing, and other development
- Scope of cumulative analysis should encompass Sonoran/transition desert areas
- Groundwater cumulative impacts related to Eagle Crest Hydro-Pumped Electric facility
- Viewshed alterations and subsequent changes to the view from wilderness
- Describe reasonably foreseeable future land use and impacts resulting from additional power supply

## B. Alternative Development and/or Alternative Design Criteria

Comments in this category will be considered in the development of alternatives or can be addressed through design criteria in the alternative descriptions.

- Project description should not be narrowly defined to rule out feasible alternatives

- Reasonable alternatives should include, but not necessarily limited to, alternative sites, capacities, and technologies as well as avoidance of environmentally sensitive areas or areas with potential use conflicts
- Identify alternative sites outside of desert tortoise occupied habitat or in disturbed lands; avoid impacts to northwest portion of the site where many desert tortoises were surveyed
- Alternative configurations should avoid Pinto Wash; microphyll washes; and other movement corridors
- Identify alternative located on adjacent fallow farmland
- Identify alternative that would designate environmentally sensitive land outside the Preferred Project Site, but within original ROW, unavailable to other solar projects
- Alternatives should include: sites not under BLM jurisdiction; project extent and electrical power generation that differ from proposal; use of different technology; benefits associated with the proposed technology; power generation sited adjacent to power consumption
- Alternatives should describe rationale used to determine whether impacts of an alternative are significant or not
- Discuss feasibility of using residential and wholesale distributed generation, in conjunction with increased energy efficiency, as an alternative

## C. Issues or Concerns Outside the Scope of the EIS

Comments in this category are outside the scope of analysis and will not be addressed in the EIS.

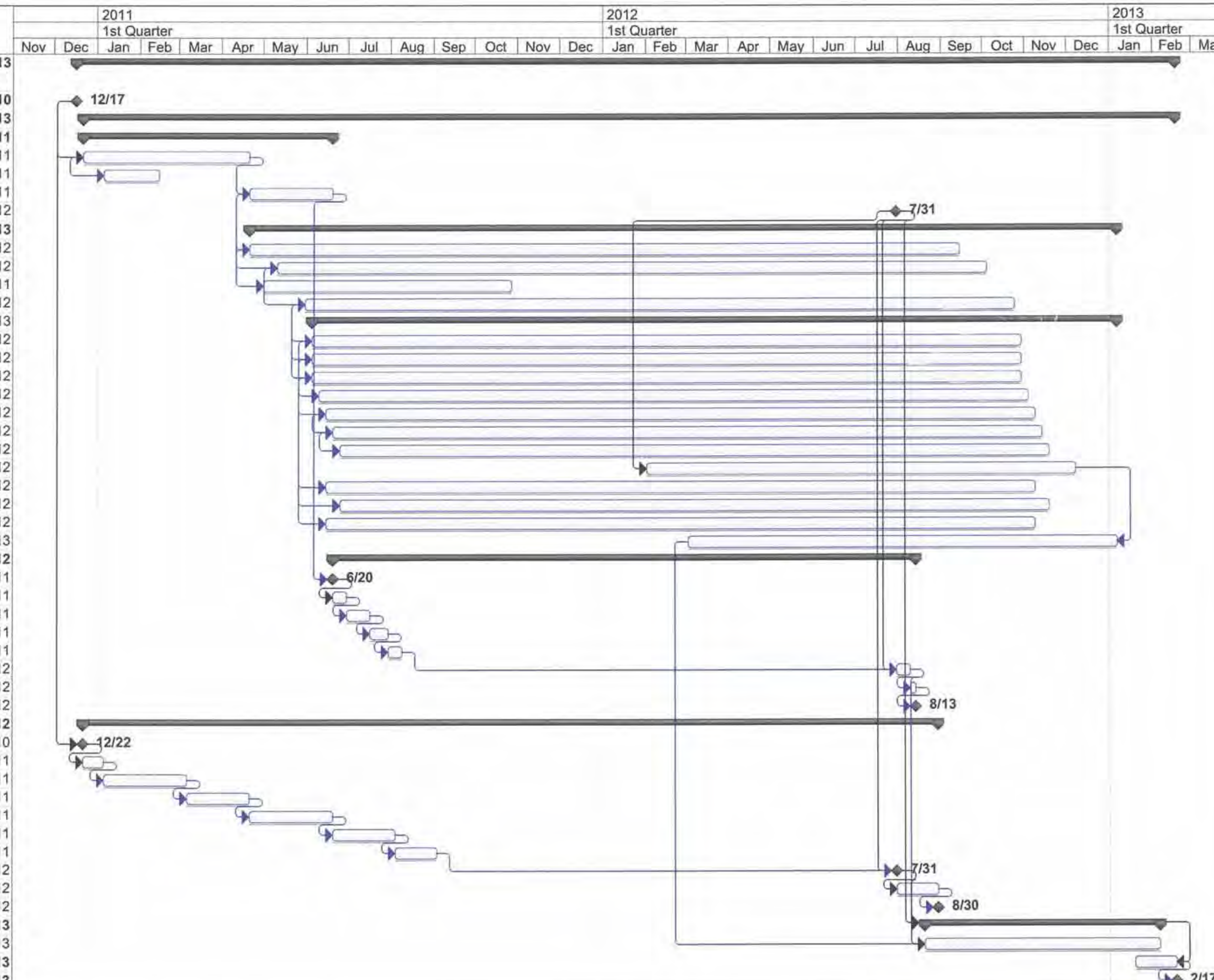
- Agencies must require adequate end of project life planning, including reuse of abandoned sites for future renewable energy projects in lieu of allowing development on other undisturbed lands; and/or returning to public use in original condition
- Include thorough analysis of anticipated costs of decommissioning and restoration of project site
- Identify how siting of large energy projects would impact private property values and quality of life
- Does First Solar have plans to expand their project?
- “Fast tracking” viewed as unwise

# Appendix B

# Construction Schedule for Solar Farm and Gen-Tie Lines

Desert Sunlight Construction Schedule

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 1 | **DESERT SUNLIGHT CONSTRUCTION SCHEDULE** | **793.33 days** | **Fri 12/17/10** | **Sun 2/17/13** |
| 2 | | | | |
| 3 | **All permits received** | **0 days** | **Fri 12/17/10** | **Fri 12/17/10** |
| 4 | **Construction Plan** | **788.33 days** | **Wed 12/22/10** | **Sun 2/17/13** |
| 5 | **FNTP / Construction Mobilization** | **180 days** | **Wed 12/22/10** | **Mon 6/20/11** |
| 6 | Site Prep | 120 days | Wed 12/22/10 | Thu 4/21/11 |
| 7 | Install initial access roads | 40 days | Thu 1/6/11 | Tue 2/15/11 |
| 8 | Set-up Office & Site Services | 60 days | Thu 4/21/11 | Mon 6/20/11 |
| 9 | **Utility Interconnection Available** | **0 days** | **Tue 7/31/12** | **Tue 7/31/12** |
| 10 | **Solar Farm Site** | **627 days** | **Thu 4/21/11** | **Mon 1/7/13** |
| 11 | Survey | 513 days | Thu 4/21/11 | Sat 9/15/12 |
| 12 | Grading | 513 days | Wed 5/11/11 | Fri 10/5/12 |
| 13 | Fencing | 180 days | Sun 5/1/11 | Fri 10/28/11 |
| 14 | Post Installation | 513 days | Tue 5/31/11 | Thu 10/25/12 |
| 15 | BOS Installation | 582 days | Sun 6/5/11 | Mon 1/7/13 |
| 16 | DC Feeders & Whips | 513 days | Sun 6/5/11 | Tue 10/30/12 |
| 17 | AC Trench & Fiber | 513 days | Sun 6/5/11 | Tue 10/30/12 |
| 18 | PCS Vaults & Transformer Pads | 513 days | Sun 6/5/11 | Tue 10/30/12 |
| 19 | Apply non-drivable palliative | 513 days | Fri 6/10/11 | Sun 11/4/12 |
| 20 | Tilt Brackets | 513 days | Wed 6/15/11 | Fri 11/9/12 |
| 21 | Tables | 513 days | Mon 6/20/11 | Wed 11/14/12 |
| 22 | Wire Harnesses | 513 days | Sat 6/25/11 | Mon 11/19/12 |
| 23 | Modules & Clips | 310 days | Thu 2/2/12 | Sat 12/8/12 |
| 24 | PV Combining Switchgear | 513 days | Wed 6/15/11 | Fri 11/9/12 |
| 25 | Combiner Boxes | 513 days | Sat 6/25/11 | Mon 11/19/12 |
| 26 | PCS Shelters & Transformers | 513 days | Wed 6/15/11 | Fri 11/9/12 |
| 27 | Pre-functional Tests | 310 days | Sat 3/3/12 | Mon 1/7/13 |
| 28 | **Onsite Substation construction** | **420.33 days** | **Mon 6/20/11** | **Mon 8/13/12** |
| 29 | Commence Construction | 0 days | Mon 6/20/11 | Mon 6/20/11 |
| 30 | Site Preparation & Grading | 0.33 mons | Mon 6/20/11 | Thu 6/30/11 |
| 31 | Below Grade Construction | 0.56 mons | Thu 6/30/11 | Sat 7/16/11 |
| 32 | Above Grade Construction | 0.44 mons | Sat 7/16/11 | Sat 7/30/11 |
| 33 | Control/Power Cables & Terminations | 10 days | Sat 7/30/11 | Tue 8/9/11 |
| 34 | Testing & Commissioning | 0.33 mons | Tue 7/31/12 | Fri 8/10/12 |
| 35 | Clean Up & Punch List | 0.11 mons | Fri 8/10/12 | Mon 8/13/12 |
| 36 | Demobilization | 0 mons | Mon 8/13/12 | Mon 8/13/12 |
| 37 | **220 kV Transmission Line** | **617 days** | **Wed 12/22/10** | **Thu 8/30/12** |
| 38 | Mobilization | 0 days | Wed 12/22/10 | Wed 12/22/10 |
| 39 | Stake Structures | 0.5 mons | Wed 12/22/10 | Thu 1/6/11 |
| 40 | Foundation Installation | 2 mons | Thu 1/6/11 | Mon 3/7/11 |
| 41 | Frame Structures | 1.5 mons | Mon 3/7/11 | Thu 4/21/11 |
| 42 | Erect Structures | 2 mons | Thu 4/21/11 | Mon 6/20/11 |
| 43 | Wire Installation | 1.5 mons | Mon 6/20/11 | Thu 8/4/11 |
| 44 | Testing | 1 mon | Thu 8/4/11 | Sat 9/3/11 |
| 45 | ENERGIZE TRANSMISSION LINE | 0 days | Tue 7/31/12 | Tue 7/31/12 |
| 46 | ROW Restoration and Cleanup | 1 mon | Tue 7/31/12 | Thu 8/30/12 |
| 47 | Project Complete | 0 days | Thu 8/30/12 | Thu 8/30/12 |
| 48 | **Commissioning** | **170 days** | **Mon 8/20/12** | **Wed 2/6/13** |
| 49 | Functional testing | 170 days | Mon 8/20/12 | Wed 2/6/13 |
| 50 | **Final Soil Stabilization** | **30 days** | **Fri 1/18/13** | **Sun 2/17/13** |
| 51 | **Project Substantial Completion** | **0 days** | **Sun 2/17/13** | **Sun 2/17/13** |




Task | Progress | Summary | External Tasks | Split
Split | Milestone | Project Summary | External MileTask

# Appendix C

# CPUC's CEQA Environmentally Superior Alternative

# APPENDIX C – CPUC'S CEQA ENVIRONMENTALLY SUPERIOR ALTERNATIVE

## C.1 INTRODUCTION

The California Environmental Quality Act (CEQA) Guidelines Section (§) 15126.6 requires an Environmental Impact Report (EIR) to consider a range of reasonable alternatives to the proposed project, or to the location of the project, that would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives. Because this EIS may be used by the California Public Utilities Commission (CPUC) in lieu of an EIR in determining whether to issue a permit for the Red Bluff Substation, this chapter compares the Red Bluff Substation alternatives evaluated in Chapter 4 of this EIS. In addition, because CEQA § 15378 (a) requires the lead agency to consider the whole of an action, not simply its constituent parts, when determining whether it will have a significant environmental effect (*Citizens Assoc. For Sensible Development of Bishop Area v. County of Inyo* (1985) 172 Cal.App.3d 151), this chapter also compares the effects of the Gen-Tie route alternatives and the Solar Farm Site alternatives, identifies the environmentally superior action alternative, and compares this to the CEQA No Project alternative (No Action alternative, identified as Alternative 4 in Chapter 2, Description of the Proposed Action and Alternatives) as required by CEQA § 15126.6 (e) (1).

## C.2 COMPARISON OF ALTERNATIVES

The BLM is required to consider in detail a range of alternatives that are considered "reasonable," usually defined as alternatives that are realistic (not speculative), technologically and economically feasible, and that respond to the purpose of and need for the Proposed Action. Similarly, CEQA requires a "reasonable range" of alternatives that are feasible and that satisfy most of the project objectives as listed in Section 2.1 but avoid or substantially lessen any of the significant environmental effects of the proposed project. The alternatives carried forward for analysis satisfy requirements under both NEPA and CEQA.

### C.2.1 Alternatives Considered in Detail

As described in Section 2.2.2, Overview of Alternatives Considered in Detail, three full action alternatives and three No Action alternatives are fully analyzed in the EIS. Each action alternative contains three main components: Solar Farm Site, Gen-Tie Line, and Substation (Red Bluff Substation). Two Solar Farm Site layout alternatives were considered in detail: Solar Farm Layout B and Solar Farm Layout C. Three Gen-Tie Line alternatives were considered in detail: GT-A-1 and GT-A-2, both of which exit the Solar Farm and go to Substation A, and GT-B-2, which would exit the Solar Farm and go to Substation B. Two substation alternatives were considered in full detail: Substation A (to the east) and Substation B (to the west). Two access road alternatives were considered for Substation A only: Access Road 1 (via Kaiser Road and Aztec Road) and Access Road 2 (via Chuckwalla Valley Road and Corn Springs Road). Supporting facilities for all substation alternatives include a telecommunications site (the Desert Center Telecommunications Site). Alternatives for each project component are compared by environmental discipline in Tables C-1, C-2, -and C-3. In each table, the key environmental disciplines (wildlife, vegetation, visual resources, cultural resources, and water resources) are listed first.

### C.2.2 Alternatives Not Carried Forward for Full Analysis

A number of Alternatives were not carried forward for detailed analysis because they did not meet project purpose and need, project objectives, were deemed to be technically disadvantageous, or had greater environmental impacts than the proposed project.

An additional Solar Farm layout was considered within the Project Study Area, identified as Solar Farm A. However, this alternative is located within a larger area of desert tortoise habitat than is the proposed Solar Farm B layout. Because this layout did not provide any advantage over Solar Farm B and would result in greater impacts on the desert tortoise, it was eliminated from consideration. Various other Solar Farm layouts were considered but eliminated, and are discussed in Section 2.6.1, Alternative Layouts in Project Solar Farm Study Area.

An additional Gen-Tie Line, GT-B-2, was considered for the proposed Project. GT-B-1 would exit the southwest corner of the Solar Farm Site across Kaiser Road, then turn west and southwest until intersecting with Eagle Mountain Road, then running south along the east side of Eagle Mountain Road across I-10 to the western location considered for the Red Bluff Substation (Red Bluff Substation B). The total length of GT-B-1 is approximately 9.3 miles within a 160-foot-wide corridor. This alternative would disturb more acres within the Chuckwalla Desert Wildlife Management Area (DWMA), would require removal of a greater number of foxtail cactus, and has the potential to disturb more significant cultural resources sites than the other Gen-Tie Lines. Since this layout did not provide any advantage over the other Gen-Tie Line that would provide a connection to Red Bluff Substation B and would result in greater impacts on the DWMA and cultural resources, it was eliminated from detailed consideration. Other alternative interconnections were considered and eliminated from detailed environmental review and are described in Section 2.6.7, Alternative Transmission and Interconnection Locations.

Various other system alternatives and technology alternatives were considered but eliminated from detailed review and are described in Section 2.6.

### C.2.3 Summary Comparison of All Alternatives

Based on the comparisons presented in Tables C-1, C-2, and C-3 below, the CPUC believes the environmentally superior action alternative under CEQA is a combination of **Substation A** with **Access Road 2**, **Gen-Tie GT-A-2**, and either **Solar Farm B or C**. As described in Chapter 2, three full action alternatives, representing three of seven possible combinations of all Solar Farm Site, Gen-Tie, and Substation alternatives that were considered in full detail in the EIS, were analyzed as follows:

- Alternative 1—Proposed Action Alternative (Solar Farm Layout B, Gen-Tie Line GT-A-1, Red Bluff Substation A, and Access Road 2);
- Alternative 2—Alternate Action Alternative (Solar Farm Layout B, Gen-Tie Line BT-B-2, and Red Bluff Substation B); and
- Alternative 3—Reduced Footprint Alternative (Solar Farm Layout C, Gen-Tie Line GT-A-2, Red Bluff Substation A, and Access Road 1).

The remaining four combinations of project components were not identified nor compared by environmental discipline in Chapter 4. However, the other four combinations are technically feasible. As described in this section, none of the three combinations of alternatives defined in the Project Description (Alternatives 1 through 3) are considered to be the environmentally superior action alternative. In addition, the No Project alternative is not found to be superior, as described in Section C.2.7. The following sections present details to support these conclusions.

### C.2.4 Comparison of Red Bluff Substation Sites

Table C-1 summarizes the impacts of the two substation alternatives, including the two different access road options for Substation A. This comparison shows that overall, **Substation A with Access Road 2** would have the fewest adverse impacts on environmental resources and would be environmentally superior under CEQA. Substation A with Access Road 1 would be located in an area without active desert tortoise sign and would affect fewer cultural resources than with Access Road 2. Although Substation A would affect more CRHR eligible sites than Substation B, as described below for the Gen-Tie Line alternatives and shown in Table C-2 the combination of Substation A and GT-A-2 would affect fewer CRHR eligible sites than the combination of Substation B and GT-B-2.

**Table C-1**
**Comparison of Action Alternatives: Red Bluff Substation**

| Environmental Discipline | Substation A (eastern) | | Substation B (western) |
|---|---|---|---|
| | Access Road 1 | Access Road 2 | |
| **Wildlife** | **Preferred**<br>• Low desert tortoise sign (no individuals, scat, burrows, or carcasses within or immediately surrounding site).<br>• Impacts to chuckwalla and burro deer individuals and habitat, and potential impacts to rosy boa.<br>• Permanent disturbance of 149 acres of Chuckwalla DWMA or critical habitat for desert tortoise.<br>• Wildlife movement impacts less than significant without further mitigation.<br>• No significant unavoidable impacts. | **Less preferred**<br>• Low desert tortoise sign (no individuals, scat, burrows, or carcasses within or immediately surrounding site).<br>• Impacts to chuckwalla and burro deer individuals and habitat, and potential impacts to rosy boa.<br>• Permanent disturbance of 149 acres of Chuckwalla DWMA or critical habitat for desert tortoise.<br>• Wildlife movement impacts less than significant without further mitigation.<br>• No significant unavoidable impacts. | **Least preferred**<br>• High desert tortoise sign (one individual, one carcass, and scat within the site, large amount of scat immediately surrounding site).<br>• No impacts to chuckwalla, burro deer, or rosy boa. Impacts to burrowing owl individuals and habitat.<br>• Permanent disturbance of 114 acres of critical habitat. No impacts to Chuckwalla DWMA (private land).<br>• Wildlife movement impacts significant, at proposed location; mitigated through relocation of Substation (MM-WIL-9). No significant unavoidable impacts. |
| **Vegetation** | **Roughly equivalent**<br>• Permanent conversion of creosote desert scrub (124 ac) and desert dry wash woodland (24 ac).<br>• Removal of 1 Las Animas colubrines, and 2 California ditaxis.<br>• Permanent loss of 46 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Permanent conversion of 143.5 acres of desert creosote scrub (124 ac) and desert dry wash woodland (24 ac).<br>• Removal of 1 Las Animas colubrines, and 2 California ditaxis.<br>• Permanent loss of 46 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Permanent conversion of desert creosote scrub (101 acres) and desert dry wash woodland (9 ac).<br>• Removal of foxtail cactus (2 acres), and several California ditaxis.<br>• Permanent loss of 24 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. |

**Table C-1 (continued)**
**Comparison of Action Alternatives: Red Bluff Substation**

| Environmental Discipline | Substation A (eastern) | | Substation B (western) |
|---|---|---|---|
| | Access Road 1 | Access Road 2 | |
| **Cultural Resources** | **Least preferred**<br>• Most CRHR eligible and potentially eligible sites impacted (1 eligible, 3 potentially eligible, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Additional impacts to 18 other archeological resources.<br>• Impacts would be significant and unavoidable. | **Less Preferred**<br>• Fewer CRHR eligible sites impacted than for Access Road 1 (1 eligible, 4 potentially eligible, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Additional impacts to 20 other archeological resources.<br>• Impacts would be significant and unavoidable. | **Preferred**<br>• Fewer CRHR eligible sites impacted than for Substation A (2 potentially eligible, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Additional impacts to 5 other archeological resources.<br>• Impacts would be significant and unavoidable. |
| **Visual Resources** | **Roughly equivalent**<br>• Substation A with Access Road 1 would have a smaller permanent impact than Substation A with Access Road 2, but a larger impact than Substation B.<br>• Significant and unavoidable impacts. | **Roughly equivalent**<br>• Substation A with Access Road 2 would have the largest visual impact of the three alternatives.<br>• Significant and unavoidable impacts. | **Roughly equivalent**<br>• Substation B would have the smallest permanent visual impact of the three alternatives.<br>• Significant and unavoidable impacts. |
| **Water Resources** | **Less preferred**<br>• Alteration of three drainages to prevent flooding requiring greater disturbance than Substation B.<br>• Access Road 1 would be less likely to be subjected to flooding.<br>• No significant unavoidable effects. | **Least preferred**<br>• Alteration of three drainages to prevent flooding requiring greater disturbance than Substation B.<br>• Access Road 2 requires improvements to prevent damage from flooding.<br>• No significant unavoidable effects. | **Preferred**<br>• Alteration of one drainage to prevent flooding requiring lesser disturbance than Substation A.<br>• No significant unavoidable effects. |
| **Air Resources** | **Less preferred**<br>• More construction emissions than Substation B, equivalent to Access road 2.<br>• No significant unavoidable impacts. | **Less preferred**<br>• More construction emissions than Substation B, equivalent to Access road 1.<br>• No significant unavoidable impacts. | **Preferred**<br>• Fewest construction emissions because of a substantially shorter new access road.<br>• No significant unavoidable impacts. |
| **Climate Change** | **Less preferred**<br>• Equivalent greenhouse gas emissions to Access Road 2, greater emissions than Substation B.<br>• No significant unavoidable impacts. | **Less preferred**<br>• Equivalent greenhouse gas emissions to Access Road 1, greater emissions than Substation B.<br>• No significant unavoidable impacts. | **Preferred**<br>• Fewer greenhouse gas emissions than Substation A because of a substantially shorter new access road.<br>• No significant unavoidable impacts. |

**Table C-1 (continued)**
**Comparison of Action Alternatives: Red Bluff Substation**

| Environmental Discipline | Substation A (eastern) | | Substation B (western) |
|---|---|---|---|
| | Access Road 1 | Access Road 2 | |
| **Paleontological Resources** | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. |
| **Geology and Soil Resources** | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. |
| **Lands and Realty** | **Equivalent**<br>• Substation would be built on multiple-use BLM land. | **Equivalent**<br>• Substation would be built on multiple-use BLM land. | **Equivalent**<br>• Substation B would be built on currently undeveloped private land zoned W-2-10 (Controlled Development); there are no existing or known planned uses of this land. |
| **Noise** | **Equivalent**<br>• No nearby residences. | **Equivalent**<br>• No nearby residences. | **Equivalent**<br>• No nearby residences. |
| **Public Health and Safety/ Hazardous Materials** | **Equivalent**<br>• Safety hazard from the proximity of the communications tower to a private air strip.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Safety hazard from the proximity of the communications tower to a private air strip.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Safety hazard from the proximity of the communications tower to a private air strip.<br>• No significant unavoidable impacts. |
| **Recreation** | **Equivalent**<br>• No impact because no OHV routes would be affected. | **Equivalent**<br>• No impact because no OHV routes would be affected. | **Equivalent**<br>• No impact because no OHV routes would be affected. |
| **Socioeconomics and Environmental Justice** | **Equivalent**<br>• No impacts. | **Equivalent**<br>• No impacts. | **Equivalent**<br>• No impacts. |
| **Special Designations** | **Less preferred**<br>• Indirect impacts to an ACEC and the Chuckwalla Mountains Wilderness. | **Less preferred**<br>• Indirect impacts to an ACEC and the Chuckwalla Mountains Wilderness. | **Preferred**<br>• No impacts expected. |
| **Transportation and Public Access** | **Equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives. | **Equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives. | **Equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives. |

Another factor considered in the analysis is that cumulative impacts to air resources, visual resources, cultural resources, and biological resources would be greater with development of Substation B than with Substation A due to the requirement for an additional approximately 6 miles of transmission gen-tie line to interconnect the proposed Palen Solar Power Project. This project is sited in close proximity to Substation A. The Palen Solar Power Project is anticipated to develop a gen-tie along the east-west portion of Gen-Tie Line GT-A-1; therefore, development of Substation B would likely result in future development of the east-west portion of GT-A-1. Impacts of Gen-Tie Line alternatives are compared in Table C-2.

### C.2.5 Comparison of Gen-Tie Routes

Table C-2 presents a comparison of the three gen-tie routes. **Gen-Tie Line GT-A-2** would have the potential to affect the least desert tortoise individuals and habitat. In addition, GT-A-2 would have the fewest noise-related impacts and the smallest visual impact due to its collocation with an existing transmission line. Although GT-A-2 would affect the most water resources by requiring 30 percent more water for construction, these impacts would be less than significant with required mitigation. Therefore, GT-A-2 would be the environmentally superior gen-tie alternative under CEQA. In addition, although Substation A would affect the largest number of CRHR eligible sites as described above and in Table C-1, the combination of Substation A and GT-A-2 would affect fewer known CRHR eligible sites than the combination of Substation B and GT-B-2; however, full-coverage surveys for the GT-A-2 corridor were not possible due to access constraints, and additional cultural resources are likely to exist and could be affected by construction of GT-A-2.

As described above for Substation B, cumulative impacts of developing GT-B-2 would likely also include the impacts of development of the east-west portion of GT-A-1 to interconnect the Palen Solar Power Project, including air, cultural, visual, and biological resources impacts. Therefore, GT-B-2 would be the least environmentally preferred Gen-Tie alternative.

**Table C-2**
**Comparison of Action Alternatives: Gen-Tie Line**

| Environmental Discipline | GT-A-1 (Kaiser Rd to Desert Center, then east: 12.2 mi.) | GT-A-2 (SCE ROW to Substation A: 9.5 mi.) | GT-B-2 (Kaiser Rd to Desert Center, then west: 10 mi.) |
|---|---|---|---|
| **Wildlife** | **Less preferred**<br>• Disturbance of 42 acres of desert tortoise critical habitat (or DWMA.<br>• No significant unavoidable impacts. | **Preferred**<br>• Disturbance of 17 acres of desert tortoise critical habitat or DWMA.<br>• No significant unavoidable impacts. | **Least preferred**<br>• Disturbance of 55.5 acres of desert tortoise critical habitat and/or DWMA.<br>• No significant unavoidable impacts. |
| **Vegetation** | **Roughly equivalent**<br>• Permanent conversion of 65 acres of desert creosote scrub.<br>• Permanent conversion of 37 acres of desert dry wash woodland.<br>• Removal of 2 crucifixion thorns, 1 California ditaxis, and 4 desert unicorn plants.<br>• Permanent removal of 46 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Permanent conversion of 40 acres of desert creosote scrub.<br>• Permanent conversion of 38 acres of desert dry wash woodland.<br>• Removal of 32 crucifixion thorns and 1 desert unicorn plant.<br>• Permanent removal of 56 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Permanent conversion of 101 acres of desert creosote scrub.<br>• Permanent conversion of 49 acres of desert dry wash woodland.<br>• Removal of 2 crucifixion thorns, several California ditaxis, and 1 desert unicorn plant.<br>• Permanent removal of 52 acres of CDFG jurisdictional resources.<br>• No significant unavoidable impacts. |

**Table C-2 (continued)**
**Comparison of Action Alternatives: Gen-Tie Line**

| Environmental Discipline | GT-A-1 (Kaiser Rd to Desert Center, then east: 12.2 mi.) | GT-A-2 (SCE ROW to Substation A: 9.5 mi.) | GT-B-2 (Kaiser Rd to Desert Center, then west: 10 mi.) |
|---|---|---|---|
| **Cultural Resources** | **Less preferred**<br>• Greatest number of CRHR eligible and potentially eligible sites impacted (6 potentially eligible).<br>• Impacts to historic landscapes of the Colorado River Aqueduct, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Impacts to 13 additional archeological resources.<br>• Impacts would be significant and unavoidable. | **Cannot be compared**<br>• Fewest number of known CRHR eligible and potentially eligible sites impacted (2 potentially eligible).<br>• Impacts to historic landscapes of the Colorado River Aqueduct, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Impacts to 2 additional archeological resources.<br>• Surveys were incomplete for this corridor, and additional resources likely exist, and therefore this alternative cannot be compared to the alternatives with full-coverage surveys.<br>• Impacts would be significant and unavoidable. | **More preferred**<br>• Greatest number of CRHR eligible and potentially eligible sites as GT-A-1 (6 potentially eligible).<br>• Impacts to historic landscapes of the Colorado River Aqueduct, the North Chuckwalla Petroglyph District, the North Chuckwalla Mountains Quarry District, and the landscape and area of the potential DTC-CAMA historic district).<br>• Impacts to 17 additional archeological resources.<br>• Impacts would be significant and unavoidable. |
| **Air Resources** | **Roughly equivalent**<br>• Emissions from stationary and mobile construction activities.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Emissions from stationary and mobile construction activities.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Emissions from stationary and mobile construction activities.<br>• No significant unavoidable impacts. |
| **Climate Change** | **Least preferred**<br>• Most greenhouse gas emissions associated with construction.<br>• Equivalent greenhouse gas emissions from operations.<br>• No significant unavoidable impacts. | **Preferred**<br>• Fewest greenhouse gas emissions associated with construction.<br>• Equivalent greenhouse gas emissions from operations.<br>• No significant unavoidable impacts. | **Less preferred**<br>• Greater greenhouse gas emissions associated with construction than GT-A-2.<br>• Equivalent greenhouse gas emissions from operations.<br>• No significant unavoidable impacts. |
| **Visual Resources** | **Less preferred**<br>• Would require a new transmission corridor; impacts roughly equivalent to GT-B-2.<br>• Impacts would be significant and unavoidable. | **Preferred**<br>• Would be collocated with an existing transmission line for the majority of its length.<br>• Impacts would be significant and unavoidable. | **Less preferred**<br>• Would require a new transmission corridor; impacts roughly equivalent to GT-A-1.<br>• Impacts would be significant and unavoidable. |

**Table C-2 (continued)**
**Comparison of Action Alternatives: Gen-Tie Line**

| Environmental Discipline | GT-A-1 (Kaiser Rd to Desert Center, then east: 12.2 mi.) | GT-A-2 (SCE ROW to Substation A: 9.5 mi.) | GT-B-2 (Kaiser Rd to Desert Center, then west: 10 mi.) |
|---|---|---|---|
| **Water Resources** | **Less preferred**<br>• Requires more water during construction than GT-B-2, but less water than GT-A-1.<br>• No significant unavoidable impacts. | **Least preferred**<br>• Requires approximately 30 percent more water for construction than GT-A-1 despite being 3 miles shorter.<br>• No significant unavoidable impacts. | **Preferred**<br>• Impacts would be the same or less than GT-A-1 due to the shorter length of GT-B-2 and lower water requirements for construction.<br>• No significant unavoidable impacts. |
| **Paleontological Resources** | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. |
| **Geology and Soil Resources** | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. |
| **Lands and Realty** | **Roughly equivalent**<br>• Temporary impacts at roadway crossings.<br>• Would traverse one private parcel designated by the County's General Plan as Open-Space Rural (OS-RUR) and zoned Natural Assets (N-A).<br>• No agricultural land impacted.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Temporary impacts at roadway crossings.<br>• Would cross SR 177, which is under the jurisdiction of Caltrans.<br>• Would cross approximately 1.5 miles of private agricultural land.<br>• Would permanently preclude cultivation of 185 acres of currently cultivated non-prime land that is not under Williamson Act Contract.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Temporary impacts at roadway crossings.<br>• Majority of line not within a designated utility corridor.<br>• No agricultural land impacted.<br>• No significant unavoidable impacts. |
| **Noise** | **Less preferred**<br>• Closest existing residence is 500 feet. Equivalent to GT-B-2<br>• No significant unavoidable impacts. | **Preferred**<br>• No nearby residences<br>• No significant unavoidable impacts. | **Less preferred**<br>• Closest existing residence is 500 feet. Equivalent to GT-A-1.<br>• No significant unavoidable impacts. |
| **Public Health and Safety/ Hazardous Materials** | **Equivalent**<br>• All three alternatives are subject to the same safety and hazards issues.<br>• No significant unavoidable impacts. | **Equivalent**<br>• All three alternatives are subject to the same safety and hazards issues.<br>• No significant unavoidable impacts. | **Equivalent**<br>• All three alternatives are subject to the same safety and hazards issues.<br>• No significant unavoidable impacts. |
| **Recreation** | **Equivalent**<br>• No impact. | **Equivalent**<br>• No impact. | **Equivalent**<br>• No impact. |

**Table C-2 (continued)**
**Comparison of Action Alternatives: Gen-Tie Line**

| Environmental Discipline | GT-A-1 (Kaiser Rd to Desert Center, then east: 12.2 mi.) | GT-A-2 (SCE ROW to Substation A: 9.5 mi.) | GT-B-2 (Kaiser Rd to Desert Center, then west: 10 mi.) |
|---|---|---|---|
| **Socioeconomics and Environmental Justice** | **Equivalent**<br>• Impacts would be the same for all alternatives.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Impacts would be the same for all alternatives.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Impacts would be the same for all alternatives.<br>• No significant unavoidable impacts. |
| **Special Designations** | **Equivalent**<br>• No impacts. | **Equivalent**<br>• No impacts. | **Equivalent**<br>• No impacts. |
| **Transportation and Public Access** | **Roughly equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives, but GT-A-2's proximity to a former airport would require coordination with airport owners prior to construction.<br>• No significant unavoidable impacts. | **Roughly equivalent**<br>• Impacts to traffic closure and road deterioration would be similar among all alternatives.<br>• No significant unavoidable impacts. |

### C.2.6 Comparison of Solar Farm Layout Alternatives

Table C-3 presents a comparison of the two solar farm layouts. Based on the comparison presented in Table C-3, Solar Farm Layout C would have the fewest short-term impacts to environmental resources overall, including the fewest significant and unavoidable impacts on cultural resources and air quality, and significant but mitigable impacts to special-status species. By more greatly contributing to California's Renewable Portfolio Standard goals, Solar Farm Layout B would have fewer long-term indirect environmental impacts through local reduction in habitat for special status plants and wildlife through increased temperatures and drought conditions and encroachment by invasive plants in the Mojave Desert, and global loss of habitat through desertification of non-desert ecosystems. These short-term and long-term environmental impacts are difficult to compare. Therefore, Solar Farm Layouts B and C are considered to be environmentally equal.

**Table C-3**
**Comparison of Action Alternatives: Solar Farm Site**

| Environmental Discipline | Solar Farm Layout B (3,912 acres) | Solar Farm Layout C (3,045 acres) |
|---|---|---|
| **Wildlife** | **Less preferred**<br>• Greater habitat impacts; impacts to low and moderate density occupied habitat.<br>• Greater impacts to special-status species, including desert tortoise.<br>• No significant unavoidable impacts. | **Preferred**<br>• Fewer habitat impacts; would avoid most moderate density occupied habitat.<br>• Fewer impacts to special-status species; would avoid the areas of high desert tortoise sign.<br>• No significant unavoidable impacts. |
| **Vegetation** | **Less preferred**<br>• Greater total acreage of impacts to vegetation.<br>• No significant unavoidable impacts. | **Preferred**<br>• Fewer acres with impacts to vegetation.<br>• No significant unavoidable impacts. |

**Table C-3 (continued)**
**Comparison of Action Alternatives: Solar Farm Site**

| Environmental Discipline | Solar Farm Layout B ( 3,912 acres) | Solar Farm Layout C (3,045 acres) |
|---|---|---|
| **Cultural Resources** | **Less preferred**<br>• Would directly impact more culturally sensitive sites.<br>• Impacts would be significant and unavoidable. | **Preferred**<br>• Would directly impact fewer culturally sensitive sites.<br>• Impacts would be significant and unavoidable. |
| **Visual Resources** | **Roughly equivalent**<br>• Marginally greater long-term impact on visual resources.<br>• Impacts would be significant and unavoidable. | **Roughly equivalent**<br>• Marginally smaller long-term impact on visual resources.<br>• Impacts would be significant and unavoidable. |
| **Water Resources** | **Equivalent**<br>• Marginally greater use of groundwater.<br>• No depletion of groundwater supply in the basin.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Marginally less use of groundwater.<br>• No depletion of groundwater supply in the basin.<br>• No significant unavoidable impacts. |
| **Air Resources** | **Less preferred**<br>• More ground disturbance. Greater emissions from construction activity<br>• Impacts would be significant and unavoidable. | **Preferred**<br>• Less ground disturbance<br>• Fewer emissions from construction activity<br>• Impacts would be significant and unavoidable. |
| **Climate Change** | **Less Preferred**<br>• Greater total construction phase greenhouse gas emissions because site is larger. | **Preferred**<br>• Fewer construction phase greenhouse gas emissions because of smaller project site. |
| **Paleontological Resources** | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. | **Equivalent**<br>• Low potential for direct and indirect impacts to resources. |
| **Geology and Soil Resources** | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Exposure of people and/or property to seismic hazards and increased erosion of soils from wind and water.<br>• No significant unavoidable impacts. |
| **Lands and Realty** | **Less preferred**<br>• Portions of Kaiser Steel Road and two OHV routes would be closed.<br>• A transmission line and FERC easement could require modification.<br>• No significant unavoidable impacts. | **Preferred**<br>• No road closures.<br>• A FERC easement could require modification.<br>• No significant unavoidable impacts. |
| **Noise** | **Equivalent**<br>• Distance to closest existing residence is 1,175 acres.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Distance to closest existing residence is 1,175 acres.<br>• No significant unavoidable impacts. |
| **Public Health and Safety/ Hazardous Materials** | **Equivalent**<br>• Both solar farm sites are subject to the same safety and hazards issues.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Both solar farm sites are subject to the same safety and hazards issues.<br>• No significant unavoidable impacts. |
| **Recreation** | **Less preferred**<br>• Temporary closure of three OHV routes.<br>• No significant unavoidable impacts. | **Preferred**<br>• No OHV route closures. |
| **Socioeconomics and Environmental Justice** | **Equivalent**<br>• Impacts would be the same for both alternatives.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Impacts would be the same for both alternatives.<br>• No significant unavoidable impacts. |

**Table C-3 (continued)**
**Comparison of Action Alternatives: Solar Farm Site**

| Environmental Discipline | Solar Farm Layout B ( 3,912 acres) | Solar Farm Layout C (3,045 acres) |
|---|---|---|
| **Special Designations** | **Less preferred**<br>• Within two miles of the Joshua Tree Wilderness Area.<br>• Fugitive dust from construction would create a temporary visual distraction for users of this wilderness.<br>• No significant unavoidable impacts. | **Preferred**<br>• Within two miles of the Joshua Tree Wilderness Area.<br>• Fugitive dust from construction would create a temporary visual distraction for users of this wilderness.<br>• Indirect impacts are marginally reduced due to the smaller footprint.<br>• No significant unavoidable impacts. |
| **Transportation and Public Access** | **Equivalent**<br>• Marginally more road closures and road deterioration due to more intensive construction.<br>• Duration of construction would be equivalent.<br>• No significant unavoidable impacts. | **Equivalent**<br>• Marginally fewer road closures and marginally less road deterioration due to less intensive construction.<br>• Duration of construction would be equivalent.<br>• No significant unavoidable impacts. |

### C.2.7 Comparison of Environmentally Superior Action Alternative to No Project Alternative

Also as described in Chapter 2, three No Action alternatives were considered as follows:

- Alternative 4—No Issuance of a Right-of-Way Grant and No Land Use Plan Amendment (No Action);
- Alternative 5—No Issuance of a Right-of-Way Grant with Land Use Plan Amendment to Exclude Solar Energy Development on the Site (No Project with Plan Amendment); and
- Alternative 6—No Issuance of a Right-of-Way Grant with Land Use Plan Amendment to Allow Solar Development on the Site (No Project with Plan Amendment).

With Alternative 4, none of the project components (Solar Farm, Gen-Tie Line, and Substation) would be built. This alternative is equivalent to the No Project Alternative under CEQA. The No Project alternative (Alternative 4) would not amend the California Desert Conservation Act Land Use Plan to allow or disallow renewable energy projects in this area; therefore, future development of renewable energy in this area cannot be precluded under this alternative. In addition, because of California's mandate for energy utilities to procure 20 percent of their energy from renewable sources by the year 2010 (with legislation mandating 33 percent is currently pending as of the writing of this EIS), it is reasonable to assume that under the No Project alternative, other renewable energy projects would be developed in other locations in Riverside County and throughout the State to meet this mandate. The following paragraph compares the environmentally superior action alternative (Substation A with Access Road 2, Gen-Tie GT-A-2, and either Solar Farm B or C) to Alternative 4, the CEQA No Project Alternative.

The No Project alternative would avoid the direct impacts of developing the project site, including removal of desert tortoise habitat and special-status plants, significant and irretrievable impacts to cultural resource sites, significant short-term impacts on air quality, and significant long-term impacts on visual resources. However, it is reasonable to expect that, under the No Project alternative, other renewable energy projects would be developed in other locations to meet California's Renewable Portfolio Standard. In addition, if BLM does not amend the California Desert Conservation Area Land Use Plan under the No Project Alternative, another renewable energy project could be approved on the site of the environmentally superior action alternative in the future to facilitate meeting California's Renewable Portfolio Standard, and such a project would likely have impacts similar to or equivalent to those of the environmentally superior action alternative. Impacts of these other potential projects could be more or less severe than the environmentally superior action alternative. Speculation on the severity and magnitude of impacts from these potential other projects is not required (CEQA Guidelines 15126.6 [f][3]). However, because the No Project alternative would likely result in development of other renewable energy projects in other locations, and because the No Project alternative would not preclude future development of a renewable energy project on the site of the environmentally superior action alternative, resulting in impacts similar to those of the environmentally superior action alternative, the CPUC believes that the environmentally superior action alternative, an alternative combining **Substation A with Access Road 2**, **Gen-Tie GT-A-2**, **and either Solar Farm Layout B or Layout C**, is environmentally superior to the No Project alternative.

## C.3 CEQA ENVIRONMENTALLY SUPERIOR ALTERNATIVE

Based on the comparison presented in Table C-1 and the following discussion, the CPUC believes the environmentally superior Substation alternative is Substation A with Access Road 2. Based on the comparison presented in Table C-2 and the following discussion, the CPUC believes the environmentally superior Gen-Tie Line alternative is GT-A-2. Based on the comparison presented in Table C-3 and the following discussion, the CPUC considers the two Solar Farm Alternatives (B and C) to be environmentally equal.

Based on the discussion presented in Section C.2.7, the CEQA environmentally superior alternative is an alternative combining **Substation A with Access Road 2**, **Gen-Tie GT-A-2**, **and either Solar Farm Layout B or Layout C**.

# Appendix D

# Air Quality Analyses

# APPENDIX D-1

# OVERVIEW OF THE CONSTRUCTION EMISSIONS SPREADSHEET MODEL

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## OVERVIEW OF THE CNSTEMIS MODEL

Emissions from construction and demolition activities have been estimated using a detailed spreadsheet model (CNSTEMIS). The CNSTEMIS spreadsheet model calculates criteria pollutant emissions, diesel particulate emissions, and greenhouse gas emissions from construction or demolition activities and equipment. Criteria pollutant emission estimates are provided for reactive organic compounds, nitrogen oxides, carbon monoxide, sulfur oxides, inhalable particulate matter ($PM_{10}$), and fine particulate matter ($PM_{2.5}$). Particulate matter emissions from diesel engines contain known and suspected carcinogens, and consequently have been designated as a toxic air contaminant by the California Air Resources Board. Exhaust emissions of $PM_{10}$ from construction and demolition equipment provide the estimate of diesel particulate matter emissions. Greenhouse gas emission estimates are provided for carbon dioxide, methane, and nitrous oxide. The overall global warming potential of greenhouse gas emissions also is calculated in terms of carbon dioxide equivalents.

The CNSTEMIS spreadsheet model uses a conventional approach to estimating emissions from construction equipment and activity. In a normal application, users:

- Divide the construction or demolition project into activity phases that have similar equipment requirements;
- Identify equipment types needed for each construction or demolition phase;
- Identify how many items of each type will be needed, the typical horsepower rating for the item, and the typical engine load factor;
- Identify the hours per day with active use for each equipment item;
- Identify the fraction of each use hour when the equipment will actually be operating;
- Identify the overall disturbed area size for each phase of construction or demolition activity;
- Identify the duration of each construction or demolition phase;
- Identify the typical area size that will be disturbed on a given day during each phase of construction or demolition activity;
- Identify typical fugitive dust emission rates for each phase of construction or demolition activity; and
- Identify which construction or demolition phases overlap with each other.

Version 11J of the CNSTEMIS model includes a database of 514 entries covering 114 basic equipment types. Entries for each equipment type are subdivided into engine size and fuel type categories that correlate with emission standards that have been adopted in recent years by the US Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). In addition to equipment powered by conventional diesel, gasoline, and compressed gas (propane/CNG/LNG/LPG) engines, the database includes information for electric arc welders, oxy-fuel welders, oxy-fuel cutting torches, plasma cutting torches, stationary diesel engines, large equipment powered by diesel-electric or turbine engines, and stationary gas turbine generators. Database entries also address multi-engine equipment designs for scrapers, concrete pavers, concrete finisher-vibrators, and off-road haul trucks. Metal fume emissions have been incorporated into the $PM_{10}$ emission rates for welders and cutting torches. Fugitive $PM_{10}$ emissions have been incorporated into the emission rates for rock drills, jackhammers, pavement breakers, pavement scarifiers, concrete/industrial saws, and abrasive blasting equipment. Default database entries are provided for the appropriate range of small, medium, and large engine sizes for each equipment type. The current database provides default data for 514 combinations of equipment type, engine size range, and fuel type. Default engine sizes are representative of current equipment models from several major manufacturers (Caterpillar, Komatsu, Terex, John Deer, Case, Bobcat, Gradall, GOMACO, LeeBoy, TSE, Vermeer, APE, Hercules, and others) as well as older equipment models that are still in use.

Greenhouse gas emission rates used in the CNSTEMIS model are based on Appendix C of the California Climate Action Registry (CCAR) 2007 general greenhouse gas emissions reporting protocol. Most of the greenhouse gas emission rates in the CCAR protocol document are based on equipment or vehicle fuel consumption rates. Equipment fuel consumption estimates used in the CNSTEMIS model are derived from horsepower-hour based fuel use data presented in documentation reports for the 2005 version of the EPA NONROAD model. The CNSTEMIS model computes the overall global warming potential of carbon dioxide, methane, and nitrous oxide emissions using carbon dioxide equivalence factors identified by the Intergovernmental Panel on Climate Change (IPCC). Users can select from the 1995, 2001, or 2007 IPCC equivalence factor data sets. The 2007 data set is the default selection.

The main calculation sheet of the CNSTEMIS model allows construction or demolition projects to be divided into four activity phases. Multiple CNSTEMIS workbooks can be used for projects involving more than four activity phases. Separate CNSTEMIS workbooks by calendar year are encouraged when construction or demolition activity will occur in more than one calendar year. The main calculation sheet provides for simple data entry by the user: lookup table codes for equipment types by engine size range and fuel type; number of items of each type by construction activity phase; and active hours per day for each equipment type by construction activity phase. Default equipment parameters (engine horsepower, average load factor, and typical use time within active hours) are automatically loaded into the calculation sheet. User can modify default equipment parameters under each activity phase. An optional calculation section is provided for computing cut and fill balances and associated bulldozer and scraper requirements if that information is not available from other sources.

CNSTEMIS users can select from three primary emission rate datasets: emission rates based on the original 1991 EPA non-road equipment database (useful only for estimates of emission rates in the absence of emission standards); emission rates adjusted for California and EPA emission standards and fuel sulfur limits (for projects in California); or emission rates adjusted for EPA emission standards and fuel sulfur limits (for projects in states other than California). When the user specifies the construction activity year, the equipment database sheet calculates appropriate average emission rates for the mix of older and newer equipment models of each equipment entry, recognizing the fleet replacement period for each equipment type and the implementation years for relevant California or EPA emission standards and fuel sulfur limits. Equipment entries are assigned fleet replacement times of 10, 15, 20, 25, or 30 years. Users can modify the fleet replacement times in the database if desired.

In addition to equipment engine emissions, CNSTEMIS calculates emissions from several other construction-related sources:

- fugitive dust emissions from general construction and demolition site disturbance;
- fugitive dust from mechanical or explosive building demolition;
- fugitive dust from construction blasting;
- volatile organic compound emissions from the curing of asphalt pavement;
- volatile organic compound emissions from paints and surface coatings; and
- $PM_{10}$ aerosol emissions from spray painting activities.

In addition to accounting for active dust control program effects, version 11J of the CNSTEMIS model allows emission calculations for fugitive dust from site disturbance to account for the seasonal frequency of precipitation events, frozen ground conditions, and snow cover. Fugitive dust emission estimates also can be adjusted to reflect the seasonal effects of persistently high soil moisture conditions from shallow perched water tables, seeps, or other natural factors. Natural dust control factors are applied to the residual fugitive dust generated after accounting for active dust control program effects.

The fugitive dust database sheet in the model provides a range of default fugitive dust generation rates for construction activity and building demolition, information on the $PM_{10}$ and $PM_{2.5}$ content of soils according to soil texture class, information on water application rates for fugitive dust control, a calculator to estimate the required number of water trucks, and a calculator to estimate fugitive $PM_{10}$ and $PM_{2.5}$ emissions from construction blasting. The fugitive volatile organic compound (VOC) database sheet includes a database of 49 categories of paints and coatings; a database of federal, state, and California air pollution control district limits for the VOC content of architectural coatings; and a calculator to generate project-specific fugitive VOC emission rates for up to four categories of coatings (e.g., exterior paints, interior paints, roof coatings, and floor coatings). The VOC emission rates account for the number and thickness of applied paint coats, which can include up to three coating types (for example, primers, main coats, and top coats) in each coating category. Internal calculations convert the coating thickness to a coating coverage value (square feet per gallon), which can be compared to a table of default coverage values for various types of coatings.

A building construction data worksheet allows users to calculate the square footage of exterior and interior wall areas, floor areas, ceiling areas, and roof areas for each building or group of buildings in a project. Building component square footage values account for building footprint area, building height, number of stories, and building shape (length to width ratio). Building component square footage data is useful for estimating the quantity of paint or architectural coatings required for individual buildings in a project. The building construction data worksheet also provides a convenient location to compute the acreage of project-related roadways, parking lots, or other features, or to develop a time schedule of project phases. The demolition debris sheet in CNSTEMIS allows users to estimate demolition debris volumes, tonnages, and debris haul truck loads when independent estimates are not available. Additional database sheets in the model provide information on typical material densities and typical heavy equipment work rates. A detailed unit conversion factor database sheet and a particle size unit conversion sheet also are included in the model.

The summary sheet in the CNSTEMIS model provides a comprehensive data summary for each phase of construction activity: disturbed acreages; total equipment item numbers; total equipment use hours; total equipment fuel use; off-site truck trips; construction worker commute trips; assumptions used for fugitive emissions calculations; and annual, quarterly, and daily summaries of criteria pollutant emissions, diesel particulate matter emissions, and greenhouse gas emissions. The summary sheet also provides a detailed tabulation of equipment items by activity phase, including the assumed horsepower, load factor, operating time factor, number of items, active hours per day, hourly fuel use rate, criteria pollutant emission rates, and greenhouse gas pollutant emission rates for each item type. A construction phase overlap calculator in the summary sheet identifies the extent of overlap among work phases by calendar quarter, allowing calculation of maximum day and maximum calendar quarter emissions. The construction phase overlap calculator allows the user to specify the number of work days by calendar quarter (with allowances for major holidays; the average default values are 64 days for a 5-day work week schedule, 77 days for a 6-day work week schedule, and 89 days for a 7-day work week schedule.

The $PM_{2.5}$ emission estimates provided by the CNSTEMIS model are extrapolated from the $PM_{10}$ emission estimates using separate $PM_{2.5}$ fractions for engine exhaust, fugitive dust, and spray painting, with the option of setting $PM_{2.5}$ fractions separately for each of these categories by construction phase. Default $PM_{2.5}$ fractions for engine exhaust and spray painting are based on the California Air Resources Board CEIDARS (California Emission Inventory Data and Reporting System) database. The default fugitive dust $PM_{2.5}$ fraction can be based on soil texture class using the fugitive dust database sheet in the model, or a more generic fraction from the CEIDARS database can be used. Users can substitute alternative $PM_{2.5}$ fractions for any of the default values.

A data entry notes sheet in the CNSTEMIS workbook provides users with detailed instructions and cell-by-cell discussions of data entry areas in the key worksheets of the model. Supplemental instructions and notes are provided in the individual worksheets throughout the workbook.

## COMPARISON OF CNSTEMIS AND THE URBEMIS CONSTRUCTION MODULE

The CNSTEMIS model had its origins as a simple Lotus 1-2-3 spreadsheet model developed in the mid 1980s using emission rate data from AP-42 (EPA 1985a, 1985b). Data from the EPA Nonroad Engine and Vehicle Emissions Study (EPA 1991) was incorporated into the spreadsheet in the early 1990s, and the model was subsequently converted to an Excel spreadsheet format. Early versions of the CNSTEMIS model were developed before construction and demolition emissions were included in the URBEMIS model, which was originally developed to estimate emissions from highway traffic associated with the operational phase of urban development projects. Modules addressing construction activities and various other emission sources are more recent additions to URBEMIS.

The CNSTEMIS model and the URBEMIS model are designed for different user audiences. The CNSTEMIS model has been developed to provide flexible calculation of project-specific emissions from any type of construction or demolition activity, with applicability to any US location, not just California. All features of the CNSTEMIS model can be modified by the user if necessary. In contrast, the URBEMIS model is designed for users with limited air quality analysis experience. Consequently, the construction module of URBEMIS model is designed to use simple default values, and is structured to evaluate common residential, commercial, office, and industrial development projects. While recent versions have improved flexibility for use by those with more extensive air quality analysis experience, the design of the URBEMIS model has never emphasized flexibility for detailed project-specific analyses of complex or unusual projects. The equipment database in URBEMIS is much smaller than that in CNSTEMIS, and is limited to diesel engine equipment. The construction equipment database in URBEMIS limits the potential for comprehensive analyses. In addition, several components of the construction module in URBEMIS use fixed coding that prevents user substitution of project-specific data. Similarities and differences between version 11J of the CNSTEMIS model and the construction activity module in URBEMIS2007 are noted in the table below.

**Summary Comparison of Construction Emissions Analyses in the CNSTEMIS Model and URBEMIS2007**

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| Source of uncontrolled equipment emission rates. | EPA 1991 nonroad engine and vehicle emissions study | CARB database |
| Incorporates emission and fuel sulfur standards for California locations. | Yes | Yes |
| Incorporates EPA emission and fuel sulfur standards for non-California locations. | Yes | No |
| Size of equipment database (equipment types and fuel type/engine size entries). | 114 equipment types, 514 total entries. Users select from the 514 individual entries. | 36 equipment types, 212 total entries (hidden from users). Users select only from the 36 |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| | | equipment types. |
| Engine/Fuel types in database. | Diesel, 2-Stroke Gasoline, 4-Stroke Gasoline, Compressed Gas, Diesel-Electric, Turbine-Electric, Gas Turbine | Diesel only |
| Database includes multi-engine equipment types. | Yes (scrapers, concrete pavers, concrete finisher-vibrators, off-road haul trucks) | No |
| Database includes specialized road construction equipment types. | Yes (cold planers, soil stabilizers, asphalt road reclaimers, roadbed trimmers, placer/spreaders, asphalt pavers, concrete pavers, concrete texture/curing machines, pavement scarifiers) | No. Only generic database entries for pavers, paving equipment, and surfacing equipment with no explanation of differences among these equipment categories. |
| Database includes agricultural and forestry equipment sometimes needed for land clearing. | Yes | No |
| Database includes hand-operated equipment. | Yes, numerous equipment types | Limited; only a few types |
| Program allows user expansion of equipment database. | Yes | No. Three generic "other equipment" entries provided in the database. Users can change equipment entry names, but cannot add new entries, change program defaults, or change emission rate data. |
| Program provides default equipment types and number of items by construction phase. | No. Users select expected equipment by phase from the database, with number of items for each type entered separately. | Yes. Default equipment types provided according to pre-defined construction phases. Default lists tend to be short, but vary somewhat by project size. Number of items based on overall project acreage. Users can modify default equipment lists. |
| Program provides default engine horsepower. | Yes. Defaults by relative size category for each equipment type. Users select equipment entries from multiple HP ranges, most tagged with general descriptions of size | Yes. Program default is statewide average engine size for equipment type. Users can override with alternative HP value, but program does not provide additional information |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| | categories (mini, small, medium, large, giant, etc.). | on equipment type HP ranges. |
| Program provides default load factor. | Yes, based mostly on EPA data | Yes, based on CARB OFFROAD model |
| Users can modify default horsepower value and load factor. | Yes | Yes |
| Program provides default equipment use hours per day. | No. Users specify active hours per day for each equipment entry in each construction phase. | Yes, with minor variations by construction phase and total project acreage. Users can modify default values. |
| Explicit consideration of percent operating time during active hours. | Yes, with user-modifiable defaults provided for each database entry. | No. Program calculates emissions assuming 100% operation time in each active hour. |
| Equipment fleet replacement cycle periods. | User-modifiable defaults of 10, 15, 20, 25, or 30 years assigned in the equipment database. | Based on the CARB OFFROAD model, but not further identified in URBEMIS2007 documentation. Other sources indicate the CARB OFFROAD model uses 2 to 32 years for different equipment types. No user modification option. |
| Equipment replacement rates can vary within an equipment type according to engine size. | Yes. User-modifiable default values identified in the equipment database. | CARB OFFROAD model data, but not further identified in URBEMIS2007 documentation. Other sources indicate the CARB OFFROAD model varies replacement period for small engine sizes in some equipment types. No user modification option. |
| Fugitive $PM_{10}$ emissions included for rock drills, jackhammers, pavement breakers, pavement scarifiers, concrete saws, and abrasive blasting equipment. | Yes | No. Database includes concrete saws but does not include rock drills, jackhammers, pavement breakers, pavement scarifiers, or abrasive blasting equipment. |
| Fugitive metal fume emissions included for cutting torches and welders. | Yes | No. Database includes electric welders but does not include cutting torches. |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| Fugitive NOx emissions included for plasma cutting torches. | Yes | No. Database does not include cutting torches. |
| Includes calculation of both $PM_{10}$ and $PM_{2.5}$ emissions. | Yes | Yes |
| Includes calculation of diesel particulate matter emissions. | Yes (equipment exhaust $PM_{10}$) | Yes (equipment exhaust $PM_{10}$) |
| Direct calculation of greenhouse gas emissions. | $CO_2$, $CH_4$, and $N_2O$, with 9 fuel type distinctions (California diesel, non-California diesel, biodiesel, gasoline, dual fuel, propane, CNG, LNG, and LPG). Choice of IPCC data sets for calculating $CO_2$ equivalents. | $CO_2$ only, diesel fuel only |
| Time frames for emissions summaries | Daily, Calendar Quarter, and Annual | Daily and Annual only |
| Calendar Year limits. | None | 2005 through 2040 only |
| Flexibility for defining work phases. | Complete flexibility, no pre-defined phases. Basic workbook accommodates 4 phases. Multiple workbooks can be used to accommodate more than 4 phases. Example building construction, building demolition, and road construction phases provided in user instructions. | Users must select from 7 pre-defined phase types (demolition, mass grading, fine grading, trenching, building construction, asphalt paving, and architectural coating). User can duplicate and rename pre-defined phase types to accommodate a larger number of phases as long as duplicated phases have different start or end dates. |
| Ease of defining work phases for highway, bridge, airport, pipeline, or other less common types of construction or demolition projects. | Complete flexibility to define phases according to project characteristics. Basic workbook accommodates 4 phases. Multiple workbooks can be used to accommodate more than 4 phases. | Somewhat cumbersome procedure. Requires users to select and re-name pre-defined construction phases, modify default equipment lists, and modify other phase-based default data such as truck activity. |
| Flexible treatment of work phase overlaps. | Yes. Users specify which if any phases overlap within each calendar quarter. | Yes. Users specify start and end dates for each phase. For phases with intermittent activity, users must duplicate the phase and enter start and end dates for each intermittent activity period. |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| Options for specifying work days per week. | Yes. Users specify available work days by calendar quarter, with defaults provided for 5-day, 6-day, and 7-day work weeks (with allowances for major holidays). Users are not limited to fixed work-week lengths. | Yes, with choice of 3-day, 4-day, 5-day, 6-day, or 7-day work weeks. |
| Fugitive dust emissions from site disturbance included in all construction phases. | Yes | No. Only included for mass grading and fine grading phases. |
| Fugitive dust emission rates can be varied by phase to reflect the phase-specific extent of site disturbance. | Yes. Typically set as a percent of EPA or CARB default TSP rates, with $PM_{10}$ and $PM_{2.5}$ fractions set separately (normally based on soil texture class). | No. Default values only, and only for mass grading and fine grading phases. Choice of 4 methods to calculate fugitive dust emission factors based on available construction details. |
| Database for identifying $PM_{10}$ and $PM_{2.5}$ fractions of fugitive dust based on soil texture class. | Yes | No |
| Fugitive dust control factors can be varied by phase. | Yes. Guidance provided. | Limited. Users can apply items on a default list of mitigation measures only for mass grading and fine grading phases |
| Optional adjustment of fugitive dust from soil disturbance based on natural conditions (seasonal frequency of precipitation, frozen ground, snow cover, or naturally high soil moisture levels). | Yes. All optional factors applied to calendar quarter and annual fugitive dust emissions. Daily fugitive dust emissions typically adjusted only for naturally high soil moisture levels. | No |
| Includes fugitive dust from mechanical building demolition. | Yes. Separate user-modifiable defaults for masonry/stone versus wood facade types. Optional separation of fugitive dust generation between building knockdown and debris removal phases. | Yes. Fixed default for all building types. |
| Includes fugitive dust from explosive building demolition. | Yes. User-modifiable default, with optional separation of fugitive dust generation between building implosion | No |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| | and debris removal phases. | |
| Includes option for specifying dust control during mechanical or explosive building demolition. | Yes. Suggested control factors by type of control. | No |
| Calculation of demolition debris quantities. | Optional worksheet for direct calculation of debris volume, debris tonnage, and truck loads based on building size and shape, extent of interior walls, extent of debris grinding, truck capacity, etc. Also default suggestions based on building type for quick analysis. | Default calculation of truck loads from building volume and truck capacity. No debris tonnage estimates. |
| Includes fugitive dust from construction blasting. | Yes. User-modifiable default. | No |
| Includes option for specifying dust control during construction blasting. | Yes. Suggested control factors by type of control. | No |
| Calculation of painted surface areas. | Optional worksheet for direct calculation from building size and shape, extent of interior walls, extent of non-painted exterior area, etc. Also default tables for quick analysis. | Default calculation based on square footage of nonresidential buildings and number of residential units. Fixed default building square footage values for residential land uses. No option for user input of actual residential building sizes. |
| Flexibility of architectural coating emission calculations. | Optional worksheet for up to 4 surface coating categories at a time, each category allowing multiple coats of up to 3 different coatings with user-specified wet coating thickness (with resulting coverage factor shown). | Default calculations only. A fixed paint coverage factor and 2 fixed coating categories (exterior and interior) for each land use type, with mitigation option of specifying % reduction from use of low VOC coatings. No option for user-specified coating types or VOC content. |
| Accuracy of architectural coating emission calculations. | Proper calculation converting regulatory VOC content into actual volumetric VOC content. Internal database of properties for 49 coating types. Users can substitute | Incorrect calculation methodology, treating regulatory VOC content as actual volumetric VOC content. No provision for user correction. Internal database |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| | product-specific data. Internal database of regulatory VOC limits for EPA, CARB, and California APCDs. | of regulatory VOC limits for California APCDs. |
| Includes $PM_{10}$ emissions from spray painting. | Yes. EPA default in fugitive ROG database. | No |
| Includes fugitive VOC emissions from the curing of asphalt pavement. | Yes. User-modifiable CARB default. | Yes. Fixed CARB default. |
| Direct calculation of emissions from on-site heavy truck activity. | Yes. 13 heavy truck types included in the equipment database. | Not in default setups. Users must add truck items to the default equipment list (using one of three truck types or "other equipment" database entries), and then modify as necessary the URBEMIS default use hours, HP ratings, and load factors. |
| Direct calculation of emissions from on-site light/medium duty vehicle activity (ATVs, pickups, vans, SUVs, etc.). | Utility ATVs (all terrain vehicles) included in database. No light/medium duty highway vehicles in database. Users should calculate light/medium duty highway vehicle emissions separately using URBEMIS2007 operational analysis or EMFAC2007 for projects in California and MOBILE6.2 for projects in other states. | No. No ATVs in database. Users should calculate light/medium duty highway vehicle emissions separately using URBEMIS2007 operational analysis procedures. |
| Direct calculation of emissions from construction worker commute vehicle traffic. | No. Users should calculate separately using URBEMIS2007 operational analysis or EMFAC2007 for projects in California and MOBILE6.2 for projects in other states. CNSTEMIS computes a direct estimate of worker commute trips by project phase. | Yes, for each construction phase. URBEMIS generates default trip data and vehicle type mix. Users can modify trip rate but not trip distance or vehicle mix. Fixed vehicle type mix (50% autos, 50% light trucks) seems to underestimate typical light and medium truck fractions for construction worker vehicles. |
| Direct calculation of emissions from off-site truck traffic. | No. Users should calculate separately using URBEMIS2007 operational analysis or EMFAC2007 for | Yes, for Demolition, Grading, Building Construction, and Asphalt Paving phases only. Users can specify truck |

| Component | CNSTEMIS-11J | URBEMIS2007 |
|---|---|---|
| | projects in California and MOBILE6.2 for projects in other states. CNSTEMIS computes a direct estimate of off-site truck trips by project phase. | capacity and round trip mileage for soil hauling in the grading phases only. For other phases, URBEMIS generates fixed values for trip data and truck mixes. |

The following tables list the equipment types included in the URBEMIS2007 and the CNSTEMIS-11J models.

### EQUIPMENT TYPES INCLUDED IN THE URBEMIS2007 MODEL

| | | |
|---|---|---|
| Rubber Tired Dozers | Rubber Tired Loaders | Crawler Tractors |
| Tractors/Loaders/Backhoes | Skid Steer Loaders | Trenchers |
| Excavators | Scrapers | Motor Graders |
| Rollers | Cranes | Dumper/Tenders |
| Bore-Drill Rigs | Off-Highway Trucks | Water Trucks |
| Off-Highway Tractors | Sweepers/Scrubbers | Forklifts |
| Rough Terrain Forklifts | Aerial Lifts | Cement and Mortar Mixers |
| Pavers | Paving Equipment | Surfacing Equipment |
| Plate Compactors | Crushing/Processing Equipment | Concrete/Industrial Saws |
| Generator Sets | Air Compressors | Pumps |
| Signal Boards | Welders | Pressure Washers |
| Other Construction Equipment | Other General Industrial Equipment | Other Material Handling Equipment |

### EQUIPMENT TYPES INCLUDED IN THE CNSTEMIS-11J MODEL

| | | |
|---|---|---|
| Wheeled Dozer | Tracked Dozer | Wheeled Tractor |
| Tracked Tractor | Wheeled Loader | Tracked Loader |
| Backhoe-Loader | Wheeled Skid-Steer Loader | Tracked Multi-Terrain Loader |
| Trencher | Continuous Excavator | Tracked Shovel Excavator |
| Wheeled Shovel Excavator | Mining Shovel | Cable Excavator/Stripping Shovel |
| Clamshell/Dragline Excavator | Scraper | Motor Grader |
| Standard Roller/Compactor | Vibratory Roller/Compactor | Mobile Crane |
| Stationary (Derrick) Crane | Side-Boom Tractor | Tracked Wrecking Ball |
| Tracked Material Handler | Wheeled Material Handler | Tracked Carrier/Dumper |

| | | |
|---|---|---|
| Wheeled Carrier/Dumper | Wheeled Pavement Breaker | Tracked Pavement Breaker |
| Excavator-Mounted Auger | Truck-Mounted Auger | Excavator-Mounted Pile Driver |
| Utility All Terrain Vehicles | Wheeled Cable Plow | Tracked Cable Plow |
| Directional Bore/Drill Rig | Dump Truck | Articulated Dump Truck |
| Off-Road Hauler | Equipment Transporter | Flatbed Truck |
| Cement Mixer Truck | Heavy Truck (mixed types) | Off-Highway Truck-Tractor Unit |
| Water Truck | Fuel Truck | Other Specialty Trucks |
| Street Sweeper | Standard Forklift | Rough Terrain Forklift |
| Extended Reach Forklift | Aerial Lift | Line Puller |
| Concrete Pump | Portable Cement/Mortar Mixer | Roofing Equipment |
| Roadbed Trimmer | Soil Stabilizer | Cold Planer/Pavement Profiler |
| Placer/Spreader | Asphalt Road Reclaimer | Asphalt Paver |
| Concrete Paver | Concrete Texture/Curing Machine | Concrete Finisher/Vibrator |
| Pavement Scarifier | Motorized Line Painter | Tampers & Rammers |
| Plate Compactor | Rock Drill Rig | Standard Pile Drivers |
| Jackhammer & Compressor | Concrete/Industrial Saws | Crushing/Grinding Equipment |
| Screening/Sorting Equipment | Generator Set < 600 hp | Air Compressors < 600 hp |
| Pumps < 600 hp | Light Set | Signal Board |
| Other Portable IC Engine Equipment | Stationary IC Engines < 600 hp | Stationary IC Engines 600+ hp |
| Gas Turbine Generator | Electric Arc Welder | Oxy-Fuel Welder |
| Plasma Cutting Torch | Oxy-Fuel Cutting Torch | Pressure Washer |
| Abrasive Blasting | Fans and Blowers | Post Hole Auger |
| Conveyor Equipment | Stackers | Stockpile Reclaimers |
| Chippers & Stump Grinders | Weed Trimmers and Cutters | Chain Saws |
| Agricultural Shredders | Agricultural Mowers | Rear Engine Riding Mowers |
| Tracked Brush Cutters | Wheeled Brush Cutters | Land Clearing Machine |
| Forestry Feller-Bunchers | Log Skidders | Forestry Forwarders |
| Knuckleboom Loaders | Timber Handler/Forestry Machine | Diesel-Electric Wheeled Loaders |
| Diesel-Electric Mining Shovels | Diesel-Electric Off-Road Haulers | Turbine-Electric Off-Road Haulers |

Comparisons of diesel equipment emission rates generated by the CNSTEMIS model and URBEMIS2007 show that the CNSTEMIS model typically generates somewhat higher emission rates (grams per horsepower-hour) than does the URBEMIS2007 model. The differences are most likely due to the differences in uncontrolled emission rates (EPA database in CNSTEMIS) and differences in equipment fleet replacement times (generally longer in CNSTEMIS).

Differences in overall construction activity emission estimates between CNSTEMIS and URBEMIS are more difficult to predict. The CNSTEMIS database includes many types of equipment not covered by the URBEMIS database. The CNSTEMIS database includes equipment using gasoline and compressed gas fuels while the URBEMIS database is limited to diesel-fueled equipment. The larger database allows CNSTEIMS analyses to account for more types of equipment than can be addressed by URBEMIS. In general, URBEMIS uses only a short list of default equipment types for each construction phase, and the default equipment lists do not include many items commonly seen at construction sites (tracked dozers, wheeled loaders, heavy trucks, trenchers, skid steer loaders, aerial lifts, air compressors, etc.). On the other hand, URBEMIS tends to assume relatively high default use hours for most equipment types, with no adjustment for the fact that most items do not operate continuously, even in active hours. The CNSTEMIS model explicitly addresses this issue through an operating time factor (percent operating time during active use hours). CNSTEMIS users select equipment items by engine size range, rather than relying on statewide average engine size defaults as in URBEMIS. In many cases, the URBEMIS statewide average horsepower rating is higher than the midpoint of the size range distribution for an equipment type. Overall, the CNSTEMIS model allows for a more comprehensive and refined analysis of construction emissions than can be provided by the URBEMIS model.

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# APPENDIX D-2

# ADDITIONAL CONSTRUCTION EMISSIONS ANALYSIS INFORMATION

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## CONSTRUCTION INFORMATION FOR THE PROPOSED PROJECT AND ALTERNATIVES

The proposed project includes three major facility components: the Solar Farm, the Gen-Tie Line, and the Red Bluff Substation. Appendix D-1 provides an overview of the CNSTEMIS spreadsheet model used for analysis of on-site construction emissions. Separate CNSTEMIS analyses have been prepared for each alternative of each component. For each facility component, individual CNSTEMIS spreadsheets have been prepared for each calendar year that would have construction activity. Multiple CNSTEMIS spreadsheets were created for a calendar year when there would be more than four construction activity phases during the year. Analyses of the seven alternative facility components required a total of 35 separate CNSTEMIS spreadsheets. The combinations of Solar Farm, Gen Tie Line, and Red Bluff Substation site for each of the three alternatives are listed below.

Alternative 1

- Solar Farm Layout B
- Gen-Tie Line Alignment A-1
- Red Bluff Substation Site A

Alternative 2

- Solar Farm Layout B
- Gen-Tie Line Alignment B-2
- Red Bluff Substation Site B

Alternative 3

- Solar Farm Layout C
- Gen-Tie Line Alignment A-2
- Red Bluff Substation Site A

Solar Farm development would occur over a 26-month period, with construction activity undertaken as a rolling sequence of activity on different subareas of the site. Construction would generally progress as incremental work areas from the south end to the north end of the project site. Tortoise exclusion fencing of the entire site would be the initial phase of activity, followed by threatened species removals and relocations. Temporary construction offices, sanitary facilities, and water supply facilities would be established prior to initiating subarea construction activities. Incremental construction of access roads and staging areas would generally lead the main construction activity sequence, followed by site clearing and grading, which would be followed by various facility construction activity stages. The overall construction process was analyzed in terms of the following 18 construction phases:

- Tortoise exclusion fencing;
- Access roads and staging areas;
- Temporary construction offices, water supply, and sanitary facilities;
- Security fencing and west side debris and drainage basins;

- Vegetation (site) clearing;
- Site grading;
- Installation of array support posts;
- Trenching and underground power cable installation;
- Soil compacting and dust palliative application;
- Installation of on-site power poles;
- Installation of on-site switchgear;
- Construction of the On-site Substation;
- Solar array assembly;
- Installation of on-site overhead power lines;
- Construction of permanent buildings;
- Functional testing;
- De-compaction of areas between solar arrays and dust palliative application; and
- Site cleanup.

Construction activity generally would occur over a standard five-day workweek with activity limited to daytime hours. For safety reasons, some electrical connection activity would typically occur at night when the solar panels are not energized, but this activity would not require any significant heavy equipment operations. For analysis purposes, it was assumed that construction activity would be initiated on about 11 acres per day (55.2 acres per week) for Solar Farm Layout B and on about 8 acres per day (39.8 acres per week) for Solar Farm Layout C.

Construction of the Gen-Tie Line would occur over an 8-month period beginning in January 2011, but the Gen-Tie Line would not be energized until late 2012 or later, depending on completion of the Red Bluff Substation. Final cleanup of the construction corridor would occur after the Gen-Tie Line is energized. The overall construction process was analyzed in terms of the following six construction phases:

- Site preparation;
- Tower foundations;
- Tower assembly and erection;
- Power line stringing;
- Testing; and
- Site cleanup.

Construction activity generally would occur over a standard five-day workweek with activity limited to daytime hours. Construction activity would progress in a linear fashion along the transmission corridor. In general, only a few acres would be actively disturbed at any one time during construction, with about five acres per day being disturbed during site preparation. The site preparation and tower foundation construction phases would overlap, but all other construction phases would occur sequentially. Normal dust control practices would be followed during construction.

The alternative Gen Tie Line routes would be of different lengths and would require somewhat different amounts of construction materials. Gen Tie Line A-1 would be about 12.2 miles long with 73 towers. Approximately 77 acres of the 233-acre transmission line corridor would be disturbed by construction activity. Gen Tie Line B-2 would be about 10 miles long, with 58 towers. Approximately 62 acres of the 189-acre transmission line corridor would be disturbed by construction. Gen Tie Line A-2 would be about 9.5 miles long with 55 towers. Approximately 62 acres of the 185-acre transmission line corridor would be disturbed by construction.

Construction of the Red Bluff Substation would occur over a 26-month period beginning in April 2011. Construction activity would include construction of the separate telecommunications site. Because the telecommunication site is so small, construction activity at that site has been included in the analysis of the main Substation site. The overall construction process was analyzed in terms of the following 11 construction phases:

- Access road construction
- Site fencing
- Site clearing
- Site grading and compaction
- Trenching and foundations
- Equipment pads
- Equipment installation
- Power line connections
- Testing
- Driveways, other paving, and security wall
- Site cleanup

At the time that emissions analyses were performed, the two Red Bluff Substation alternatives were each assumed to require 90 acres for the substation proper, 0.22 acres for the telecommunications site along Highway 177, plus additional land area for access roads, transmission line connections, drainage improvements (30 acres for Substation Site A and 20 acres for Substation Site b), and temporary construction staging areas. Current plans for the Red Bluff Substation have reduced the acreage requirement for the substation proper to 75 acres, reduced the area required for drainage improvements (20 acres for Substation Site A and 11 acres for Substation Site B), and have increased the area required for access roads and associated drainage improvements. The revisions to the Red Bluff Substation design were received too late to allow revisions of the CNSTEMIS analyses for the substation and associated facilities.

Emissions summaries from the CNSTEMIS analyses have been presented in Sections 4.2 and 4.5 of the EIS, and are not repeated here. The material that follows provides tabular summaries of additional information supporting the emission estimates presented in the EIS. This additional information is organized into groups of tables identifying:

- Construction schedules by activity phase;
- Equipment use by activity phase;
- Construction-related vehicle trips per day by activity phase; and
- Fugitive emissions parameters by activity phase.

## SOLAR FARM CONSTRUCTION, LAYOUT B (ALTERNATIVES 1 AND 2)

**Table D2-1.**
**Schedule For Solar Farm Layout B Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Exclusion Fencing | 98 | 61 | 37 | 0 | 0 |
| Roads and Staging Areas | 89 | 44 | 15 | 15 | 15 |
| Construction Offices | 43 | 0 | 43 | 0 | 0 |
| Security Fencing | 148 | 0 | 42 | 64 | 42 |
| Site Clearing | 161 | 0 | 42 | 64 | 55 |
| Site Grading | 161 | 0 | 37 | 64 | 60 |
| Array Support Posts | 141 | 0 | 21 | 64 | 56 |
| Trenching and Cables | 141 | 0 | 16 | 64 | 61 |
| Soil Compacting | 141 | 0 | 21 | 64 | 56 |
| On-Site Power Poles | 49 | 0 | 7 | 21 | 21 |
| Switchgear Facilities | 140 | 0 | 16 | 64 | 60 |
| On-Site Substation | 43 | 0 | 21 | 22 | 0 |
| Solar Array Assembly | 141 | 0 | 21 | 64 | 56 |
| On-Site Power Lines | 49 | 0 | 7 | 21 | 21 |
| **Net Construction Days** | **250** | **61** | **64** | **64** | **61** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 30 | 15 | 15 | 0 | 0 |
| Site Clearing | 181 | 61 | 64 | 56 | 0 |
| Site Grading | 181 | 56 | 64 | 61 | 0 |
| Array Support Posts | 201 | 51 | 64 | 64 | 22 |
| Trenching and Cables | 201 | 46 | 64 | 64 | 27 |
| Soil Compacting | 221 | 61 | 64 | 64 | 32 |
| On-Site Power Poles | 70 | 21 | 21 | 21 | 7 |
| Switchgear Facilities | 220 | 61 | 64 | 64 | 31 |
| Solar Array Assembly | 221 | 61 | 64 | 64 | 32 |
| On-Site Power Lines | 77 | 21 | 21 | 21 | 14 |
| Permanent Buildings | 54 | 54 | 0 | 0 | 0 |
| Functional Testing | 200 | 21 | 64 | 64 | 64 |
| **Net Construction Days** | **253** | **61** | **64** | **64** | **64** |
| **2013 Activity** | | | | | |
| Functional Testing | 21 | 21 | 0 | 0 | 0 |
| Soil De-Compacting | 21 | 21 | 0 | 0 | 0 |
| Site Cleanup | 21 | 21 | 0 | 0 | 0 |
| **Net Construction Days** | **34** | **34** | **0** | **0** | **0** |

| | | | | |
|---|---|---|---|---|
| **Available Work Days Per Quarter** | **61** | **64** | **64** | **64** |

**Table D2-2.**
**Equipment Use For Solar Farm Layout B Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Exclusion Fencing | 36.2 | 7 | 16 | 1,492 | 4,087 |
| Roads and Staging Areas | 42.6 | 23 | 41 | 5,663 | 32,632 |
| Construction Offices | 9.7 | 11 | 25 | 2,763 | 6,757 |
| Security Fencing | 83.7 | 9 | 20 | 2,888 | 8,310 |
| Site Clearing | 1,766.4 | 18 | 30 | 10,635 | 36,703 |
| Site Grading | 1,766.4 | 27 | 47 | 19,385 | 169,124 |
| Array Support Posts | 1,545.6 | 26 | 47 | 13,174 | 36,006 |
| Trenching and Cables | 772.8 | 11 | 20 | 5,663 | 24,240 |
| Soil Compacting | 1,545.6 | 13 | 22 | 6,360 | 71,771 |
| On-Site Power Poles | 7.2 | 8 | 15 | 569 | 1,883 |
| Switchgear Facilities | 6.7 | 11 | 19 | 2,401 | 9,289 |
| On-Site Substation | 14.4 | 29 | 70 | 2,049 | 7,690 |
| Solar Array Assembly | 1,545.6 | 78 | 133 | 41,521 | 63,538 |
| On-Site Power Lines | 7.2 | 13 | 20 | 2,313 | 9,073 |
| **2011 Totals** | **1,938.6** | **284** | **525** | **116,876** | **481,102** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 29.4 | 23 | 38 | 1,815 | 10,497 |
| Site Clearing | 1,987.2 | 18 | 30 | 11,868 | 40,451 |
| Site Grading | 1,987.2 | 27 | 47 | 21,792 | 190,109 |
| Array Support Posts | 2,208.0 | 27 | 48 | 19,041 | 54,991 |
| Trenching and Cables | 1,104.0 | 11 | 20 | 7,594 | 32,684 |
| Soil Compacting | 2,428.8 | 13 | 22 | 9,967 | 112,454 |
| On-Site Power Poles | 10.3 | 8 | 15 | 812 | 2,674 |
| Switchgear Facilities | 9.5 | 11 | 18 | 3,740 | 14,261 |
| Solar Array Assembly | 2,428.8 | 78 | 132 | 65,055 | 98,667 |
| On-Site Power Lines | 11.4 | 13 | 20 | 3,634 | 14,249 |
| Permanent Buildings | 2.9 | 15 | 34 | 1,032 | 3,082 |
| Functional Testing | 1.0 | 33 | 37 | 43,563 | 14,903 |
| **2012 Totals** | **2,470.6** | **277** | **461** | **189,914** | **589,023** |
| **2013 Activity** | | | | | |
| Functional Testing | 1.0 | 31 | 33 | 4,465 | 1,405 |
| Soil De-Compacting | 1,534.9 | 16 | 32 | 1,115 | 6,217 |
| Site Cleanup | 250.0 | 7 | 13 | 284 | 1,263 |

| 2013 Totals | 1,784.9 | 54 | 78 | 5,864 | 8,885 |
|---|---|---|---|---|---|

**Table D2-3.**
**Traffic Generation For Solar Farm Layout B Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Exclusion Fencing | 29 | 42 | 4 | 5 | 0.2 |
| Roads and Staging Areas | 31 | 44 | 4 | 6 | 0.6 |
| Construction Offices | 30 | 43 | 4 | 5 | 3.5 |
| Security Fencing | 30 | 43 | 4 | 5 | 5.4 |
| Site Clearing | 38 | 54 | 5 | 6 | 2.3 |
| Site Grading | 37 | 53 | 5 | 6 | 0.8 |
| Array Support Posts | 46 | 66 | 6 | 8 | 8.1 |
| Trenching and Cables | 21 | 30 | 3 | 4 | 1.2 |
| Soil Compacting | 21 | 30 | 3 | 3 | 0.4 |
| On-Site Power Poles | 18 | 26 | 2 | 3 | 0.4 |
| Switchgear Facilities | 24 | 34 | 3 | 4 | 2.8 |
| On-Site Substation | 46 | 66 | 6 | 8 | 9.9 |
| Solar Array Assembly | 175 | 251 | 21 | 30 | 48.2 |
| On-Site Power Lines | 23 | 33 | 3 | 4 | 0.3 |
| **2011 Totals** | **569** | **815** | **73** | **97** | **84** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 31 | 44 | 4 | 5 | 1.1 |
| Site Clearing | 38 | 54 | 4 | 6 | 0.2 |
| Site Grading | 37 | 53 | 4 | 5 | 0.8 |
| Array Support Posts | 47 | 67 | 4 | 5 | 8.0 |
| Trenching and Cables | 21 | 30 | 5 | 6 | 1.2 |
| Soil Compacting | 21 | 30 | 5 | 6 | 0.4 |
| On-Site Power Poles | 18 | 26 | 6 | 8 | 0.3 |
| Switchgear Facilities | 24 | 34 | 3 | 4 | 2.8 |
| Solar Array Assembly | 175 | 251 | 3 | 3 | 47.4 |
| On-Site Power Lines | 23 | 33 | 2 | 3 | 0.2 |
| Permanent Buildings | 30 | 43 | 3 | 4 | 2.8 |
| Functional Testing | 15 | 21 | 6 | 8 | 0.1 |
| **2012 Totals** | **480** | **686** | **21** | **30** | **65** |
| **2013 Activity** | | | | | |
| Functional Testing | 33 | 47 | 5 | 6 | 0.1 |

| | | | | | |
|---|---|---|---|---|---|
| Soil De-Compacting | 21 | 30 | 3 | 4 | 1.9 |
| Site Cleanup | 19 | 27 | 3 | 4 | 1.0 |
| **2013 Totals** | **73** | **104** | **11** | **14** | **3** |

**Table D2-4.**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction**

| **Parameter** | **Exclusion Fencing** | **Access Roads and Staging Areas** | **Construction Offices** | **Security Fencing** | **Site Clearing** |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 75% | 75% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 6.4% | 6.1% | 1.4% | 2.9% | 3.0% |
| Area Disturbed on a Typical Day, acres | 0.37 | 0.48 | 9.68 | 0.57 | 11.00 |
| Days of Disturbance | 98 | 89 | 43 | 148 | 161 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 80.0 | 80.0 | 40.0 | 80.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 | 1.4 | 2.8 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-4 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction**

| Parameter | Site Grading | Array Support Posts | Trenching and Cables | Soil Compacting | On-Site Power Poles |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 3.1% | 1.5% | 3.4% | 3.3% | 3.3% |
| Area Disturbed on a Typical Day, acres | 11.00 | 11.00 | 5.50 | 11.00 | 0.15 |
| Days of Disturbance | 161 | 141 | 141 | 141 | 49 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 60.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 2.8 | 2.1 | 1.4 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-4 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2011 Construction**

| Parameter | Switchgear Facilities | On-Site Substation | Solar Array Assembly | On-Site Power Lines |
|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% | 75% |

| | | | | |
|---|---|---|---|---|
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 1.5% | 2.2% | 3.3% | 3.3% |
| Area Disturbed on a Typical Day, acres | 0.05 | 14.40 | 11.00 | 0.15 |
| Days of Disturbance | 140 | 43 | 141 | 49 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-5.**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction**

| Parameter | Access Roads and Staging Areas | Site Clearing | Site Grading | Array Support Posts | Trenching and Cables |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 50% | 50% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 5.4% | 4.6% | 4.4% | 3.8% | 4.1% |
| Area Disturbed on a Typical Day, acres | 0.98 | 11.00 | 11.00 | 11.00 | 5.50 |
| Days of Disturbance | 30 | 181 | 181 | 201 | 201 |

| | | | | | |
|---|---|---|---|---|---|
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 80.0 | 80.0 | 60.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 2.8 | 2.8 | 2.1 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-5 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction**

| Parameter | Soil Compacting | On-Site Power Poles | Switchgear Facilities | Solar Array Assembly | On-Site Power Lines |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 4.5% | 4.6% | 3.9% | 4.5% | 4.6% |
| Area Disturbed on a Typical Day, acres | 11.00 | 0.15 | 0.04 | 11.00 | 0.15 |
| Days of Disturbance | 221 | 70 | 220 | 221 | 77 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-5 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2012 Construction**

| Parameter | Permanent Buildings | Functional Testing |
|---|---|---|
| Assumed Soil Texture Class | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 3.5% |
| Area Disturbed on a Typical Day, acres | 2.88 | 1.00 |
| Days of Disturbance | 54 | 200 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 |
| Painted Surface Area, square feet | 20,864 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% |

**Table D2-6.**
**Fugitive Emissions Parameters For Solar Farm Layout B, 2013 Construction**

| Parameter | Functional Testing | Soil De-Compacting | Site Cleanup |
|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 9.4% |
| Area Disturbed on a Typical Day, acres | 1.00 | 73.09 | 11.90 |
| Days of Disturbance | 21 | 21 | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 16.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.3 |
| Demolition PM10, total pounds | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% |

## SOLAR FARM CONSTRUCTION, LAYOUT C (ALTERNATIVE 3)

**Table D2-7.**
**Schedule for Solar Farm Layout C Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Exclusion Fencing | 86 | 61 | 25 | 0 | 0 |
| Roads and Staging Areas | 89 | 44 | 15 | 15 | 15 |
| Construction Offices | 43 | 0 | 43 | 0 | 0 |
| Security Fencing | 129 | 0 | 42 | 64 | 23 |
| Site Clearing | 160 | 0 | 42 | 64 | 54 |
| Site Grading | 160 | 0 | 37 | 64 | 59 |
| Array Support Posts | 140 | 0 | 21 | 64 | 55 |
| Trenching and Cables | 140 | 0 | 16 | 64 | 60 |
| Soil Compacting | 140 | 0 | 21 | 64 | 55 |
| On-Site Power Poles | 49 | 0 | 7 | 21 | 21 |
| Switchgear Facilities | 140 | 0 | 16 | 64 | 60 |
| On-Site Substation | 43 | 0 | 21 | 22 | 0 |
| Solar Array Assembly | 140 | 0 | 21 | 64 | 55 |
| On-Site Power Lines | 49 | 0 | 7 | 21 | 21 |
| **Net Construction Days** | **249** | **61** | **64** | **64** | **60** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 30 | 15 | 15 | 0 | 0 |
| Site Clearing | 180 | 61 | 64 | 55 | 0 |
| Site Grading | 173 | 56 | 64 | 53 | 0 |
| Array Support Posts | 192 | 51 | 64 | 64 | 13 |
| Trenching and Cables | 192 | 46 | 64 | 64 | 18 |
| Soil Compacting | 220 | 61 | 64 | 64 | 31 |
| On-Site Power Poles | 70 | 21 | 21 | 21 | 7 |
| Switchgear Facilities | 220 | 61 | 64 | 64 | 31 |
| Solar Array Assembly | 215 | 61 | 64 | 64 | 26 |
| On-Site Power Lines | 77 | 21 | 21 | 21 | 14 |
| Permanent Buildings | 54 | 54 | 0 | 0 | 0 |
| Functional Testing | 200 | 21 | 64 | 64 | 64 |
| **Net Construction Days** | **253** | **61** | **64** | **64** | **64** |
| **2013 Activity** | | | | | |
| Functional Testing | 21 | 21 | 0 | 0 | 0 |
| Soil De-Compacting | 21 | 21 | 0 | 0 | 0 |
| Site Cleanup | 21 | 21 | 0 | 0 | 0 |
| **Net Construction Days** | **34** | **34** | **0** | **0** | **0** |

| Available Work Days Per Quarter | 61 | 64 | 64 | 64 |
|---|---|---|---|---|

**Table D2-8.**
**Equipment Use for Solar Farm Layout C Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Exclusion Fencing | 17.3 | 7 | 16 | 1,103 | 3,217 |
| Roads and Staging Areas | 39.0 | 22 | 40 | 5,328 | 30,481 |
| Construction Offices | 9.7 | 11 | 25 | 2,763 | 6,757 |
| Security Fencing | 45.9 | 9 | 20 | 2,200 | 6,627 |
| Site Clearing | 1,273.6 | 15 | 25 | 7,775 | 27,123 |
| Site Grading | 1,273.6 | 21 | 38 | 14,889 | 127,558 |
| Array Support Posts | 1,114.4 | 22 | 40 | 10,722 | 30,745 |
| Trenching and Cables | 557.2 | 11 | 20 | 4,786 | 21,484 |
| Soil Compacting | 1,114.4 | 11 | 19 | 5,233 | 57,285 |
| On-Site Power Poles | 6.0 | 8 | 15 | 569 | 1,880 |
| Switchgear Facilities | 5.0 | 11 | 19 | 2,376 | 9,009 |
| On-Site Substation | 14.4 | 29 | 70 | 2,049 | 7,690 |
| Solar Array Assembly | 1,114.4 | 60 | 108 | 31,475 | 49,824 |
| On-Site Power Lines | 6.0 | 13 | 20 | 2,088 | 8,413 |
| **2011 Totals** | **1,385.5** | **250** | **475** | **93,354** | **388,093** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 19.5 | 22 | 36 | 1,590 | 9,229 |
| Site Clearing | 1,432.8 | 15 | 25 | 8,716 | 30,214 |
| Site Grading | 1,965.6 | 21 | 38 | 16,097 | 137,889 |
| Array Support Posts | 2,184.0 | 22 | 41 | 14,703 | 42,128 |
| Trenching and Cables | 1,092.0 | 11 | 20 | 6,431 | 28,264 |
| Soil Compacting | 1,751.2 | 11 | 19 | 8,224 | 89,993 |
| On-Site Power Poles | 8.6 | 8 | 15 | 812 | 2,673 |
| Switchgear Facilities | 7.1 | 11 | 19 | 3,729 | 14,074 |
| Solar Array Assembly | 1,711.6 | 60 | 107 | 48,306 | 75,725 |
| On-Site Power Lines | 9.5 | 13 | 20 | 3,280 | 13,211 |
| Permanent Buildings | 2.9 | 15 | 34 | 1,033 | 3,089 |
| Functional Testing | 1.0 | 26 | 30 | 33,763 | 11,950 |
| **2012 Totals** | **1,741.1** | **235** | **404** | **146,684** | **458,440** |
| **2013 Activity** | | | | | |
| Functional Testing | 1.0 | 24 | 26 | 3,436 | 1,098 |
| Soil De-Compacting | 1,192.4 | 13 | 25 | 844 | 5,555 |
| Site Cleanup | 200.0 | 7 | 13 | 283 | 1,328 |

| 2013 Totals | 1,392.4 | 44 | 64 | 4,563 | 7,981 |
|---|---|---|---|---|---|

**Table D2-9.**
**Traffic Generation From Solar Farm Layout C Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Exclusion Fencing | 29 | 42 | 4 | 5 | 0.2 |
| Roads and Staging Areas | 30 | 43 | 4 | 5 | 0.6 |
| Construction Offices | 30 | 43 | 4 | 5 | 3.5 |
| Security Fencing | 30 | 43 | 4 | 5 | 5.2 |
| Site Clearing | 35 | 50 | 4 | 6 | 2.2 |
| Site Grading | 31 | 44 | 4 | 5 | 0.6 |
| Array Support Posts | 42 | 60 | 5 | 7 | 6.1 |
| Trenching and Cables | 21 | 30 | 3 | 4 | 0.9 |
| Soil Compacting | 19 | 27 | 2 | 3 | 0.3 |
| On-Site Power Poles | 18 | 26 | 2 | 3 | 0.4 |
| Switchgear Facilities | 24 | 34 | 3 | 4 | 2.1 |
| On-Site Substation | 46 | 66 | 6 | 8 | 9.9 |
| Solar Array Assembly | 157 | 225 | 19 | 26 | 36.7 |
| On-Site Power Lines | 23 | 33 | 3 | 4 | 0.3 |
| **2011 Totals** | **535** | **766** | **67** | **90** | **69** |
| **2012 Activity** | | | | | |
| Roads and Staging Areas | 30 | 43 | 4 | 5 | 1.0 |
| Site Clearing | 35 | 50 | 4 | 6 | 2.2 |
| Site Grading | 31 | 44 | 4 | 5 | 0.6 |
| Array Support Posts | 42 | 60 | 4 | 5 | 6.1 |
| Trenching and Cables | 21 | 30 | 5 | 6 | 0.9 |
| Soil Compacting | 19 | 27 | 5 | 6 | 0.3 |
| On-Site Power Poles | 18 | 26 | 6 | 8 | 0.3 |
| Switchgear Facilities | 24 | 34 | 3 | 4 | 2.1 |
| Solar Array Assembly | 157 | 225 | 3 | 3 | 37.6 |
| On-Site Power Lines | 23 | 33 | 2 | 3 | 0.2 |
| Permanent Buildings | 30 | 43 | 3 | 4 | 2.9 |
| Functional Testing | 15 | 21 | 6 | 8 | 0.1 |
| **2012 Totals** | **445** | **636** | **21** | **30** | **54** |
| **2013 Activity** | | | | | |
| Functional Testing | 26 | 37 | 3 | 5 | 0.2 |

| | | | | | |
|---|---|---|---|---|---|
| Soil De-Compacting | 18 | 26 | 2 | 3 | 1.3 |
| Site Cleanup | 19 | 27 | 2 | 4 | 0.6 |
| **2013 Totals** | **63** | **90** | **7** | **12** | **2** |

**Table D2-10.**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction**

| Parameter | Exclusion Fencing | Access Roads and Staging Areas | Construction Offices | Security Fencing | Site Clearing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 75% | 75% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 7.1% | 6.1% | 1.4% | 2.7% | 3.0% |
| Area Disturbed on a Typical Day, acres | 0.20 | 0.44 | 9.68 | 0.36 | 7.96 |
| Days of Disturbance | 86 | 89 | 43 | 129 | 160 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 80.0 | 80.0 | 40.0 | 80.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 | 1.4 | 2.8 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-10 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction**

| Parameter | Site Grading | Array Support Posts | Trenching and Cables | Soil Compacting | On-Site Power Poles |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 3.1% | 1.6% | 3.4% | 3.3% | 3.3% |
| Area Disturbed on a Typical Day, acres | 7.96 | 7.96 | 3.98 | 7.96 | 0.12 |
| Days of Disturbance | 160 | 140 | 140 | 140 | 49 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 60.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 2.8 | 2.1 | 1.4 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-10 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2011 Construction**

| Parameter | Switchgear Facilities | On-Site Substation | Solar Array Assembly | On-Site Power Lines |
|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% | 75% |

| | | | | |
|---|---|---|---|---|
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 1.5% | 2.2% | 3.3% | 3.3% |
| Area Disturbed on a Typical Day, acres | 0.04 | 14.40 | 7.96 | 0.12 |
| Days of Disturbance | 140 | 43 | 140 | 49 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-11.**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction**

| Parameter | Access Roads and Staging Areas | Site Clearing | Site Grading | Array Support Posts | Trenching and Cables |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 50% | 50% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 5.4% | 4.6% | 4.5% | 4.0% | 4.1% |
| Area Disturbed on a Typical Day, acres | 0.65 | 7.96 | 7.96 | 7.96 | 3.98 |
| Days of Disturbance | 30 | 180 | 173 | 192 | 192 |

| | | | | | |
|---|---|---|---|---|---|
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 80.0 | 80.0 | 60.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 2.8 | 2.8 | 2.1 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-11 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction**

| Parameter | Soil Compacting | On-Site Power Poles | Switchgear Facilities | Solar Array Assembly | On-Site Power Lines |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 4.5% | 4.6% | 3.9% | 4.5% | 4.6% |
| Area Disturbed on a Typical Day, acres | 7.96 | 0.12 | 0.03 | 7.96 | 0.12 |
| Days of Disturbance | 220 | 70 | 220 | 215 | 77 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-11 (continued).**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2012 Construction**

| Parameter | Permanent Buildings | Functional Testing |
|---|---|---|
| Assumed Soil Texture Class | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 3.5% |
| Area Disturbed on a Typical Day, acres | 2.88 | 1.00 |
| Days of Disturbance | 54 | 200 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 0.7 |
| Demolition PM10, total pounds | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 |
| Painted Surface Area, square feet | 20,864 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% |

**Table D2-12.**
**Fugitive Emissions Parameters For Solar Farm Layout C, 2013 Construction**

| Parameter | Functional Testing | Soil De-Compacting | Site Cleanup |
|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 75% | 75% | 75% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 9.4% |
| Area Disturbed on a Typical Day, acres | 1.00 | 56.78 | 9.52 |
| Days of Disturbance | 21 | 21 | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 16.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 | 0.7 | 0.3 |
| Demolition PM10, total pounds | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% |

## GEN-TIE LINE CONSTRUCTION, ALIGNMENT A-1 (ALTERNATIVE 1)

**Table D2-13.**
**Schedule for Gen Tie Line A-1 Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Site Preparation | 15 | 15 | 0 | 0 | 0 |
| Tower Foundations | 45 | 45 | 0 | 0 | 0 |
| Tower Assembly and Erection | 65 | 15 | 50 | 0 | 0 |
| Power Line Stringing | 45 | 0 | 10 | 35 | 0 |
| Testing | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **176** | **60** | **60** | **56** | **0** |
| **2012 Activity** | | | | | |
| Site Cleanup | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **21** | **0** | **0** | **21** | **0** |
| **Available Work Days Per Quarter** | | **61** | **64** | **64** | **64** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-14.**
**Equipment Use for Gen Tie Line A-1 Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Site Preparation | 76.7 | 7 | 21 | 407 | 2,781 |
| Tower Foundations | 1.0 | 24 | 56 | 1,588 | 6,182 |
| Tower Assembly and Erection | 38.4 | 9 | 15 | 1,697 | 6,622 |
| Power Line Stringing | 38.4 | 18 | 30 | 1,798 | 11,416 |
| Testing | 18.0 | 2 | 2 | 109 | 913 |
| **2011 Totals** | **76.7** | **60** | **124** | **5,600** | **27,913** |
| **2012 Activity** | | | | | |
| Site Cleanup | 18.0 | 4 | 4 | 70 | 192 |
| **2012 Totals** | **18.0** | **4** | **4** | **70** | **192** |

**Table D2-15.**
**Traffic Generation From Gen Tie Line A-1 Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Site Preparation | 20 | 0 | 0 | 35 | 3.7 |
| Tower Foundations | 30 | 0 | 0 | 53 | 23.5 |
| Tower Assembly and Erection | 20 | 0 | 0 | 35 | 2.4 |
| Power Line Stringing | 30 | 0 | 0 | 53 | 1.8 |
| Testing | 5 | 0 | 0 | 8 | 0.0 |
| **2011 Maximum** | **50** | **0** | **0** | **88** | **27** |
| **2012 Activity** | | | | | |
| Site Cleanup | 9 | 0 | 0 | 14 | 0 |
| **2012 Maximum** | **9** | **0** | **0** | **14** | **0** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-16.**
**Fugitive Emissions Parameters For Gen Tie Line A-1, 2011 Construction**

| Parameter | Site Preparation | Tower Foundations | Tower Assembly and Erection | Power Line Stringing | Testing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% | 0% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 3.3% | 2.6% | 2.9% |
| Area Disturbed on a Typical Day, acres | 5.11 | 0.02 | 0.59 | 0.85 | 0.86 |
| Days of Disturbance | 15 | 45 | 65 | 45 | 21 |
| Uncontrolled TSP Rate, | 40.0 | 80.0 | 80.0 | 40.0 | 20.0 |

| | | | | | |
|---|---|---|---|---|---|
| lbs/acre-day | | | | | |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 2.8 | 2.8 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-17.**
**Fugitive Emissions Parameters For Gen Tie Line A-1, 2012 Construction**

| Parameter | Site Cleanup |
|---|---|
| Assumed Soil Texture Class | sand |
| Soil PM10 Fraction | 7.0% |
| Active Dust Control Program Effectiveness | 50% |
| Natural Dust Control, Daily Basis | 0% |
| Natural Dust Control, Annual Basis | 2.9% |
| Area Disturbed on a Typical Day, acres | 0.86 |
| Days of Disturbance | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 |
| Demolition PM10, total pounds | 0 |
| Construction Blasting PM10, total pounds | 0 |
| Acres of asphalt paving | 0.00 |
| Painted Surface Area, square feet | 0 |

| | |
|---|---|
| PM2.5 fraction of engine exhaust PM10 | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% |

## GEN-TIE LINE CONSTRUCTION, ALIGNMENT A-2 (ALTERNATIVE 3)

**Table D2-18.**
**Schedule for Gen Tie Line A-2 Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Site Preparation | 15 | 15 | 0 | 0 | 0 |
| Tower Foundations | 45 | 45 | 0 | 0 | 0 |
| Tower Assembly and Erection | 65 | 15 | 50 | 0 | 0 |
| Power Line Stringing | 45 | 0 | 10 | 35 | 0 |
| Testing | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **176** | **60** | **60** | **56** | **0** |
| **2012 Activity** | | | | | |
| Site Cleanup | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **21** | **0** | **0** | **21** | **0** |
| **Available Work Days Per Quarter** | | **61** | **64** | **64** | **64** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-19.**
**Equipment Use for Gen Tie Line A-2 Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Site Preparation | 62.3 | 7 | 21 | 407 | 2,781 |
| Tower Foundations | 1.0 | 24 | 56 | 1,566 | 5,976 |
| Tower Assembly and Erection | 31.2 | 9 | 15 | 1,693 | 6,581 |
| Power Line Stringing | 31.2 | 18 | 30 | 1,798 | 11,416 |
| Testing | 21.0 | 2 | 2 | 109 | 913 |
| **2011 Totals** | **62.3** | **60** | **124** | **5,573** | **27,668** |
| **2012 Activity** | | | | | |
| Site Cleanup | 21 | 4 | 4 | 70 | 192 |
| **2012 Totals** | **21** | **4** | **4** | **70** | **192** |

**Table D2-20.**
**Traffic Generation From Gen Tie Line A-2 Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Site Preparation | 20 | 0 | 0 | 35 | 3.7 |
| Tower Foundations | 30 | 0 | 0 | 53 | 20.2 |
| Tower Assembly and Erection | 20 | 0 | 0 | 35 | 1.9 |
| Power Line Stringing | 30 | 0 | 0 | 53 | 1.8 |
| Testing | 5 | 0 | 0 | 8 | 0.0 |
| **2011 Maximum** | **50** | **0** | **0** | **88** | **24** |
| **2012 Activity** | | | | | |
| Site Cleanup | 9 | 0 | 0 | 14 | 0 |
| **2012 Maximum** | **9** | **0** | **0** | **14** | **0** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-21.**
**Fugitive Emissions Parameters For Gen Tie Line A-2, 2011 Construction**

| Parameter | Site Preparation | Tower Foundations | Tower Assembly and Erection | Power Line Stringing | Testing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% | 0% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 3.3% | 2.6% | 2.9% |
| Area Disturbed on a Typical Day, acres | 4.15 | 0.02 | 0.48 | 0.69 | 1.00 |
| Days of Disturbance | 15 | 45 | 65 | 45 | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 80.0 | 80.0 | 40.0 | 20.0 |

| | | | | | |
|---|---|---|---|---|---|
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 2.8 | 2.8 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-22.**
**Fugitive Emissions Parameters For Gen Tie Line A-2, 2012 Construction**

| Parameter | Site Cleanup |
|---|---|
| Assumed Soil Texture Class | sand |
| Soil PM10 Fraction | 7.0% |
| Active Dust Control Program Effectiveness | 50% |
| Natural Dust Control, Daily Basis | 0% |
| Natural Dust Control, Annual Basis | 2.9% |
| Area Disturbed on a Typical Day, acres | 1.00 |
| Days of Disturbance | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 |
| Demolition PM10, total pounds | 0 |
| Construction Blasting PM10, total pounds | 0 |
| Acres of asphalt paving | 0.00 |
| Painted Surface Area, square feet | 0 |
| PM2.5 fraction of engine | 92.0% |

| | |
|---|---|
| exhaust PM10 | |
| PM2.5 fraction of fugitive dust PM10 | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% |

## GEN-TIE LINE CONSTRUCTION, ALIGNMENT B-2 (ALTERNATIVE 2)

**Table D2-23.**
**Schedule for Gen Tie Line B-2 Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Site Preparation | 15 | 15 | 0 | 0 | 0 |
| Tower Foundations | 45 | 45 | 0 | 0 | 0 |
| Tower Assembly and Erection | 65 | 15 | 50 | 0 | 0 |
| Power Line Stringing | 45 | 0 | 10 | 35 | 0 |
| Testing | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **176** | **60** | **60** | **56** | **0** |
| **2012 Activity** | | | | | |
| Site Cleanup | 21 | 0 | 0 | 21 | 0 |
| **Net Construction Days** | **21** | **0** | **0** | **21** | **0** |
| **Available Work Days Per Quarter** | | **61** | **64** | **64** | **64** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-24.**
**Equipment Use for Gen Tie Line B-2 Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Site Preparation | 62.1 | 7 | 21 | 407 | 2,781 |
| Tower Foundations | 1.0 | 24 | 56 | 1,568 | 5,993 |
| Tower Assembly and Erection | 31.1 | 9 | 15 | 1,694 | 6,589 |
| Power Line Stringing | 31.1 | 18 | 30 | 1,798 | 11,416 |
| Testing | 12.0 | 2 | 2 | 109 | 913 |
| **2011 Totals** | **62.1** | **60** | **124** | **5,576** | **27,691** |
| **2012 Activity** | | | | | |
| Site Cleanup | 12.0 | 4 | 4 | 70 | 192 |
| **2012 Totals** | **12.0** | **4** | **4** | **70** | **192** |

**Table D2-25.**
**Traffic Generation From Gen Tie Line B-2 Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Site Preparation | 20 | 0 | 0 | 35 | 3.7 |
| Tower Foundations | 30 | 0 | 0 | 53 | 21.1 |
| Tower Assembly and Erection | 20 | 0 | 0 | 35 | 2.0 |
| Power Line Stringing | 30 | 0 | 0 | 53 | 1.8 |
| Testing | 5 | 0 | 0 | 8 | 0.0 |
| **2011 Maximum** | **50** | **0** | **0** | **88** | **25** |
| **2012 Activity** | | | | | |
| Site Cleanup | 9 | 0 | 0 | 14 | 0 |
| **2012 Maximum** | **9** | **0** | **0** | **14** | **0** |

Site Preparation and Tower Foundations phases would overlap. Other phases would not overlap.

**Table D2-26.**
**Fugitive Emissions Parameters For Gen Tie Line B-2, 2011 Construction**

| Parameter | Site Preparation | Tower Foundations | Tower Assembly and Erection | Power Line Stringing | Testing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% | 0% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 3.3% | 2.6% | 2.9% |
| Area Disturbed on a Typical Day, acres | 4.14 | 0.02 | 0.48 | 0.69 | 0.57 |
| Days of Disturbance | 15 | 45 | 65 | 45 | 21 |

| | | | | | |
|---|---|---|---|---|---|
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 80.0 | 80.0 | 40.0 | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 2.8 | 2.8 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-27.**
**Fugitive Emissions Parameters For Gen Tie Line B-2, 2012 Construction**

| Parameter | Site Cleanup |
|---|---|
| Assumed Soil Texture Class | sand |
| Soil PM10 Fraction | 7.0% |
| Active Dust Control Program Effectiveness | 50% |
| Natural Dust Control, Daily Basis | 0% |
| Natural Dust Control, Annual Basis | 2.9% |
| Area Disturbed on a Typical Day, acres | 0.57 |
| Days of Disturbance | 21 |
| Uncontrolled TSP Rate, lbs/acre-day | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 0.7 |
| Demolition PM10, total pounds | 0 |
| Construction Blasting PM10, total pounds | 0 |
| Acres of asphalt paving | 0.00 |
| Painted Surface Area, square | 0 |

| | |
|---|---|
| feet | |
| PM2.5 fraction of engine exhaust PM10 | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% |

## RED BLUFF SUBSTATION CONSTRUCTION, SITE A (ALTERNATIVES 1 AND 3)

**Table D2-28.**
**Schedule for Red Bluff Substation A Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Access Road Improvements | 40 | 0 | 40 | 0 | 0 |
| Site Fencing | 25 | 0 | 20 | 5 | 0 |
| Site Clearing | 60 | 0 | 0 | 59 | 1 |
| Grading and Compacting | 60 | 0 | 0 | 0 | 60 |
| **Net Construction Days** | **185** | **0** | **60** | **64** | **61** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 20 | 20 | 0 | 0 | 0 |
| Equipment Pads | 30 | 30 | 0 | 0 | 0 |
| Equipment Installation | 90 | 10 | 64 | 16 | 0 |
| Power Line Connections | 60 | 0 | 0 | 45 | 15 |
| Testing | 45 | 0 | 0 | 0 | 45 |
| **Net Construction Days** | **245** | **60** | **64** | **61** | **60** |
| **2013 Activity** | | | | | |
| Testing | 45 | 45 | 0 | 0 | 0 |
| Driveways and Walls | 40 | 15 | 25 | 0 | 0 |
| Site Cleanup | 15 | 0 | 15 | 0 | 0 |
| **Net Construction Days** | **100** | **60** | **40** | **0** | **0** |
| **Available Work Days Per Quarter** | | **61** | **64** | **64** | **64** |

Construction phases would not overlap.

**Table D2-29.**
**Equipment Use for Red Bluff Substation A Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Access Road Improvements | 1.2 | 5 | 12 | 395 | 3,283 |
| Site Fencing | 3.5 | 6 | 14 | 298 | 848 |
| Site Clearing | 114.0 | 6 | 17 | 1,065 | 4,939 |
| Grading and Compacting | 114.0 | 9 | 17 | 1,642 | 11,678 |

| | | | | | |
|---|---|---|---|---|---|
| **2011 Totals** | **118.7** | **26** | **60** | **3,401** | **20,747** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 114.0 | 12 | 21 | 511 | 2,257 |
| Equipment Pads | 114.0 | 8 | 24 | 999 | 8,210 |
| Equipment Installation | 114.0 | 8 | 15 | 1,977 | 11,689 |
| Power Line Connections | 22.5 | 10 | 20 | 1,180 | 4,882 |
| Testing | 1.0 | 1 | 1 | 88 | 725 |
| **2012 Totals** | **114.0** | **39** | **81** | **4,755** | **27,763** |
| **2013 Activity** | | | | | |
| Testing | 1.0 | 1 | 1 | 88 | 717 |
| Driveways and Walls | 26.3 | 8 | 41 | 1,226 | 6,639 |
| Site Cleanup | 5.0 | 3 | 6 | 59 | 162 |
| **2013 Totals** | **32.3** | **12** | **48** | **1,372** | **7,518** |

**Table D2-30.**
**Traffic Generation From Red Bluff Substation A Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Access Road Improvements | 6 | 0 | 0 | 10 | 2.2 |
| Site Fencing | 10 | 0 | 0 | 16 | 0.6 |
| Site Clearing | 8 | 0 | 0 | 13 | 0.4 |
| Grading and Compacting | 11 | 0 | 0 | 18 | 0.3 |
| **2011 Maximum** | **11** | **0** | **0** | **18** | **2** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 13 | 0 | 0 | 20 | 3.1 |
| Equipment Pads | 12 | 0 | 0 | 19 | 116.6 |
| Equipment Installation | 12 | 0 | 0 | 19 | 21.3 |
| Power Line Connections | 14 | 0 | 0 | 22 | 0.5 |
| Testing | 2 | 0 | 0 | 4 | 0.0 |
| **2012 Maximum** | **14** | **0** | **0** | **22** | **117** |
| **2013 Activity** | | | | | |
| Testing | 2 | 0 | 0 | 4 | 0.0 |
| Driveways and Walls | 10 | 0 | 0 | 20 | 86.9 |
| Site Cleanup | 5 | 0 | 0 | 10 | 0.5 |

| 2013 Maximum | 10 | 0 | 0 | 20 | 87 |
|---|---|---|---|---|---|

Construction phases would not overlap.

**Table D2-31.**
**Fugitive Emissions Parameters For Red Bluff Substation A, 2011 Construction**

| Parameter | Access Road Improvements | Site Fencing | Site Clearing | Grading and Compacting |
|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 1.4% | 1.7% | 2.9% | 4.3% |
| Area Disturbed on a Typical Day, acres | 0.03 | 0.12 | 1.90 | 1.90 |
| Days of Disturbance | 40 | 25 | 60 | 60 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 40.0 | 80.0 | 80.0 |
| Controlled PM10 Rate, lbs/acre-day | 2.8 | 1.4 | 2.8 | 2.8 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-33.**
**Fugitive Emissions Parameters For Red Bluff Substation A, 2012 Construction**

| Parameter | Trenching and Foundations | Equipment Pads | Equipment Installation | Power Line Connections | Testing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% | 0% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9.4% | 9.4% | 2.6% | 3.3% | 4.3% |
| Area Disturbed on a Typical Day, acres | 5.70 | 11.40 | 11.40 | 22.50 | 1.00 |
| Days of Disturbance | 20 | 30 | 90 | 60 | 45 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-34.**
**Fugitive Emissions Parameters For Red Bluff Substation A, 2013 Construction**

| Parameter | Testing | Driveways and Walls | Site Cleanup |
|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 0% | 50% | 50% |
| Natural Dust Control, Daily | 0% | 0% | 0% |

| | | | |
|---|---|---|---|
| Basis | | | |
| Natural Dust Control, Annual Basis | 9.4% | 4.4% | 1.4% |
| Area Disturbed on a Typical Day, acres | 1.00 | 2.63 | 0.33 |
| Days of Disturbance | 45 | 40 | 15 |
| Uncontrolled TSP Rate, lbs/acre-day | 20.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 22.81 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% |

## RED BLUFF SUBSTATION CONSTRUCTION, SITE B (ALTERNATIVE 2)

**Table D2-34.**
**Schedule for Red Bluff Substation B Construction**

| Activity Phase | Activity Duration, days | Work Days By Calendar Quarter | | | |
|---|---|---|---|---|---|
| | | Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| **2011 Activity** | | | | | |
| Access Road Improvements | 15 | 0 | 15 | 0 | 0 |
| Site Fencing | 25 | 0 | 20 | 5 | 0 |
| Site Clearing | 60 | 0 | 0 | 59 | 1 |
| Grading and Compacting | 60 | 0 | 0 | 0 | 60 |
| **Net Construction Days** | **160** | **0** | **35** | **64** | **61** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 20 | 20 | 0 | 0 | 0 |
| Equipment Pads | 30 | 30 | 0 | 0 | 0 |
| Equipment Installation | 90 | 10 | 64 | 16 | 0 |
| Power Line Connections | 60 | 0 | 0 | 45 | 15 |
| Testing | 45 | 0 | 0 | 0 | 45 |
| **Net Construction Days** | **245** | **60** | **64** | **61** | **60** |
| **2013 Activity** | | | | | |
| Testing | 45 | 45 | 0 | 0 | 0 |
| Driveways and Walls | 40 | 15 | 25 | 0 | 0 |
| Site Cleanup | 15 | 0 | 15 | 0 | 0 |
| **Net Construction Days** | **100** | **60** | **40** | **0** | **0** |
| **Available Work Days Per Quarter** | | **61** | **64** | **64** | **64** |

Construction phases would not overlap.

**Table D2-35.**
**Equipment Use for Red Bluff Substation B Construction**

| Activity Phase | Acres Disturbed | On-Site Equipment Items | Total Items Including Off-Site Trucks | Equipment Use Hours At Site | On-Site Fuel Use, Gallons |
|---|---|---|---|---|---|
| **2011 Activity** | | | | | |
| Access Road Improvements | 1.2 | 5 | 12 | 147 | 1,219 |
| Site Fencing | 3.1 | 6 | 14 | 298 | 848 |
| Site Clearing | 114.0 | 6 | 17 | 1,065 | 4,939 |
| Grading and Compacting | 114.0 | 9 | 17 | 1,642 | 11,678 |

| | | | | | |
|---|---|---|---|---|---|
| **2011 Totals** | **118.3** | **26** | **60** | **3,152** | **18,683** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 114.0 | 12 | 21 | 511 | 2,257 |
| Equipment Pads | 114.0 | 8 | 24 | 999 | 8,210 |
| Equipment Installation | 114.0 | 8 | 15 | 1,977 | 11,689 |
| Power Line Connections | 22.5 | 10 | 20 | 1,180 | 4,882 |
| Testing | 1.0 | 1 | 1 | 88 | 725 |
| **2012 Totals** | **114.0** | **39** | **81** | **4,755** | **27,763** |
| **2013 Activity** | | | | | |
| Testing | 1.0 | 1 | 1 | 88 | 717 |
| Driveways and Walls | 12.8 | 8 | 35 | 939 | 4,054 |
| Site Cleanup | 5.0 | 3 | 6 | 59 | 162 |
| **2013 Totals** | **18.8** | **12** | **42** | **1,085** | **4,933** |

**Table D2-36.**
**Traffic Generation From Red Bluff Substation B Construction**

| Activity Phase | Total Workers | Daily Average 1-Way Vehicle Trips | | | |
|---|---|---|---|---|---|
| | | To/From Shuttle Assembly Points | Shuttle Trips To/From Site | Personal Vehicle Trips To/From Site | Construction Truck Trips To/From Site |
| **2011 Activity** | | | | | |
| Access Road Improvements | 6 | 0 | 0 | 10 | 1.2 |
| Site Fencing | 10 | 0 | 0 | 16 | 0.6 |
| Site Clearing | 8 | 0 | 0 | 13 | 0.4 |
| Grading and Compacting | 11 | 0 | 0 | 18 | 0.3 |
| **2011 Maximum** | **11** | **0** | **0** | **18** | **1** |
| **2012 Activity** | | | | | |
| Trenching and Foundations | 13 | 0 | 0 | 20 | 3.1 |
| Equipment Pads | 12 | 0 | 0 | 19 | 116.6 |
| Equipment Installation | 12 | 0 | 0 | 19 | 21.3 |
| Power Line Connections | 14 | 0 | 0 | 22 | 0.5 |
| Testing | 2 | 0 | 0 | 4 | 0.0 |
| **2012 Maximum** | **14** | **0** | **0** | **22** | **117** |
| **2013 Activity** | | | | | |
| Testing | 2 | 0 | 0 | 4 | 0.0 |
| Driveways and Walls | 10 | 0 | 0 | 20 | 37.6 |
| Site Cleanup | 5 | 0 | 0 | 10 | 0.5 |
| **2013 Maximum** | **10** | **0** | **0** | **20** | **38** |

Construction phases would not overlap.

**Table D2-37.**
**Fugitive Emissions Parameters For Red Bluff Substation B Construction**

| Parameter | Access Road Improvements | Site Fencing | Site Clearing | Grading and Compacting |
|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 1.4% | 1.7% | 2.9% | 4.3% |
| Area Disturbed on a Typical Day, acres | 0.08 | 0.12 | 1.90 | 1.90 |
| Days of Disturbance | 15 | 25 | 60 | 60 |
| Uncontrolled TSP Rate, lbs/acre-day | 80.0 | 40.0 | 80.0 | 80.0 |
| Controlled PM10 Rate, lbs/acre-day | 2.8 | 1.4 | 2.8 | 2.8 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-38.**
**Fugitive Emissions Parameters For Red Bluff Substation B, 2012 Construction**

| Parameter | Trenching and Foundations | Equipment Pads | Equipment Installation | Power Line Connections | Testing |
|---|---|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 50% | 50% | 50% | 50% | 0% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% | 0% | 0% |
| Natural Dust Control, Annual Basis | 9% | 9% | 3% | 3% | 4% |
| Area Disturbed on a Typical Day, acres | 5.70 | 11.40 | 11.40 | 22.50 | 1.00 |
| Days of Disturbance | 20 | 30 | 90 | 60 | 45 |
| Uncontrolled TSP Rate, lbs/acre-day | 40.0 | 40.0 | 40.0 | 40.0 | 20.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% | 91.2% | 91.2% |

**Table D2-39.**
**Fugitive Emissions Parameters For Red Bluff Substation B, 2013 Construction**

| Parameter | Testing | Driveways and Walls | Site Cleanup |
|---|---|---|---|
| Assumed Soil Texture Class | sand | sand | sand |
| Soil PM10 Fraction | 7.0% | 7.0% | 7.0% |
| Active Dust Control Program Effectiveness | 0% | 50% | 50% |
| Natural Dust Control, Daily Basis | 0% | 0% | 0% |

| | | | |
|---|---|---|---|
| Natural Dust Control, Annual Basis | 9.4% | 4.4% | 1.4% |
| Area Disturbed on a Typical Day, acres | 1.00 | 1.28 | 0.33 |
| Days of Disturbance | 45 | 40 | 15 |
| Uncontrolled TSP Rate, lbs/acre-day | 20.0 | 40.0 | 40.0 |
| Controlled PM10 Rate, lbs/acre-day | 1.4 | 1.4 | 1.4 |
| Demolition PM10, total pounds | 0 | 0 | 0 |
| Construction Blasting PM10, total pounds | 0 | 0 | 0 |
| Acres of asphalt paving | 0.00 | 9.67 | 0.00 |
| Painted Surface Area, square feet | 0 | 0 | 0 |
| PM2.5 fraction of engine exhaust PM10 | 92.0% | 92.0% | 92.0% |
| PM2.5 fraction of fugitive dust PM10 | 20.0% | 20.0% | 20.0% |
| PM2.5 fraction of spray paint PM10 | 91.2% | 91.2% | 91.2% |

# APPENDIX D-3

# URBEMIS VEHICLE EMISSIONS ANALYSIS INFORMATION

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## URBEMIS ANALYSES FOR ON-ROAD TRAFFIC EMISSIONS

Criteria pollutant and greenhouse gas emissions from construction-related traffic and from operational traffic were estimated using version 9.4 of the URBEMIS2007 model spreadsheet (Rimpo and Associates 2008) and supplemental spreadsheet analyses. URBEMIS2007 estimates carbon dioxide emissions from vehicle use, but does not estimate emission rates for methane or nitrous oxide.  A spreadsheet analysis was used to estimate overall greenhouse gas emissions from worker commute travel. Emission rates for methane and nitrous oxide were obtained from Appendix C of the California Climate Action Registry 2007 general greenhouse gas emissions reporting protocol.

To simplify the number of URBEMIS runs required for the analysis, a series of generic URBEMIS runs were made for each relevant calendar year for each vehicle mix category that would comprise construction-related or operations traffic for the various project components (Solar Farm, Gen-Tie Line, and Red Bluff Substation). These generic URBEMIS runs used a mix of trip numbers (200 per day) and mean travel distances (75 miles per trip) that were high enough to avoid having any emission results round to zero. Subsequent spreadsheet analyses were used to convert the generic results from the URBEMIS runs into project-specific emission estimates. Because most travel would occur on freeways, an average travel speed of 55 mph was used for all URBEMIS runs.

Five general vehicle mixes were used for the generic URBEMIS runs, as indicated in Table D3-1. URBEMIS runs were made for 2011, 2012, and 2013 for each vehicle mix group. Separate runs were made for winter and summer temperature conditions. Separate URBEMIS runs also were made with roadway re-suspended dust turned on and off. URBEMIS runs with re-suspended dust turned on provided overall $PM_{10}$ and $PM_{2.5}$ emission rates. URBEMIS runs with re-suspended dust turned off provided exhaust $PM_{10}$ emission rates, which were used as the estimate of diesel particulate matter emissions. A monthly mean temperature values at the Eagle Mountain meteorological station were used to determine the weighting factors for winter and summer emission rates. Temperatures below or over 75 degrees Fahrenheit used to determine the number of months classified as winter or summer, respectively. Data from the Eagle Mountain meteorological station showed six months each for winter and summer temperature conditions. The construction worker personal vehicle mix presented in Table D3-1 reflects the high fraction of pickup truck and SUV vehicles expected for a construction project work force. The construction worker personal vehicle mix was also used for operational worker traffic analyses. The MHD truck mix was used for operational truck traffic at the Solar Farm. The LHT2 vehicle mix was used for operational maintenance inspection traffic for the Gen Tie Line and the Red Bluff Substation.

**Table D3-1.**
**Vehicle Mix Groups Used for Generic URBEMIS Runs**

| Trip Type | Vehicle | Percent By | Temperature, Deg F | Average | Fuel Mix |
|---|---|---|---|---|---|

| | Type | Type | Winter | Summer | Speed, mph | |
|---|---|---|---|---|---|---|
| Construction Worker Personal Vehicles | LDA | 25.6% | 60 | 90 | 55 | Default |
| | LDT1 | 16.3% | 60 | 90 | 55 | Default |
| | LDT2 | 37.4% | 60 | 90 | 55 | Default |
| | MDT | 20.7% | 60 | 90 | 55 | Default |
| Shuttles | LHT2 | 100.0% | 60 | 90 | 55 | All Gasoline |
| Construction Trucks, most phases | HDD | 100.0% | 60 | 90 | 55 | Default |
| Construction Trucks, site clearing and site cleanup | MHD | 100.0% | 60 | 90 | 55 | All Diesel |
| Construction Trucks, selected Gen Tie Line phases | MHD | 96.7% | 60 | 90 | 55 | Default |
| | HHD | 3.3% | 60 | 90 | 55 | Default |

LDA = light duty autos
LDT1 = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating up to 3,750 pounds
LDT2 = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating of 3,751 – 5,750 pounds
MDT = pickup trucks, vans, and sport utility vehicles, gross vehicle weight rating of 5,751 – 8,500 pounds
LHT2 = medium trucks and multi-passenger vehicles, gross vehicle weight rating of 10,001 – 14,000 pounds
MDT = heavy trucks, gross vehicle weight rating of 14,001 – 33,000 pounds
HHD = heavy trucks, gross vehicle weight rating of 33,001 – 60,000 pounds

The generic URBEMIS runs were all made using trip number and trip distance data that produced 15,000 vmt (vehicle miles traveled) per day. The URBEMIS estimates of criteria pollutant emissions for this generic amount of vehicle travel are summarized in Table D3-2. The companion estimates of greenhouse gas pollutant emissions for this generic amount of vehicle travel are summarized in Table D3-3.

**Table D3-2.**
**URBEMIS Estimates of Criteria Pollutant Emissions For 15,000 VMT**

| Vehicle Group | Season | Pounds Per Day Produced By 15,000 VMT | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ROG | NOx | CO | SOx | $PM_{10}$ | $PM_{2.5}$ | DPM |
| **2011 Emission Rates** | | | | | | | | |
| Personal Vehicles | Winter | 6.31 | 12.58 | 91.08 | 0.13 | 25.71 | 4.86 | 1.21 |
| | Summer | 7.26 | 9.16 | 119.43 | 0.16 | 25.71 | 4.86 | 1.21 |
| | Average | 6.79 | 10.87 | 105.26 | 0.15 | 25.71 | 4.86 | 1.21 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Shuttles | Winter | 5.01 | 18.18 | 45.85 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Summer | 4.24 | 12.95 | 47.13 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Average | 4.63 | 15.57 | 46.49 | 0.17 | 25.43 | 4.51 | 0.93 |
| HHD Trucks | Winter | 21.84 | 425.85 | 91.39 | 0.53 | 43.10 | 20.00 | 18.60 |
| | Summer | 21.84 | 354.35 | 91.39 | 0.53 | 43.10 | 20.00 | 18.60 |
| | Average | 21.84 | 390.10 | 91.39 | 0.53 | 43.10 | 20.00 | 18.60 |
| MHD Trucks | Winter | 4.06 | 256.42 | 41.80 | 0.46 | 30.32 | 9.01 | 5.81 |
| | Summer | 4.06 | 213.37 | 41.80 | 0.46 | 30.32 | 9.01 | 5.81 |
| | Average | 4.06 | 234.90 | 41.80 | 0.46 | 30.32 | 9.01 | 5.81 |
| Mixed Trucks | Winter | 5.34 | 239.88 | 59.88 | 0.43 | 30.15 | 8.83 | 5.65 |
| | Summer | 5.28 | 198.28 | 60.51 | 0.43 | 30.15 | 8.83 | 5.65 |
| | Average | 5.31 | 219.08 | 60.20 | 0.43 | 30.15 | 8.83 | 5.65 |
| **2012 Emissions** | | | | | | | | |
| Personal Vehicles | Winter | 6.09 | 11.71 | 86.76 | 0.13 | 25.71 | 4.86 | 1.21 |
| | Summer | 6.99 | 8.53 | 113.53 | 0.16 | 25.71 | 4.86 | 1.21 |
| | Average | 6.54 | 10.12 | 100.15 | 0.15 | 25.71 | 4.86 | 1.21 |
| Shuttles | Winter | 4.67 | 17.41 | 40.89 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Summer | 3.90 | 12.02 | 41.96 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Average | 4.29 | 14.72 | 41.43 | 0.17 | 25.43 | 4.51 | 0.93 |
| HHD Trucks | Winter | 19.66 | 373.94 | 85.28 | 0.53 | 41.45 | 18.48 | 16.95 |
| | Summer | 19.66 | 311.17 | 85.28 | 0.53 | 41.45 | 18.48 | 16.95 |
| | Average | 19.66 | 342.56 | 85.28 | 0.53 | 41.45 | 18.48 | 16.95 |
| MHD Trucks | Winter | 3.90 | 231.24 | 40.67 | 0.46 | 30.05 | 8.67 | 5.55 |
| | Summer | 3.90 | 192.42 | 40.67 | 0.46 | 30.05 | 8.67 | 5.55 |
| | Average | 3.90 | 211.83 | 40.67 | 0.46 | 30.05 | 8.67 | 5.55 |
| Mixed Trucks | Winter | 5.01 | 215.87 | 56.29 | 0.43 | 29.88 | 8.58 | 5.38 |
| | Summer | 4.96 | 178.46 | 56.82 | 0.43 | 29.88 | 8.58 | 5.38 |
| | Average | 4.99 | 197.17 | 56.56 | 0.43 | 29.88 | 8.58 | 5.38 |
| **2013 Emissions** | | | | | | | | |
| Personal Vehicles | Winter | 5.89 | 10.89 | 82.65 | 0.13 | 25.73 | 4.88 | 1.22 |
| | Summer | 6.74 | 7.92 | 107.92 | 0.16 | 25.73 | 4.88 | 1.22 |
| | Average | 6.32 | 9.41 | 95.29 | 0.15 | 25.73 | 4.88 | 1.22 |
| Shuttles | Winter | 4.32 | 16.12 | 36.44 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Summer | 3.62 | 11.13 | 37.34 | 0.17 | 25.43 | 4.51 | 0.93 |
| | Average | 3.97 | 13.63 | 36.89 | 0.17 | 25.43 | 4.51 | 0.93 |
| HHD Trucks | Winter | 17.51 | 324.81 | 79.10 | 0.53 | 39.86 | 17.02 | 15.36 |
| | Summer | 17.51 | 270.30 | 79.10 | 0.53 | 39.86 | 17.02 | 15.36 |
| | Average | 17.51 | 297.56 | 79.10 | 0.53 | 39.86 | 17.02 | 15.36 |
| MHD Trucks | Winter | 3.73 | 208.88 | 39.75 | 0.46 | 29.82 | 8.55 | 5.32 |
| | Summer | 3.73 | 173.79 | 39.75 | 0.46 | 29.82 | 8.55 | 5.32 |
| | Average | 3.73 | 191.34 | 39.75 | 0.46 | 29.82 | 8.55 | 5.32 |
| Mixed Trucks | Winter | 4.70 | 194.44 | 53.17 | 0.43 | 29.63 | 8.35 | 5.13 |
| | Summer | 4.65 | 160.75 | 53.61 | 0.43 | 29.63 | 8.35 | 5.13 |
| | Average | 4.68 | 177.60 | 53.39 | 0.43 | 29.63 | 8.35 | 5.13 |

ROG = reactive organic compounds (ozone and particulate matter precursors)

NOx = nitrogen oxides (ozone and particulate matter precursors)
CO = carbon monoxide
SOx = sulfur oxides
$PM_{10}$ = inhalable particulate matter, particles generally smaller than 50 microns
$PM_{2.5}$ = fine particulate matter, particles generally smaller than 6 microns
DPM = diesel particulate matter (carcinogen)

**Table D3-3.**
**Estimates of Greenhouse Gas Emissions For 15,000 VMT**

| Vehicle Group | Season | Pounds Per Day Produced By 15,000 VMT | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
| **2011 Emissions** | | | | | |
| Personal Vehicles | Winter | 13,084.86 | 1.65 | 1.65 | 13,618.93 |
| | Summer | 16,514.08 | 1.65 | 1.65 | 17,048.15 |
| | Average | 14,799.47 | 1.65 | 1.65 | 15,333.54 |
| Shuttles | Winter | 16,875.21 | 1.98 | 1.65 | 17,417.55 |
| | Summer | 16,875.21 | 1.98 | 1.65 | 17,417.55 |
| | Average | 16,875.21 | 1.98 | 1.65 | 17,417.55 |
| HHD Trucks | Winter | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Summer | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Average | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| MHD Trucks | Winter | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Summer | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Average | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| Mixed Trucks | Winter | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Summer | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Average | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| **2012 Emissions** | | | | | |
| Personal Vehicles | Winter | 13,082.90 | 1.65 | 1.65 | 13,616.97 |
| | Summer | 16,518.44 | 1.65 | 1.65 | 17,052.51 |
| | Average | 14,800.67 | 1.65 | 1.65 | 15,334.74 |
| Shuttles | Winter | 16,875.00 | 1.98 | 1.65 | 17,417.34 |
| | Summer | 16,875.00 | 1.98 | 1.65 | 17,417.34 |
| | Average | 16,875.00 | 1.98 | 1.65 | 17,417.34 |
| HHD Trucks | Winter | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Summer | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Average | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| MHD Trucks | Winter | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Summer | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Average | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| Mixed Trucks | Winter | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Summer | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Average | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| **2013 Emissions** | | | | | |
| Personal | Winter | 13,081.22 | 1.65 | 1.65 | 13,615.29 |

| | | | | | |
|---|---|---|---|---|---|
| Vehicles | Summer | 16,524.23 | 1.65 | 1.65 | 17,058.30 |
| | Average | 14,802.73 | 1.65 | 1.65 | 15,336.79 |
| Shuttles | Winter | 16,874.81 | 1.98 | 1.65 | 17,417.15 |
| | Summer | 16,874.81 | 1.98 | 1.65 | 17,417.15 |
| | Average | 16,874.81 | 1.98 | 1.65 | 17,417.15 |
| HHD Trucks | Winter | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Summer | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| | Average | 54,923.52 | 1.98 | 1.65 | 55,465.86 |
| MHD Trucks | Winter | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Summer | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| | Average | 49,724.67 | 1.98 | 1.65 | 50,267.01 |
| Mixed Trucks | Winter | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Summer | 45,926.01 | 1.98 | 1.65 | 46,468.35 |
| | Average | 45,926.01 | 1.98 | 1.65 | 46,468.35 |

$CO_2$ = carbon dioxide, GWP multiplier = 1
$CH_4$ = methane, GWP multiplier = 25
$N_2O$ = nitrous oxide, GWP multiplier = 298
$CO_2e$ = carbon dioxide equivalents
GWP = global warming potential as $CO_2e$, based on multipliers from IPCC 2007

To assist in estimating travel distances within California for construction-related and operational vehicle trips, a map program was used to measure distances between the Solar Farm site and various communities. The results of that analysis are presented in Table D3-4. The analysis of emissions from construction-related truck trips was limited to truck travel in California. No attempt was made to estimate the residency pattern for construction workers, but the data in Table D3-4 were used to assist in making generalized travel distance estimates.

**Table D3-4.**
**Highway Distances Between the Solar Farm Site and Surrounding Communities**

| Community | 1-Way Miles | Miles in SCAQMD Jurisdiction | 1-Way Miles By Air Basin | | | % Miles By Air Basin | | |
|---|---|---|---|---|---|---|---|---|
| | | | South Coast | Salton Sea | Mojave Desert | South Coast | Salton Sea | Mojave Desert |
| Blythe | 55 | 27 | 55 | 0 | 0 | 100.0% | 0.0% | 0.0% |
| Twentynine Palms | 84 | 37 | 84 | 0 | 0 | 100.0% | 0.0% | 0.0% |
| Indio | 60 | 60 | 16 | 44 | 0 | 26.7% | 73.3% | 0.0% |
| Palm Springs | 81 | 81 | 16 | 65 | 0 | 19.8% | 80.2% | 0.0% |
| Salton City | 89 | 75 | 16 | 73 | 0 | 18.0% | 82.0% | 0.0% |
| Brawley | 123 | 75 | 16 | 107 | 0 | 13.0% | 87.0% | 0.0% |
| El Centro | 138 | 75 | 16 | 122 | 0 | 11.6% | 88.4% | 0.0% |
| Yucca Valley | 102 | 89 | 29 | 73 | 0 | 28.4% | 71.6% | 0.0% |
| Victorville | 169 | 89 | 96 | 73 | 0 | 56.8% | 43.2% | 0.0% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Banning | 101 | 101 | 16 | 72 | 13 | 15.8% | 71.3% | 12.9% |
| Morengo Valley | 121 | 121 | 16 | 72 | 33 | 13.2% | 59.5% | 27.3% |
| Riverside | 134 | 134 | 16 | 72 | 46 | 11.9% | 53.7% | 34.3% |
| Corona | 145 | 145 | 16 | 72 | 57 | 11.0% | 49.7% | 39.3% |
| San Bernardino | 133 | 133 | 16 | 72 | 45 | 12.0% | 54.1% | 33.8% |
| Fontana | 137 | 137 | 16 | 72 | 49 | 11.7% | 52.6% | 35.8% |
| Ontario Airport | 144 | 144 | 16 | 72 | 56 | 11.1% | 50.0% | 38.9% |
| Upland | 150 | 150 | 16 | 72 | 62 | 10.7% | 48.0% | 41.3% |

Criteria pollutant and greenhouse gas emission estimates associated with construction and operation of Project facilities have been presented in Sections 4.2 and 4.5 of the EIS, and are not repeated here. Section 4.2 of the EIS also summarizes daily and annual vehicle trips and VMT for construction and operational phases of each project component, so that data is not repeated here. The following sections provide additional information specific to the analyses of emissions from construction truck traffic, construction worker traffic, and operational traffic.

## CONSTRUCTION-RELATED HEAVY-DUTY TRUCK TRAFFIC ANALYSES

Construction-related vehicle trip numbers were estimated using the CNSTEMIS model analyses (see Appendix D-1 and Appendix D-2). Sunlight and SCE provided preliminary estimates of construction-related truck traffic. Sunlight also provided estimates on the point of origin for most construction material deliveries. CNSTEMIS analyses allocated the applicant-supplied truck load estimates to appropriate construction phases and made further adjustments to reflect other expected truck traffic (including equipment transporters). Additional adjustments were made as necessary when changes were made to the project description. In particular, the decision to use on-site power screeners resulted in deleting estimates of sand and gravel deliveries to the Solar Farm site. Sunlight provided generalized estimates of average and maximum construction worker numbers for construction of the Solar Farm and Gen Tie Line. The CNSTEMIS model was used to develop estimates of the number of construction workers by activity phase so as to approximate Sunlight's estimate of the maximum work force. SCE provided estimates of work force requirements for the Red Bluff Substation according to type of construction activity. The SCE workforce numbers were extrapolated to the construction phases used in the CNSTEMIS analyses.

## CONSTRUCTION WORKER COMMUTE TRAFFIC ANALYSES

Construction worker commute traffic for the Solar Farm was analyzed in terms of several components. Sunlight plans to provide a shuttle bus system transport most construction workers to and from the Solar Farm site, with shuttle assembly points in the Palm Springs and Blythe areas. Some workers, however, would commute to the Solar Farm site in personal vehicles, either by choice, because they miss the shuttle connection, or because their travel route makes it inconvenient to use the shuttle buses. The analysis assumed that 10.5 percent of workers would use personal vehicles, and that 40 percent of those workers would carpool with two workers per vehicle. The remaining 89.5 percent of workers were assumed to use the shuttle buses. To provide a conservative analysis, it was assumed that the 20-passenger shuttles would have an average occupancy of 15 workers per vehicle. Workers who use the shuttle bus system would still need to drive to and from the shuttle assembly points. It was assumed that 40 percent of those trips would be by 2-person carpools.

No shuttle system use was assumed in the analysis of construction worker commute traffic for the Gen Tie Line and the Red Bluff Substation. The analysis of the Gen Tie Line assumed that for most construction phases, 25 percent of the workers would carpool with two workers per vehicle. Construction of the Red Bluff Substation might be done by SCE crews or by contractor. SCE will require any contractors bidding on the project to provide a transportation plan for outlining procedures that would be used to reduce construction worker commute traffic. The analysis of construction worker commute traffic for the Red Bluff Substation assumed that for most construction phases, 50 percent of the workers would carpool with two workers per vehicle.

## OPERATIONAL TRAFFIC ANALYSES

The only component of the Project that would have on-site operational employees would be the Solar Farm. The Solar Farm would have only 10 to 15 workers on-site on any given day. Due to the low number of on-site employees, the analysis of operational worker commute emissions assumed no shuttle system or carpooling.

**References**

California Climate Action Registry. 2007. **General Reporting Protocol Version 2.2: Reporting Entity-Wide Greenhouse Gas Emissions.** Los Angeles, CA

Intergovernmental Panel on Climate Change. 2007. **Climate Change 2007: Technical Summary of the Working Group I Report.** Internet website www.ipcc.ch. Accessed on June 23, 2008.

Rimpo and Associates. 2008. **URBEMIS2007 Version 9.2.4.** Computer program downloaded from URBEMIS website http://www.urbemis.com. Accessed on February 18, 2008.

# APPENDIX D-4

# WIND EROSION EMISSIONS ANALYSIS INFORMATION

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# FUGITIVE DUST EMISSIONS FROM WIND EROSION

## Introduction

Wind can move soil particles by three general processes: surface creep (rolling along the ground surface), saltation (a bouncing movement along the ground surface caused by particle collisions that help force a particle into the air for a brief time before it falls back to the ground), and suspension transport (particles lofted into the air and remaining suspended for more than a minute). Surface creep and saltation typically account for most soil mass movement associated with wind erosion, and normally involve larger sand-size soil particles. Suspension transport normally involves smaller silt and clay size soil particles. From an air pollution standpoint, suspension transport of soil particles is the wind erosion process that generates fugitive dust.

The extent of fugitive dust generated by wind erosion is affected by numerous factors, including:

- Soil texture (the mix of clay, silt, and sand sized particles in a soil);
- Particle aggregation (mostly due to clay content);
- Soil moisture conditions;
- Organic matter content of soils;
- Non-erodible surface features (gravel, rocks, boulders, rock outcrops, etc.);
- Extent and density of vegetation cover;
- Surface crusting – mineral or biological crusts – especially between vegetation stems;
- Wind speed;
- Vertical air turbulence;
- Sedimentation of erodible material from upslope water erosion or from flood deposits; and
- Active disturbance of surface soils.

Soil moisture conditions and surface conditions are important factors determining the vulnerability of an area to wind erosion. In desert areas, soil moisture levels are high only during and after rainfall or flash flood events. Consequently, soil moisture levels in desert areas are high enough to influence wind erosion processes for only brief intermittent periods.

The surface features of greatest importance are non-erodible surface material, vegetation cover, mineralized soil crusts, and biological soil crusts. The most common types of non-erodible surface materials in deserts include scattered rocks and boulders, rock formation outcrops, and desert pavement. Desert pavements are areas with rock fragments of pebble to cobble size that cover an underlying layer of sand, silt, or clay. Desert pavement areas typically have little or no vegetation cover. The extent to which desert pavement reduces wind erosion and resulting fugitive dust depends on the density of the rock fragments covering the underlying soil.

Vegetation is commonly the primary feature affecting natural wind erosion conditions. Both live and dead vegetation can reduce wind erosion. Studies of the effect of vegetation on wind erosion show that:

- Canopy cover is a better predictor of wind erosion control than overall biomass.
- The effectiveness of vegetation cover in reducing wind erosion is strongly non-linear, with even low vegetation cover values providing meaningful reductions in wind erosion.
- Upright vegetation is more effective at reducing wind erosion than the same vegetation knocked flat against the ground.
- For a given biomass, vegetation with multiple thin stems is more effective at reducing wind erosion than vegetation with fewer thick stems.
- A vegetation structure with canopy cover distributed down to ground level is more effective than vegetation structure with the canopy limited to the tops of tall stems or trunks.

Vegetation plantings often provide a more effective windbreak than solid barriers of equivalent height. Solid barriers tend to generate air turbulence along the upwind side, over the top of the barrier, and at the ends of the barrier. This air turbulence increases localized wind erosion. Somewhat porous windbreaks, such as vegetation plantings, reduce wind speeds in the downwind area without off-setting increases in wind turbulence.

Surveys of the proposed solar farm site indicate that there are areas of desert pavement in both the northwest and southwest portions of the site. An estimated 20 to 30 percent of the overall site has moderate to strong desert pavement, with an additional 5 to 15 percent of the overall site having weakly developed desert pavement (Earth Systems Southwest 2010a). The remainder of the solar farm site is typical Mojave Desert vegetation on a sandy soil. Vegetation cover, mineral soil crusts, and biological soil crusts all help reduce fugitive dust from wind erosion from such areas. Existing vegetation at the solar farm site provides an estimated 15 percent canopy coverage, with little or no stable biological or mineral crusts in the open areas between desert shrubs (Hughes 2010).

Geotechnical studies conducted at the solar farm site indicate sandy soils throughout the site, with a typical silt plus clay content of 5 to 13 percent (Eberhart/United Consultants 2007; Earth Systems Southwest 2010b). The Natural Resources Conservation Service (NRCS) has conducted limited soil surveys on some private agricultural lands near Desert Center. Agricultural development of desert soils typically results in an increase in organic matter content, resulting in a more loamy texture to the soils than would occur without agricultural development. Agricultural lands near the solar farm site were generally characterized as gravelly loamy, coarse sand, or loamy sand with a high potential for wind erosion (Houdeshell 2010).

## Overview of the WNDEROSN Model

Fugitive dust emissions from wind erosion have been estimated using a spreadsheet model (WNDEROSN) that was developed from analyses used to model wind erosion and dust storm conditions at Mono Lake in the early 1990s. The spreadsheet model generates a sigmoidal curve equation based on a minimum of two data points: a zero value point at the threshold wind speed for initiating wind erosion, and a practical maximum emission rate normally set at a wind speed of 50 mph. The sigmoidal curve equation can be fitted to data points for additional wind speed values if portable wind tunnel study data are available. Most environmental assessments, however, lack project-specific portable wind tunnel data, and thus rely on a default curve generated from the assumed wind speed threshold for initiating wind erosion and a practical maximum wind erosion rate based on comparison to emission rates from other types of soil disturbance.

The spreadsheet model also includes default emission reduction equations that can be used to assess the effects of vegetation cover on wind erosion. The vegetation cover effectiveness equations also can be used in assessing wind erosion reduction from other types of ground cover (desert pavement, solar arrays, etc.) by converting coverage values for those conditions into "equivalent vegetation cover" factors.

The spreadsheet model provides default maximum emission rates based on other types of soil disturbance, all of which have emission rates that vary according to soil clay plus silt content. The following types of conditions are used for setting the maximum wind erosion rate:

- Fugitive dust form agricultural tilling;
- Fugitive dust from general construction activity;
- Fugitive dust from vehicle travel on unpaved dirt roads, with an adjustment for silt depletion on heavily used unpaved roads; and
- Fugitive dust from vehicle travel on unpaved dirt roads, assuming no silt content depletion compared to adjacent soils.

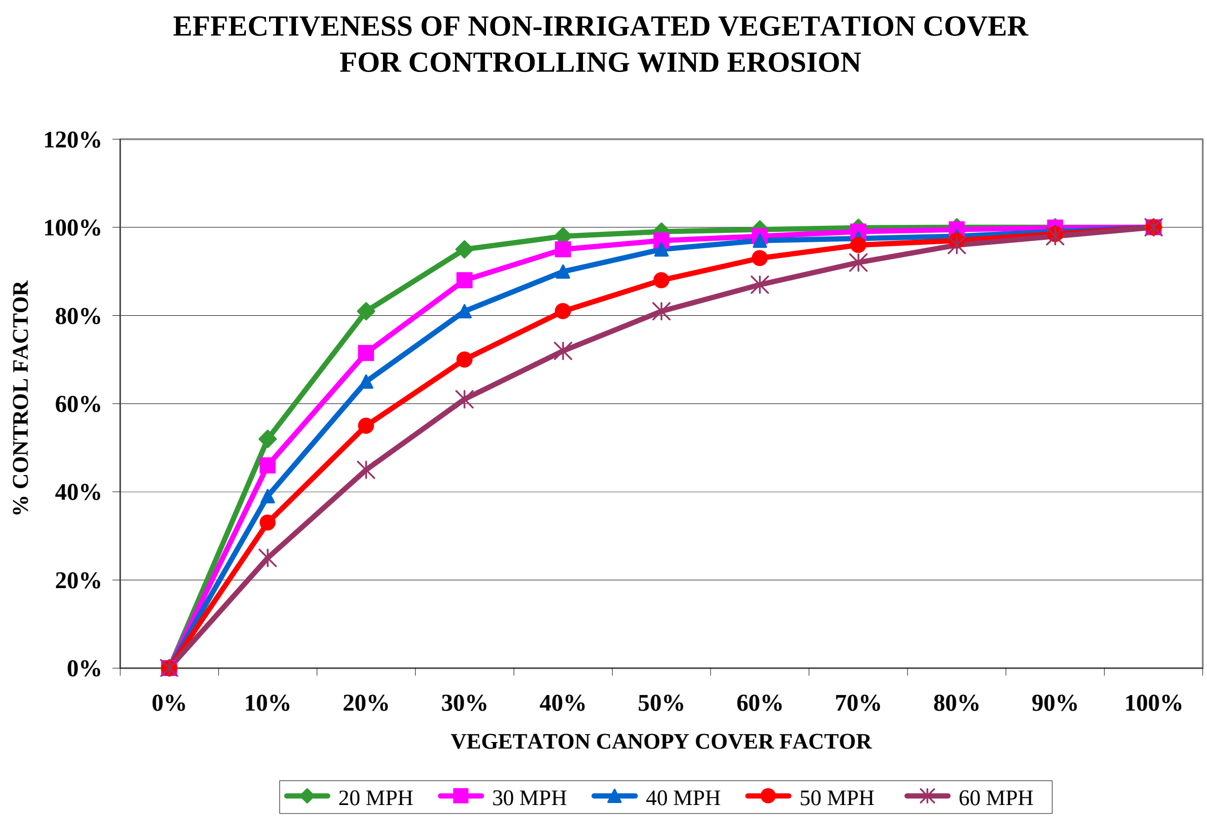
The spreadsheet model provides three general categories of default equations:

- Normal wind erosion conditions, using maximum wind erosion rates based on agricultural tilling or construction site fugitive dust, whichever is greater for the soil conditions of interest;
- Unusual wind erosion conditions (high silt content soils with little clay content, oxidized peat soils, diatomaceous earth sediments, etc.), using maximum wind erosion rates based on unpaved dirt roads with silt depletion compared to adjacent soils; and
- Extreme wind erosion conditions (unconsolidated volcanic ash deposits, etc.), using maximum wind erosion rates based on unpaved dirt roads with no silt depletion.

The normal wind erosion condition equations are applicable to the project area.

The basic equations generated by the WNDEROSN model apply to barren soil conditions. The model includes optional equations that can be used to estimate the wind erosion control effect of vegetation cover. The effectiveness of vegetation cover in reducing wind erosion varies with wind speed. Figure D4-1 illustrates the default vegetation cover effectiveness estimates used in the WNDEROSION model.

**Figure D4-1**




## Parameters Used for the Desert Sunlight Analysis

The wind erosion analysis for the Solar Farm site was prepared as a net change analysis comparing the developed Solar Farm site conditions to existing natural conditions. All analyses used the normal wind erosion condition equations and a 7 percent clay plus silt content. Annual emission estimates were developed by estimating the annual wind speed frequency distribution for the project area, and then applying the wind erosion equations to that wind speed frequency distribution to generate an annual barren ground wind erosion emission estimate. The barren ground wind erosion data were then adjusted for natural conditions (ground cover by vegetation, desert pavement, and soil biological crusts) to produce an annual baseline wind erosion estimate. For the Solar Farm layout alternatives, the barren ground wind erosion data were adjusted for ground cover by Solar Farm facilities (converting ground cover by solar arrays, building and equipment pads, gravel roads, etc. to equivalent vegetation cover values) to produce annual developed site wind erosion estimates. The difference between annual wind erosion estimates for the developed Solar Farm layouts and baseline conditions represents the net change in wind erosion conditions for the site.

No site-specific wind speed data was readily available, so data from other locations was used to develop estimates for the project area. Hourly wind speed data was not readily available for the Blythe airfield. The closest location with a reasonable period of readily available hourly wind data was the Barstow-Daggett airfield in San Bernardino County (WebMet 2010). Hourly wind speed data from Barstow-Daggett for January 1980 through December 1990 were used to establish a basic wind speed frequency profile. A comparison of summary wind statistics for the Barstow-Daggett and Blythe airfields showed that wind speeds at Blythe were noticeably lower than concurrent wind speeds at Barstow-Daggett. The mean wind speed at Barstow-Daggett was 11.4 mph for 1996 – 2006, while the mean wind speed at Blythe was 7.9 mph for the same period (Western Regional Climate Center 2007). Consequently, the Barstow-Daggett hourly wind data were adjusted by the ratio of mean wind speeds to approximate a wind speed profile for Blythe. The estimated wind speed profile for Blythe was assumed to be representative of wind speeds in the Project area. This analysis procedure produced a mean wind speed estimate at Blythe of 8.1 mph for the 1980 through 1990 data, with a maximum hourly average wind speed of 36 mph. Table D4-1 summarizes the wind speed distribution generated from the 1980 through 1990 data.

**Table D4-1.**

**Estimated Wind Speed Distribution for the Project Area**

| Wind Speed, mph | Incremental Percent of Hours | Cumulative Percent of Hours |
|---|---|---|
| 0 | 8.654% | 8.65% |
| 1 | 0.004% | 8.66% |
| 2 | 2.083% | 10.74% |
| 3 | 5.676% | 16.42% |
| 4 | 9.583% | 26.00% |
| 5 | 6.121% | 32.12% |
| 6 | 6.300% | 38.42% |
| 7 | 12.800% | 51.22% |
| 8 | 10.982% | 62.20% |
| 9 | 3.572% | 65.78% |
| 10 | 6.287% | 72.06% |
| 11 | 6.117% | 78.18% |
| 12 | 5.556% | 83.74% |
| 13 | 1.606% | 85.34% |
| 14 | 1.684% | 87.03% |
| 15 | 3.544% | 90.57% |
| 16 | 3.915% | 94.48% |
| 17 | 0.617% | 95.10% |

| Wind Speed, mph | Incremental Percent of Hours | Cumulative Percent of Hours |
|---|---|---|
| 18 | 1.152% | 96.25% |
| 19 | 0.669% | 96.92% |
| 20 | 0.595% | 97.52% |
| 21 | 1.361% | 98.88% |
| 22 | 0.203% | 99.08% |
| 23 | 0.377% | 99.46% |
| 24 | 0.070% | 99.53% |
| 25 | 0.301% | 99.83% |
| 26 | 0.053% | 99.88% |
| 27 | 0.033% | 99.91% |
| 28 | 0.016% | 99.93% |
| 29 | 0.047% | 99.98% |
| 30 | 0.004% | 99.98% |
| 31 | 0.007% | 99.99% |
| 32 | 0.001% | 99.99% |
| 33 | 0.007% | 100.00% |
| 34 | 0.000% | 100.00% |
| 35 | 0.000% | 100.00% |
| 36 | 0.001% | 100.00% |
| 37 | 0.000% | 100.00% |
| 38 | 0.000% | 100.00% |
| 39 | 0.000% | 100.00% |
| 40 | 0.000% | 100.00% |
| 41 | 0.000% | 100.00% |
| 42 | 0.000% | 100.00% |
| 43 | 0.000% | 100.00% |
| 44 | 0.000% | 100.00% |
| 45 | 0.000% | 100.00% |

The wind erosion equation generated for the project area was based on sandy soils with a silt plus clay fraction of 7 percent and an 18-mph threshold for the initiation of wind erosion. The sigmoidal equation generated by the WNDEROSN model for the Solar Farm site was:

$$Q = \frac{0.00048907*0.514206*[0.944748+e^{(-4.85366+0.170731707*U)} - e^{(-1*(-.85366+0.170731707*U))}]}{[0.944748+e^{(-4.85366+0.170731707*U)} + e^{(-1*(-.85366+0.170731707*U))}]}$$

where:

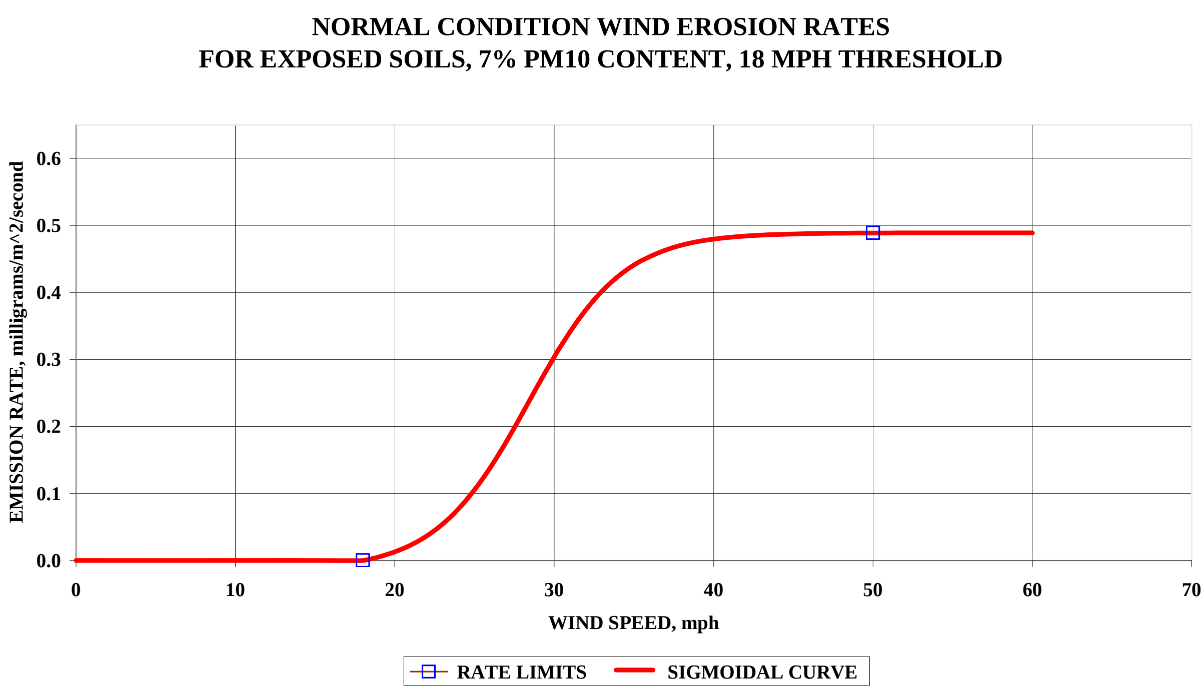
Q = wind erosion rate for $PM_{10}$ in grams per square meter per second

$e$ = the base for natural logarithms

U = hourly average wind speed in mph

Figure D4-2 illustrates the PM10 wind erosion rates estimated for the project area as a function of hourly average wind speed.

**Figure D4-2**




The wind erosion rates illustrated in Figure D4-2 represent barren soil conditions. Under existing conditions, these emission rates are reduced by the combination of vegetation cover, desert pavement cover, and soil biological crust cover. Desert pavement conditions vary in different portions of the site, with most desert pavement areas showing moderate to strong development. For simplicity in the wind erosion analysis, the overall desert pavement coverage was assumed to be equivalent to 35 percent area coverage with moderately strong desert pavement development. The Solar Farm site does not have extensive soil biological crusts. A nominal 5 percent of the Solar Farm site was assumed to have soil biological crusts. The remaining 60 percent of the Solar Farm site was assumed to have a vegetation cover of about 15 percent.

The vegetation cover effect equations in the WNDEROSN model were used to estimate wind erosion reductions attributable to desert pavement and soil crusts. This was accomplished by assigning a "vegetation cover equivalence factor" to these types of surface coverings. Soil biological crusts were assumed to be as effective in reducing wind erosion as vegetation with 35 percent vegetation canopy coverage. Desert pavement areas were assumed to be as effective in reducing wind erosion as vegetation with 50 percent canopy coverage. For existing conditions, the combination of vegetation, desert pavement, and soil biological crusts would be equivalent to vegetation with 28.3 percent canopy coverage across the entire Solar Farm site.

Development of the Solar Farm would remove existing vegetation, soil biological crusts, and desert pavement from the site, replacing these features with gravel road and parking areas; buildings and equipment pads; solar panel arrays; and open areas that have been compacted and treated with dust palliatives. Solar Farm operations would have limited site disturbance from periodic security, equipment inspection, and equipment maintenance activities. On-site traffic volumes would be quite low compared to the construction period. Areas covered by buildings and equipment pads would be completely protected from wind erosion. Areas covered by gravel surfaces or by solar arrays would be partially protected from wind erosion. Mitigation measures recommended in the EIS text include annual re-application of dust palliatives to gravel roads and open areas.

Evaluation of wind erosion rates for the Solar Farm alternatives required assigning a vegetation cover equivalence factor to each of the categories of physical features that would be present following construction. Buildings and equipment pads were assigned a vegetation cover equivalence factor of 100 percent. Gravel roads and parking areas were assigned a vegetation cover equivalence factor of 27 percent. Previous compaction and dust palliative applications for open areas of the site would reduce wind erosion from these areas. In addition, open areas between the solar panel arrays would receive wind shielding from the array structures, especially for the predominant wind directions. Given these considerations, open areas of the site were assigned a vegetation cover equivalence factor of 23 percent.

Approximately one third of the Solar Farm site would be directly covered by solar panel arrays. The solar panel arrays would have a windbreak effect that varies according to wind direction. The panel arrays would be aligned in an east-west direction, with the panels would be sloped to the south. The vegetation cover equivalence factor assigned to the areas directly covered by the solar panels was varied according to wind direction. For winds from the south, the vegetation cover equivalence factor was set equal to the area coverage factor for the solar panels (33 percent for Solar Farm Layout B and 34.1 percent for Solar Farm Layout C). For north winds, the vegetation cover equivalence factor was set at 5 percentage points less than the physical area coverage for the solar panels, since the slope of the panels would generate some downward wind turbulence when winds blow from the north. The linear solar array layout would result in only limited wind erosion reduction for winds from the east or west. The vegetation cover equivalence factor for east and west winds was set at 8 percent. Overall wind direction frequencies were assumed to be 35 percent for north winds, 5 percent for east winds, 45 percent for south winds, and 15 percent for west winds. Table D4-2 summarizes the vegetation cover equivalence factors and resulting wind erosion reduction factors used for the analysis.

**Table D4-2.**

**Summary of Wind Erosion Control Factors for Solar Farm Features**

| Parameter | Wind Speed, mph | Vegetation Cover Equivalence Factor | Percent Reduction in Wind Erosion Rates | | |
|---|---|---|---|---|---|
| | | | Existing Conditions | Solar Farm Layout B | Solar Farm Layout C |
| Vegetation Cover | 20 | 15.0% | 69.8% | 0.0% | 0.0% |
| | 30 | 15.0% | 58.2% | 0.0% | 0.0% |
| | 40 | 15.0% | 54.9% | 0.0% | 0.0% |
| | 50 | 15.0% | 44.8% | 0.0% | 0.0% |
| | 60 | 15.0% | 35.8% | 0.0% | 0.0% |
| Soil Biological Crusts | 20 | 35.0% | 96.5% | 0.0% | 0.0% |
| | 30 | 35.0% | 92.1% | 0.0% | 0.0% |
| | 40 | 35.0% | 84.5% | 0.0% | 0.0% |
| | 50 | 35.0% | 76.1% | 0.0% | 0.0% |
| | 60 | 35.0% | 66.7% | 0.0% | 0.0% |
| Desert Pavement | 20 | 50.0% | 99.1% | 0.0% | 0.0% |
| | 30 | 50.0% | 97.0% | 0.0% | 0.0% |
| | 40 | 50.0% | 93.8% | 0.0% | 0.0% |
| | 50 | 50.0% | 88.2% | 0.0% | 0.0% |
| | 60 | 50.0% | 81.0% | 0.0% | 0.0% |
| Gravel Surfaced Areas with dust palliative treatments | 20 | 27.0% | 0.0% | 92.2% | 92.2% |
| | 30 | 27.0% | 0.0% | 85.4% | 85.4% |
| | 40 | 27.0% | 0.0% | 75.9% | 75.9% |
| | 50 | 27.0% | 0.0% | 66.2% | 66.2% |
| | 60 | 27.0% | 0.0% | 56.2% | 56.2% |

| Parameter | Wind Speed, mph | Vegetation Cover Equivalence Factor | Percent Reduction in Wind Erosion Rates | | |
|---|---|---|---|---|---|
| | | | Existing Conditions | Solar Farm Layout B | Solar Farm Layout C |
| Open Areas with dust palliative treatments | 20 | 23.0% | 0.0% | 88.0% | 88.0% |
| | 30 | 23.0% | 0.0% | 79.6% | 79.6% |
| | 40 | 23.0% | 0.0% | 70.3% | 70.3% |
| | 50 | 23.0% | 0.0% | 60.0% | 60.0% |
| | 60 | 23.0% | 0.0% | 50.1% | 50.1% |
| Solar Arrays, North Wind Conditions | 20 | 28.0% - 29.1% | 0.0% | 93.0% | 93.7% |
| | 30 | 28.0% - 29.1% | 0.0% | 86.6% | 87.7% |
| | 40 | 28.0% - 29.1% | 0.0% | 77.2% | 78.5% |
| | 50 | 28.0% - 29.1% | 0.0% | 67.6% | 69.1% |
| | 60 | 28.0% - 29.1% | 0.0% | 57.7% | 59.2% |
| Solar Arrays, East Wind Conditions | 20 | 8% | 0.0% | 44.0% | 44.0% |
| | 30 | 8% | 0.0% | 39.5% | 39.5% |
| | 40 | 8% | 0.0% | 35.0% | 35.0% |
| | 50 | 8% | 0.0% | 27.4% | 27.4% |
| | 60 | 8% | 0.0% | 20.7% | 20.7% |
| Solar Arrays, South Wind Conditions | 20 | 33.0% - 34.1% | 0.0% | 95.8% | 96.2% |
| | 30 | 33.0% - 34.1% | 0.0% | 90.9% | 91.6% |
| | 40 | 33.0% - 34.1% | 0.0% | 82.6% | 83.7% |
| | 50 | 33.0% - 34.1% | 0.0% | 73.9% | 75.2% |
| | 60 | 33.0% - 34.1% | 0.0% | 64.3% | 65.6% |

| Parameter | Wind Speed, mph | Vegetation Cover Equivalence Factor | Percent Reduction in Wind Erosion Rates | | |
|---|---|---|---|---|---|
| | | | Existing Conditions | Solar Farm Layout B | Solar Farm Layout C |
| Solar Arrays, West Wind Conditions | 20 | 8% | 0.0% | 44.0% | 44.0% |
| | 30 | 8% | 0.0% | 39.5% | 39.5% |
| | 40 | 8% | 0.0% | 35.0% | 35.0% |
| | 50 | 8% | 0.0% | 27.4% | 27.4% |
| | 60 | 8% | 0.0% | 20.7% | 20.7% |
| **Overall Site Conditions** | **20** | **24.4% - 28.3%** | **93.2%** | **89.7%** | **90.0%** |
| | **30** | **24.4% - 28.3%** | **86.9%** | **81.9%** | **82.4%** |
| | **40** | **24.4% - 28.3%** | **77.6%** | **72.4%** | **72.8%** |
| | **50** | **24.4% - 28.3%** | **68.0%** | **62.3%** | **62.8%** |
| | **60** | **24.4% - 28.3%** | **58.1%** | **52.3%** | **52.8%** |

Under existing conditions for the assumed wind speed distribution, natural vegetation and ground cover conditions provide a 90.5 percent reduction from barren ground wind erosion rates. Under developed Solar Farm conditions with the assumed wind speed distribution, the developed Solar Farm site would provide an 86.4 percent reduction from barren ground wind erosion rates under Solar Farm Layout B, and an 86.8 percent reduction from barren ground wind erosion rates under Solar Farm Layout C. Table D4-3 summarizes the net changes in wind erosion rates estimated by the WNDEROSN model.

**Table D4-3.**

**Estimated Net Changes in Wind Erosion Rates for the Solar Farm Site**

| Parameter | Units | Solar Farm Site B | Solar Farm Site C |
|---|---|---|---|
| Site Acres | Acres | 4,245 | 3,045 |
| Barren Ground Wind Erosion Rate for $PM_{10}$ | Tons Per Year | 818.0 | 586.8 |
| Natural Condition Wind Erosion Rate for $PM_{10}$ | Tons Per Year | 78.0 | 55.9 |
| Developed Solar Farm Condition Wind Erosion Rate for $PM_{10}$ | Tons Per Year | 111.7 | 77.2 |
| **Net Change, Solar Farm versus Natural Conditions** | **Tons Per Year** | **33.7** | **21.2** |
| **Net Change, Solar Farm versus Natural Conditions** | **Pounds Per Acre Per Year** | **15.863** | **13.943** |

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# APPENDIX D-5

# GREENHOUSE GAS EMISSIONS AVOIDED THROUGH DISPLACEMENT OF ALTERNATIVE POWER GENERATION SOURCES

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## INTRODUCTION

The proposed Solar Farm would have a power generation capacity of 550 MW under Solar Farm Layout B, and 413 MW under Solar Farm Layout C. These power generation capacities translate into an estimated 1.2 billion kilowatt-hours of electrical power generation per year for Solar Farm Layout B and 901 million kilowatt-hours or electrical power generation per year for Solar Farm C. Southern California Edison (SCE) and Pacific Gas and Electric (PG&E) have signed power purchase agreements with Desert Sunlight. Based on their respective power purchase agreements, SCE would receive 45.45 percent of the power generated by the Solar Farm and PG&E would receive 54.55 percent of the power.

Electrical power is distributed through an integrated transmission system grid with multiple inter-connected power generation sources. Electrical power demand at any time is balanced among available sources of power generation. Any new source of power generation added to the grid necessarily affects power generation by other power plants that are connected to the transmission grid, since total power generation must be balanced against current power demand. Consequently, power generation by the Proposed Project will effectively displace other power generation sources that otherwise would be used to meet the prevailing electrical power demand in the SCE and PG&E service areas.

## POWER GENERATION MIXES FOR SCE AND PG&E

Both SCE and PG&E rely on a mix of power generation sources to meet electrical power demands in their respective service areas. Tables D5-1 and D5-2 summarize current (2009) overall power generation mixes for SCE and PG&E, respectively. Also included in Tables D5-1 and D5-2 are average greenhouse gas emission rates associated with each type of power source.

**Table D5-1.**
**Summary of 2009 Power Generation Mix for SCE**

| Power Plant Type | Percent of Annual Power Generation | Emission Factor, Pounds per Kilowatt-Hour | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | GWP as $CO_2e$ |
| Coal | 10.0% | 0.710 | 0.000075 | 0.000011 | **0.715** |
| Large Hydro | 5.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Natural Gas | 50.7% | 0.399 | 0.000007 | 0.000001 | **0.399** |
| Nuclear | 17.9% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Biomass/Waste | 2.0% | 0.706 | 0.000226 | 0.000030 | **0.720** |
| Geothermal | 9.0% | 0.057 | 0.000000 | 0.000000 | **0.057** |
| Small Hydro | 1.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Solar | 1.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Wind | 3.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |

| Power Plant Type | Percent of Annual Power Generation | Emission Factor, Pounds per Kilowatt-Hour | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | GWP as $CO_2e$ |
| Other | 0.5% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Total | **100.0%** | **0.292** | **0.000015** | **0.000002** | **0.293** |
| Renewable Sources | **16.4%** | **0.116** | **0.000027** | **0.000004** | **0.118** |

$CO_2$ = carbon dioxide, GWP multiplier = 1
$CH_4$ = methane, GWP multiplier = 25
$N_2O$ = nitrous oxide, GWP multiplier = 298
$CO_2e$ = carbon dioxide equivalents
GWP = global warming potential as $CO_2e$, based on multipliers from IPCC 2007
Data Sources: Southern California Edison (2009); California Air Resources Board (2008)

**Table D5-2.**
**Summary of 2009 Power Generation Mix for PG&E**

| Power Plant Type | Percent of Annual Power Generation | Emission Factor, Pounds per Kilowatt-Hour | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | GWP as $CO_2e$ |
| Coal | 2.0% | 0.710 | 0.000075 | 0.000011 | **0.715** |
| Large Hydro | 15.8% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Natural Gas | 46.3% | 0.399 | 0.000007 | 0.000001 | **0.399** |
| Nuclear | 19.7% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Biomass/Waste | 3.9% | 0.706 | 0.000226 | 0.000030 | **0.720** |
| Geothermal | 3.9% | 0.057 | 0.000000 | 0.000000 | **0.057** |
| Small Hydro | 3.9% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Solar | 0.5% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Wind | 3.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Other | 1.0% | 0.000 | 0.000000 | 0.000000 | **0.000** |
| Total | **100.0%** | **0.229** | **0.000014** | **0.000002** | **0.230** |
| Renewable Sources | **16.3%** | **0.185** | **0.000055** | **0.000007** | **0.188** |

$CO_2$ = carbon dioxide, GWP multiplier = 1
$CH_4$ = methane, GWP multiplier = 25
$N_2O$ = nitrous oxide, GWP multiplier = 298
$CO_2e$ = carbon dioxide equivalents
GWP = global warming potential as $CO_2e$, based on multipliers from IPCC 2007
Data Sources: Pacific Gas & Electric (2009); California Air Resources Board (2008)

Based on 2009 data, both SCE and PG&E obtain slightly more than 16 percent of their power generation from renewable energy sources. Both utilities, however, are still below the Renewable Portfolio Standard of 20 percent by 2010.

## GREENHOUSE GAS EMISSIONS AVOIDED THROUGH THE USE OF DESERT SUNLIGHT POWER INSTEAD OF ALTERNATIVE POWER SOURCES

Because operation of electrical power distribution grids balances power generation from multiple power sources against prevailing power demand, the addition of power from the Desert Sunlight project would necessary result in compensating reductions in power generation from other power plants connected to the grid. As discussed in the EIS text, operation of the Solar Farm and associated substations will directly and indirectly generate small amounts of greenhouse gases throughout the operational life of the Project. Direct greenhouse gas emissions would come primarily from sulfur hexafluoride emissions associated with substation equipment. Indirect greenhouse gas emissions would come from vehicle traffic associated with operation and maintenance activities for the Solar Farm, Gen-Tie Line, and Red Bluff Substation.

The small quantities of direct and indirect greenhouse gas emissions associated with Solar Farm operations would be more than off-set by greenhouse gas emissions avoided through the use of solar power instead of alternative power sources. Relative power generation costs and operational flexibility would typically be dominant factors in determining which power generation sources are displaced by power from the Desert Sunlight Project. An additional consideration, however, is the fact that all power plants are subject to scheduled and unscheduled maintenance shutdowns. Consequently, power from the Desert Sunlight Project could, over the course of a year, displace or replace power from any other existing power generation source being used by SCE and PG&E. The existing power mixes for SCE and PG&E have been used to provide a conservative estimate of the greenhouse gas emissions avoided through use of power generated by the Desert Sunlight Project. Tables D5-3 and D5-4 summarize the amounts of greenhouse gas emissions avoided annually through use of Desert Sunlight power from Solar Farm Layouts B and C, respectively.

**Table D5-3.**
**Avoided Greenhouse Gas Emissions For SCE and PG&E**
**Using Power From Solar Farm Layout B**

| Utility | Annual Power Received From the Solar Farm B, kilowatt-hours per year | Avoided Greenhouse Gas Emissions, Tons Per Year | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | GWP as $CO_2e$ |
| SCE | 545,454,545 | 79,678.9 | 4.203 | 0.574 | **79,955.0** |
| PG&E | 654,545,455 | 74,852.1 | 4.422 | 0.575 | **75,133.9** |
| **Total** | **1,200,000,000** | **154,531.0** | **8.625** | **1.148** | **155,088.9** |

$CO_2$ = carbon dioxide, GWP multiplier = 1
$CH_4$ = methane, GWP multiplier = 25
$N_2O$ = nitrous oxide, GWP multiplier = 298
$CO_2e$ = carbon dioxide equivalents
GWP = global warming potential as $CO_2e$, based on multipliers from IPCC 2007

**Table D5-4.**
**Avoided Greenhouse Gas Emissions For SCE and PG&E**
**Using Power From Solar Farm Layout C**

| Utility | Annual Power Received From the Solar Farm B, kilowatt-hours per year | Avoided Greenhouse Gas Emissions, Tons Per Year | | | |
|---|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ | GWP as $CO_2e$ |
| SCE | 409,586,777 | 60,130.8 | 3.172 | 0.433 | **60,339.1** |
| PG&E | 491,504,132 | 57,050.2 | 3.370 | 0.438 | **57,265.0** |
| **Total** | **901,090,909** | **117,181.0** | **6.542** | **0.871** | **117,604.1** |

$CO_2$ = carbon dioxide, GWP multiplier = 1
$CH_4$ = methane, GWP multiplier = 25
$N_2O$ = nitrous oxide, GWP multiplier = 298
$CO_2e$ = carbon dioxide equivalents

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# APPENDIX D-6

# WIND EROSION MEMORANDUM

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AECOM
1220 Avenida Acaso
Camarillo, CA 93012

(805)388-3775 tel
(805)388-3577 fax

# Memorandum

| | |
|---|---|
| To | Bureau of Land Management Palm Springs - South Coast Field Office |
| Subject | Wind Erosion, PM10, and PM2.5 Formation at Desert Sunlight Solar Farm Site |
| From | Amanda Beck, First Solar |
| Date | December 27, 2010 |

# Wind Erosion, PM10, and PM2.5 Formation at Desert Sunlight Solar Farm Site

## INTRODUCTION

This report provides an estimate of the change in emissions of particulate matter (PM) from the modified First Solar Desert Sunlight Solar Farm Project (Project) site due to wind erosion. The change is evaluated based on comparing the wind erosion emissions during normal operations (i.e., post-construction) from the modified Project to wind erosion emissions from the pre-Project condition (i.e., undisturbed desert). The modified Project reduces the footprint and alters the conditions of the disturbed soil which will alter the quantity of soil eroded and emissions formed. The potential impacts of the Project from PM emission are being assessed by BLM as part of the environmental review process for the Project under the National Environmental Protection Act (NEPA).

The Project will be located in an arid desert area with a variety of soils and geologic conditions that are influenced by wind (aeolian) processes. There are two principal processes by which wind erosion occurs: creep and saltation. Creep is the process by which kinetic energy is transferred from the wind to a soil particle causing the particle to move along the ground. Saltation occurs when the moving particle collides with a stationary particle or object and becomes temporarily airborne before returning to the soil surface. The creeping or saltating particle can impact and shatter in the collision, resulting in additional suspended airborne particles. These processes are initiated when wind energy immediately above the ground exceeds the creep/saltation threshold for the soils at the site, at which point soil particles of various sizes can be suspended and carried by the wind. The majority of creeping and saltating particles settle quickly and thus do not contribute to emissions, but do contribute to soil erosion. Similarly, the majority of suspended particles do not contribute to emissions; only some of this suspended particulate matter is smaller than 10 micrometers (μm) (PM10), and an even smaller proportion is smaller than 2.5 μm (PM2.5). Together, these fine particulates are criteria air pollutants. Only the PM that becomes suspended and subsequently exits the boundary of the Project site would be considered emissions.

## METHODOLOGY

Wind erosion leading to PM emissions is a complex process. Quantifying potential PM emissions requires understanding various physical factors that lead to wind erosion. These factors include soil properties, climatological conditions such as wind and precipitation, the hydrologic and physical properties of the soils, and the boundary layer meteorological attributes of the site, such as characterization of surface roughness, friction velocity, and vertical wind profile.

To estimate emissions from the pre-Project undisturbed desert, AECOM used the Wind Erosion from Unpaved Operational Areas calculation recommended by the Mojave Desert Air Quality Management District in it's Emissions Inventory Guidance: Mineral Handling and Processing Industries (MDAQMD model), which is adapted from Industrial Wind Erosion discussion (§13.2.5) in USEPA's AP-42 (MDAQMD 2000). This model is believed to provide a representative emissions estimate from undisturbed desert.

A number of wind erosion models for use in estimating wind-blown dust emissions from the Project were reviewed. To date, no single model that adequately addresses all of the parameters that would contribute to changes in windblown dust emissions due to the Project, such as the change from natural vegetation to the installation of solar panels or from soil compaction were identified. Due to these limitations, two models are used in combination to estimate emissions, and certain other factors are discussed qualitatively rather than quantitatively. To estimate uncontrolled emissions from Project site during normal operations, emissions from the Project site were calculated using the MDAQMD model, assuming all vegetation is removed. Then the Wind Erosion Prediction System (WEPS) model developed by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) (Skidmore and Hagen 2000) was used to estimate the reduction in wind erosion emissions that could be attributed to site compaction. Finally, the reduction in emissions that can be attributed to the application of dust palliatives was estimated. A method to quantitatively evaluate the influence solar panels would have on wind erosion emissions was not identified; however, a qualitative assessment of the influence that solar panels would likely have on the wind erosion emissions is provided.

Both the WEPS and MDAQMD models require various input parameters. A discussion of how those parameters are defined and applied to the models is provided in the following sections.

## Overview of Models

The MDAQMD model was developed for consistency, accuracy, and fairness when permitting mineral handling and processing industries and provides various levels of complexity, dependent upon availability of environmental data such as wind data and soil conditions.

The NRCS developed WEPS to estimate wind erosion from agricultural fields. It is a comprehensive model that includes modules to account for meteorological process (i.e., rain and wind) that result in wind erosion, boundary layer meteorological effects that govern the transfer of energy from the wind to particles on the ground, physical and hydrological properties of the soil that govern its susceptibility to erosion, the physics of creep and saltation that produce movement of soil particles, and the influence of agricultural crops on the wind flow over the field.

Vegetation in the WEPS model is dealt with in a manner specific to agriculture, rather than the general coverage method used in the MDAQMD model. Because the WEPS model is intended for agricultural fields, the existing vegetation type at the Project site is not contained within the WEPS crops database. Also, the plant communities in the database have little resemblance to the existing site vegetation. AECOM evaluated the crop module of WEPS with sensitivity testing of alternative plant community designations and densities. However, we ultimately concluded that use of the crop module in WEPS introduced unacceptable uncertainty into the analysis because of the generally ad-hoc assumptions that were required.

Both the WEPS and MDAQMD models were used to offset the limitations of each individual model. The WEPS model is intended for use in evaluating soil erosion in agricultural fields, but not in natural or non-agricultural landscapes, while the MDAQMD model is an adaptation of USEPA's model for a desert landscape, but does not have the complexity necessary to account for all the changes due to construction of the Project such as soil compaction or the installation of solar panels. As discussed below, a number of conservative assumptions were necessary in order to apply the two models for the Project site.

## Site Soils

The soils in the region of the Project site have been mapped by the NRCS (U.S. Department of Agriculture 2006) to be approximately 80 percent gravel-based Vaiva-Quilotosa-Hyder-Cipriano-Cherioni and 20 percent sand-based Rositas-Dune land-Carsitas. Geotechnical studies of the Project site were conducted as part of the Project development and environmental review process (Earth Systems Southwest 2010). Five test pits were excavated during the geotechnical survey in order to characterize site soils. Of these test pits, four show sandy soil consistent with the Rositas-Dune land-Carsitas series, while only one test pit shows gravelly soil consistent with the Vaiva-Quilotosa-Hyder-Cipriano-Cherioni series. In general, the susceptibility to wind erosion of gravel-based soil is much less than that of sand-based soil due to the higher concentration of large particles in the gravel-based soil. Consequently, AECOM made the conservative assumption (i.e., conservative in that it will allow a high estimate of soil erosion), that the soil on the Project site is the sand-based Rositas-Dune land-Carsitas soil type. In addition, approximately 30 percent of the site is composed of naturally compacted soil, commonly referred to as “desert pavement”. This compacted and agglomerated soil is highly resistant to wind erosion, which is directly relevant to the evaluation of wind erosion from the Project site (post-construction). In order to account for the erosion resistant desert pavement, 30 percent of the proposed total Project acreage is omitted from the pre-Project emissions study. That acreage is included in the post-Project study as construction requires disturbing and re-compacting the desert pavement, leading to exposure of erosion-susceptible soil below the compact top layer.

Data describing the soil in the 2010 Project geotechnical report were used to calculate soil composition and density inputs for the WEPS model. The proportions of soil constituents were averaged from the four pits with sandy soil and the composition is estimated to be 28 percent gravel, 65 percent sand, 3 percent silt, and 4 percent clay. The one pit with gravelly soil has a composition of 60 percent gravel, 34 percent sand, 5 percent silt, and 1 percent clay. When gravel and rock fragments are neglected, as they are often not considered a soil constituent, the silt composes 13 percent of the remaining soil. This would indicate the soil from this pit to be highly susceptible to erosion, but the large proportion of gravel and rock fragments in the ground prevent all but the very surface layer of small particles from being eroded. Desert pavement is an extreme example of this phenomenon occuring over time. As this gravel-based soil was found in only one out of five test pits, and is less susceptible to erosion as compared to the sand-based soil, it was neglected in the averaging to determine the soil composition used in the WEPS model (Appendix B, Tables 1 and 2).

Soil bulk density is also a critical parameter in the WEPS model in that a soil which is more densely compacted will have fewer loose surface particles available for creep and saltation than would the same soil at a lower level of compaction, thus raising the threshold friction velocity. The threshold friction velocity is a measurement of the saltation threshold described above, and is directly proportional to the minimum wind speed required for erosion to occur. The soil bulk density values were estimated as the average maximum soil density from the geotechnical report multiplied by the estimated level of soil compaction at the Project site. The existing, undisturbed site soil’s estimated level of compaction is between 70 and 80 percent, while the post-construction level of compaction is estimated at between 84 and 89 percent, based on First Solar’s planned site preparation approach (Eberhart/United Consultants 2007). The post-construction values are derived from the weighted average density increase resulting from the planned soil compaction methods. The higher density within the range of natural soil bulk densities, 80 percent, was chosen as it would minimize pre-Project particulate emission estimates, and the lower density from the range of post-Project compacted soil bulk densities, 84 percent, was utilized to maximize the potential post-Project emission estimates. This approach leads to a conservative estimation of the existing and post-Project emissions (Appendix B, Tables 4 and 5). All other soil inputs, such as soil crust parameters and carbonate fraction, were obtained from the existing Rositas soil profile in the WEPS model database.

The MDAQMD model does not allow for variations in soil parameters, such as bulk density and composition, when determining the minimum wind speed for erosion. However, MDAQMD provides a value of 0.38 meters per second (m/s) for the threshold friction velocity of desert scrub. Published methods for determining threshold friction velocity show that this value can range by +/- 0.007 m/s (Mansell 2006, Marticorena 1997). Because the threshold friction velocity is incorporated in many parts of the MDAQMD model, small changes in this value can have a large effect on final calculated emissions, and thus a range of friction velocities were used in determining model uncertainty (Appendix C, Table 2).

The MDAQMD model also requires that the project area be determined as either a limited or unlimited source of PM. A limited source will become exhausted of PM after the wind exceeds the saltation threshold for an extended period of time, while an unlimited source can emit throughout the length of a wind event. In general, the soil at the Project site is characteristic of an unlimited PM reservoir in pre- and post-Project states, but desert pavement is characteristic of a limited PM reservoir prior to construction, but not easily defined after construction due to the possible effects of solar panels. However, to maintain consistency between the WEPS and MDAQMD models, the area that is desert pavement is neglected in the pre-Project MDAQMD model run, but included in the post-Project model runs. This has the added benefit of under-estimating pre-Project emissions, which results in a more conservative pre-Project emissions estimate calculated by the MDAQMD model (Appendix C, Tables 3 and 6).

The MDAQMD model calculates total emissions by mutiplying the calculated emissions factor by the area of the Project site. It does not account for the shape of the site. As mentioned above, the desert pavement is excluded in the pre-Project calculations, but included in post-Project calculations. This means the MDAQMD modeling for existing conditions was calculated using an area of 2,700 acres, while 3,800 acres was used in the modeling of post-construction conditions.

## Site Vegetation

Project biological surveys indicate that, in general, the vegetation type for the Project site is typical desert scrub composed of sparsely populated plants with a small amount of foliage. These surveys also show average ground coverage by vegetation to be highly variable, ranging between 16 and 43 percent, with an average value of approximately 35 percent.

The MDAQMD model allows for changes in vegetation coverage. For the pre-Project emission estimates, AECOM used the average coverage value of 35 percent, while post-Project vegetation coverage used was 0 percent, as no studies could be found that compare solar panel arrays to an equivalent percentage of vegetative cover. AECOM considered using a percentage cover equivalent to a vineyard or orchard, as these types of agricultural fields are similar to solar panels in that they have an exposed base, extensive canopy, and are often located in an erosion susceptible climate. We decided against this, as the wind emission processes for vineyards and orchards are not well understood (Mansell 2006). However, it has been suggested that mature vineyards are not highly susceptible to aeolian erosion as their canopies provide good protection from wind (White 2003). For this reason, we believe that MDAQMD modeling of post-Project conditions provide a conservative over-estimate for emissions after solar panel installation.

## Site Compaction

As noted, the soil would be compacted during Project construction. Compacted soil is less susptable to wind erosion. To assess the reduction in wind erosion potential due to compaction, the WEPS model is used. The limitations of the WEPS model require the field shape to be a rectangle or a quarter, half, or full circle. The Project site is approximately 3,800 acres in an irregular shape, but project site maps show nearly 30 percent of the site to be desert pavement. As explained above, the desert pavement is omitted from the modeling of existing conditions as it is nearly impervious to wind erosion. By excluding the desert pavement, the pre-Project area is reduced to approximately 2,700 acres in a shape resembling a quarter-circle. After construction, the desert pavement is replaced with a mechanically compacted surface. Thus, the post-Project modeled area is presented in two sections closely resembling the full Project area. The same quarter-circle that was used for pre-Project modeling is again used, and a 1,100 acre square is also modeled to account for an area desert pavement that will be distrurbed during construction. Because per-acre emissions depend strongly on a field's perimeter to area ratio in the WEPS model, it was essential to model the post-Project in two pieces to best accomadate the modified Project site shape and perimeter. The project shape and modeled shape are shown graphically as Figure 1 in Appendix A.

## Climate and Wind Data

The WEPS model requires both climate and wind data to determine wind erosion. While climate data is available from Eagle Mountain, CA, a town only 5 miles from the Project site, the nearest wind data comes from Blythe, CA at a distance of 40 miles. For consistency, Blythe climate and wind data were used, as Blythe is the nearest location with both sets of data available. Climate and wind data from Indio, CA is not available in the WEPS model database.

The MDAQMD model only requires mean annual wind speed in its calculation of emissions. For consistency, the annual mean of wind speed from the wind data used in the WEPS model was used for the MDAQMD modeling, which is 2.7 m/s.

## Application of Dust Palliatives

A dust palliative will be applied on a periodic basis to the Project site during normal operations to reduce wind erosion PM emissions. Dust palliatives have been shown to effectively reduce PM emissions between 79 percent and 89 percent (CARB 2002, Countess 2006). This control efficiency is applied to the uncontrolled, compacted, post-Project emissions to determine the controlled post-Project emissions. The range of control efficiencies is taken into account in the uncertainty of the results (Appendix C, Table 4).

## Solar Arrays

Due to the challenges and assumptions needed for incorporting solar panels in either the MDAQMD model or the WEPS model, the influence of the change from existing site vegetation to one of solar panels is discussed below in a qualitative manner based on boundary layer meteorological concepts.

With respect to wind erosion, the main effect of both existing vegetation and future solar array structures would be to reduce the wind energy reaching the ground surface of the Project Site. An estimation of low-level wind energy can be inferred from a boundary layer meteorological parameter called “surface roughness” that is characteristic of the number and size of obstacles on the ground that interfere with free wind flow across that surface. Surface roughness is a computed value with units of length that is a normalized measure of the influence that objects pose to flow of fluid (wind) past them. Using the concept of a roughness length, an idealized vertical profile of wind speed with height can be computed from boundary layer theory (Prandtl 1932). In the boundary layer, the wind speed near the surface is zero and increases with height above the ground. The rate of increase of wind speed with height is a function of the surface roughness, with the wind speed proportional to the square root of the wind energy. This relationship can be represented mathematically as a function of the natural logarithm of the height of the wind speed estimate divided by the applicable surface roughness height.

That is:

$$u(z) \propto \ln\left(\frac{z}{z_o}\right)$$

where u is wind speed, z is height of the desired wind measurement, and $z_o$ is roughness length. This relationship shows that $z_o$ is the height above the ground where wind speed becomes zero; therefore, as roughness length increases, the height where wind speed reaches zero will be further above the ground for all wind speeds.

Published values for $z_o$ indicate that the surface roughness for flat desert grass and scrub is approximately 3 centimeters (cm) (Hodgin 1980). The removal of the existing vegetation and replacement with arrays of solar panels with a maximum height of approximately 2.5 meters (m) will increase the surface roughness values at the Project site. For example, the published surface roughness value for a flat island with 1 m to 2 m scrub is reported to be 16 cm (Hodgin 1980). Even if the post-Project roughness is only half this value (8 cm), the surface roughness of the Project site will still be considerably larger than that for the existing plant communities (3 cm). Then, since surface roughness is in the denominator of the above equation, the expected wind speed at any given height above the ground will be larger for the natural desert environment than for the post-Project case with its higher roughness value. It follows that the amount of kinetic energy in the surface boundary will be higher for current conditions compared to future conditions, resulting in more wind erosion potential for current conditions compared to post-construction conditions.

Based on the above qualitative analysis, exchanging desert flora for solar panels will increase the roughness length ($z_o$), due to the greater height of the solar panels when compared to natural desert vegetation, resulting in a lower potential for PM emissions from the Project Site. Therefore, neglecting the influence of solar panels from the post-construction emission estimates provides a conservative estimate for changes in PM emissions due to construction of the Project.

# EMISSION CALCULATIONS

## Modeling Parameters

Table 1 shows the input parameters for the model runs that were used to determine the change in PM emissions from pre-Project to post-Project conditions.

**Table 1: Model Input Parameters**

| Model/Period | Field | | Soil | | Vegetation | Wind Speed (m/s) |
|---|---|---|---|---|---|---|
| | Size (acres) | Shape | Type | Density (lbs/ft$^3$) | | |
| WEPS - Undisturbed Desert | 2700 | NE Quarter Circle | Rositas-based sand | 99.6 | 0% | Varying in time |
| WEPS - Post-Construction | 3800 | NE Quarter Circle w/ square | Rositas-based sand | 104.58 | 0% | Varying in time |
| MDAQMD - Undisturbed Desert | 2700 | NA | Rositas-based sand | NA | 35% | 2.7 |
| MDAQMD - Post-Construction | 3800 | NA | Rositas-based sand | NA | 0% | 2.7 |
| MDAQMD - Palliative | 3800 | NA | Rositas-based sand | NA | 0% | 2.7 |

## Site Compaction

The results presented in Table 2 represent the difference in the output of the WEPS model runs. Total erosion is the sum of soil leaving the bounded area through creep, saltation, and suspension. Recall that only PM is considered for emissions, and PM10 is a fraction of the erosion due to suspension, and PM2.5 is a fraction of PM10. Also, only a fraction of the PM emissions calculated by the MDAQMD model are in the form of PM10 and PM2.5. These mass fractions are 0.5 and 0.2 respectively. These ratios are applied to the raw WEPS PM emission estimates to determine PM2.5 emissions, as they are not an output of that model.

**Table 2: Results of WEPS Model Runs in tons per acre per year**

| Scenario | Total Erosion | Creep/Saltation | Suspension | PM10 | PM2.5 |
|---|---|---|---|---|---|
| Undisturbed Desert | 245 | 31.5 | 213 | 18.9 | 7.56 |
| Post-Construction | 238 | 38.4 | 200 | 17.8 | 7.12 |
| Difference | -7 | 6.9 | -13 | -1.1 | -0.44 |
| Percent Difference | -2.9% | 22% | -6.1% | -5.9% | -5.9% |

AECOM reminds the reader that the values presented in Table 2 do not attempt to quantify the potential surface wind energy reduction due to the solar panel installation; this is a factor that would tend to decrease post-construction wind erosion at the Project Site.

Even though the gross emission values determined by the WEPS model are abnormally large, the model runs show a clear reduction in wind erosion from the Project site from pre-existing conditions to post-construction conditions strictly due to compaction. Most importantly, modeling shows an approximate 6 percent reduction in both PM10 and PM2.5 emission rates, which is a conservative estimate because of the assumptions described above. For example, if the minimum within the range of natural bulk densities is used and the maximum within the range of predicted post-Project bulk densities are chosen as inputs for the model, the expected PM emissions would show a decrease of approximately 15 percent. Because of the large emission rates predicted by the WEPS model, AECOM studied the equations presented in the WEPS models's technical documentation and performed sensitivity analysis on the model to determine the effect of changes in bulk density on PM emissions. This sensitivity analysis neglects other modules within WEPS and does not account for the iterative processes required to run the model and thus an exact value cannot be determined, but AECOM was able to confirm that an increase in bulk density will lead to a decrease in PM emissions. Thus, the 6 percent decrease in emissions was applied to the uncontrolled emissions estimates from the MDAQMD model to determine emissions from the compacted site.

## Results

The results of the emission calculations are presented in Table 3. The change in emissions shown in Table 3 is the change from modeled undisturbed desert at the Project site to a post-construction site with no vegetation, compacted soil, and a dust palliative applied. As noted elsewhere, the change in wind erosion emissions due to the installation of solar panels is neglected in this analysis, but the installation of solar panels is expected to reduce emissions due to a reduction in wind energy at the ground surface.

**Table 3: Emission Comparison**

| Scenario | PM10 | PM2.5 |
|---|---|---|
| **Pre-Project Emissions (lbs/day)** | | |
| Undisturbed Desert | 673 | 269 |
| **Post-Project Emissions (lbs/day)** | | |
| Site w/ vegetation removed | 1,460 | 583 |
| | 1,370 | 548 |
| Site w/ vegetation removed, with compaction and quarterly palliative application | 219 | 88 |
| Change in emissions | -454 | -181 |
| Uncertainty | +/- 22% | +/- 22% |

This analysis shows a 67 percent reduction in PM emissions with an uncertainty of +/- 22 percent, primarily due to the application of a dust palliative (Appendix C). Although this is a significant decrease, this is a conservative result due to the removal of desert pavement from the pre-Project conditions, the neglection of solar panels in post-Project conditions, and the minimum increase in bulk density due to compaction evaluated with the WEPS model.

In summary, construction of the Project is expected to significantly reduce wind erosion PM emissions from the Project Site. As such, the Project will not have an adverse effect on air quality due to wind erosion.

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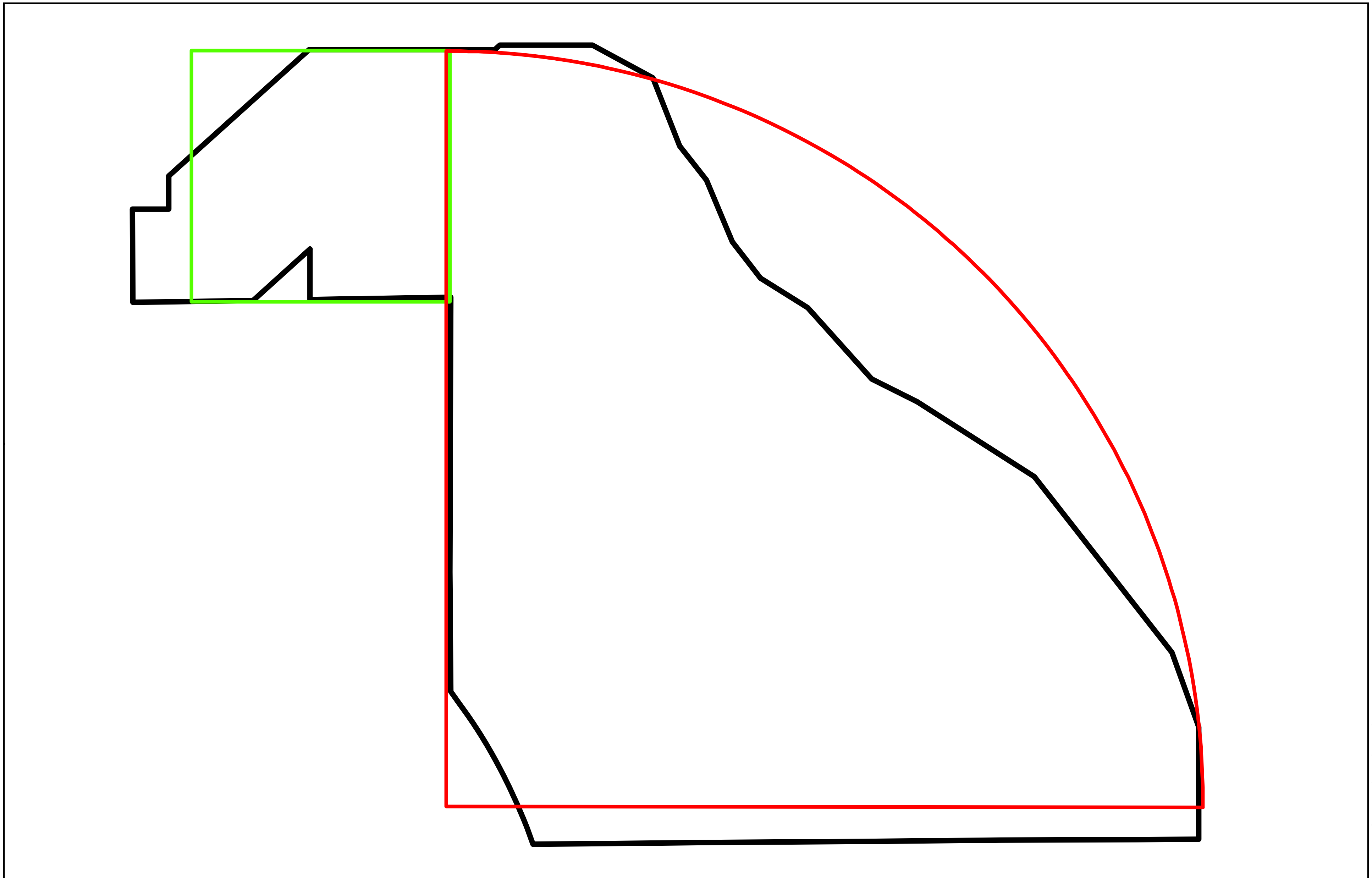

Map Location


Legend

- Post Project
- Pre and Post Project
- Currently Proposed Footprint

0 0.25 0.5 Miles

1 in = 1 miles

N W E S

**Desert Sunlight**
**Solar Farm Project**

**Figure 1**
**Comparison of Modeled Area**
**to Project Site**

First Solar.

AECOM

Project: 60139386-14
Date: December 2010

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## Appendix B: Soil Properties

### Table 1: Soil Constituent Information [1]

| | | Size [3] | BP1 | BP2 | BP3 (surf) | BP3 (deep) | BP3 (avg) | BP4 | BP5 |
|---|---|---|---|---|---|---|---|---|---|
| Gravel | | >2 mm | 0.6 | 0.35 | 0.22 | 0.43 | 0.325 | 0.28 | 0.18 |
| Sand | Very Course | 1mm-2mm | 0.1 | 0.1 | 0.08 | 0.1 | 0.09 | 0.19 | 0.15 |
| | Course | .5mm-1mm | 0.07 | 0.12 | 0.12 | 0.14 | 0.13 | 0.26 | 0.17 |
| | Medium | .25mm-.5mm | 0.07 | 0.07 | 0.1 | 0.13 | 0.115 | 0.13 | 0.16 |
| | Fine | .10mm-.25mm | 0.08 | 0.29 | 0.42 | 0.13 | 0.275 | 0.06 | 0.19 |
| | Very Fine | .05mm-.10mm | 0.02 | 0.02 | 0.04 | 0.02 | 0.03 | 0.01 | 0.03 |
| | Total | .05mm-2mm | 0.34 | 0.6 | 0.76 | 0.52 | 0.64 | 0.65 | 0.7 |
| Silt | | 2um-50um | 0.05 | 0.04 | 0 | 0.03 | 0.015 | 0.02 | 0.06 |
| Clay | | <2um | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.05 | 0.06 |
| Total | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

### Table 2: Inputs for WEPS Modeled Soil [2]

| | | Size [3] | Vaiva based (BP1) | | Rositas based (avg BP2-5) | |
|---|---|---|---|---|---|---|
| | | | Mean | Less Gravel | Mean | Less Gravel |
| Gravel | | >2 mm | 0.60 | -- | 0.28 | -- |
| Sand | Very Course | 1mm-2mm | 0.10 | 0.25 | 0.13 | 0.18 |
| | Course | .5mm-1mm | 0.07 | 0.18 | 0.17 | 0.24 |
| | Medium | .25mm-.5mm | 0.07 | 0.18 | 0.12 | 0.17 |
| | Fine | .10mm-.25mm | 0.08 | 0.20 | 0.20 | 0.28 |
| | Very Fine | .05mm-.10mm | 0.02 | 0.05 | 0.02 | 0.03 |
| | Total | .05mm-2mm | 0.34 | 0.85 | 0.65 | 0.90 |
| Silt | | 2um-50um | 0.05 | 0.13 | 0.03 | 0.05 |
| Clay | | <2um | 0.01 | 0.03 | 0.04 | 0.05 |
| Total | | | 1 | 1 | 1 | 1 |

### Table 3: Mean Soil Particle Size (mm) [4]

| | Vaiva based | Rositas based |
|---|---|---|
| Min | 1.36 | 0.84 |
| Max | 2.73 | 1.68 |
| Mean | 2.05 | 1.26 |

### Table 4: Soil Compaction

| | Original Compaction | | Compaction After Construction | | | |
|---|---|---|---|---|---|---|
| | Min | Max | | % Project area | Min | Max |
| Undisturbed | 0.7 | 0.8 | Till and Roll | 59% | 0.80 | 0.85 |
| | | | Cut and Fill | 32% | 0.90 | 0.95 |
| | | | Surgical | 9% | 0.90 | 0.95 |
| | | | Average | | 0.84 | 0.89 |

### Table 5: Bulk Density [2]

| | | Vaiva Based | | Rositas Based | |
|---|---|---|---|---|---|
| | | pcf | Mg/m3 | pcf | Mg/m3 |
| Average Maximum [5] | | 142.50 | 2.28 | 124.50 | 1.99 |
| Undisturbed | Min | 99.75 | 1.60 | 87.15 | 1.39 |
| | Max | 114.00 | 1.82 | 99.60 | 1.59 |
| Post-Project | Min | 119.84 | 1.92 | 104.70 | 1.68 |
| | Max | 126.97 | 2.03 | 110.93 | 1.77 |

### Table 6: Limited or Unlimited susceptibility to erosion [6]

| Soil Type | | Surf. Cover [7] | MPS | Crust [8] | L or U? |
|---|---|---|---|---|---|
| Undisturbed | Rositas based | L | U | U | U |
| | Vaiva based | L | L | L | L |
| Post-Project | Rositas based | U/L | U | U | U |
| | Vaiva based | U/L | L | U | U/L |

1) Taken from plots in Appendix A of Appendix F - Geotechnical Studies of DEIS

2) Green highlighted values from Tables 2 and 5 were used as inputs in WEPS for the two soil types at First Solar location near Desert Center. Other values are set from Vaiva soil and Rositas soil in WEPS database.

3) Size classifications are taken from WEPS model inputs as defined in the User's Guide.

4) The mean soil particle size was used to determine the soil as a limited or unlimited source of PM in the MDAQMD model.

5) Maximum density values are taken from Sunlight Compact + Dust Control Water Est 12.08.2010.xlsx

6) MDAQMD has 3 criteria to determine this: a) Surface cover with rocks and/or clumps of vegetation is limited, b) Mean Particle Size (MPS) (>1.5mm limited susceptibility, <1.5 mm unlimited susceptibility), c) A non-friable crust greater than .25 inches thick is limited susceptibility.

7) Rositas based (pre) soil generally has clumps of vegetation. Vaiva based soil (pre) has large surface rock fragments. The post values depend on considerations of solar panels.

8) Rositas based soil (pre) does not have a non-friable or thick surface crust. Vaiva based soil (pre) is generally desert pavement with a thick crust.

## Appendix C: MDAQMD Model Calculations

The unlimited erosion equations and parameters are:

$$E = k \times E_f \times A$$
$$E_f = 2.814 \times (1 - v) \times \left(\frac{u}{u_t}\right)^3 \times C(x)$$
$$u_t = u_t^* \times u^*$$

where

| | |
|---|---|
| **E** | Emission rate in tons per year |
| **k** | Aerodynamic factor (0.5 for PM10, 0.2 for PM2.5) |
| **A** | Area is acres |
| **$E_f$** | Emission factor in tons per acre |
| **v** | Vegetation cover fraction |
| **C** | Correction factor based on x. |
| **x** | .886*($u_t$/u) |
| **u** | Mean wind speed (m/s) |
| **$u_t$** | Threshold value of wind speed (m/s) |
| **$u_t$*** | Threshold friction velocity (m/s) |
| **u*** | Ratio of wind speed to friction velocity |

**Table 1: Input Parameters**

| | | | | |
|---|---|---|---|---|
| **u (m/s)** | | 2.73 | **PM10 fac (k)** | 0.5 |
| **Area (acres)** | **Undisturbed** | 2700 | **PM2.5 fac (k)** | 0.2 |
| | **Post-Project** | 3800 | | |
| **Friction Particle size (mm)** [1] | | 0.3 | | |

**Table 2: Determining threshold wind speed**

| **Variable** | **$z_o$ (m)** [2] | **$u_t$* (m/s)** [3] | | **u*** [2] | **$u_t$ (m/s)** | |
|---|---|---|---|---|---|---|
| | **Rough. H.** | **Marti.** | **alt** | **vel. ratio** | **Marti.** | **alt** |
| | 0.04 | 0.373 | 0.388 | 13.80 | 5.14 | 5.35 |

**Table 3: Determining the Correction Factor** [4]

| **Variable** | **x** | | **C(x)** | |
|---|---|---|---|---|
| | **Marti.** | **alt** | **Marti.** | **alt** |
| | 1.67 | 1.74 | 0.73 | 0.64 |

**Table 4: MDAQMD Calculated Emissions**

| | **Area** | **Correction Factor C(x)** | | **Control Factor** [5] | | **Vegetative Cover** | **Emission Factor** | | **Emissions (tons/year)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | **PM10** | | **PM2.5** | |
| | | **Marti.** | **alt** | **Compaction** | **Palliative** | **v** | **Marti.** | **alt** | **Marti.** | **alt** | **Marti.** | **alt** |
| **Undisturbed** | 2700 | 0.73 | 0.64 | 0 | 0 | 0.35 | 0.10 | 0.08 | 137.81 | 107.84 | 55.13 | 43.13 |
| **No Veg** | 3800 | 0.73 | 0.64 | 0 | 0 | 0 | 0.16 | 0.12 | 298.40 | 233.49 | 119.36 | 93.40 |
| **Compacted** | 3800 | 0.73 | 0.64 | 0.06 | 0 | 0 | 0.16 | 0.12 | 280.49 | 219.48 | 112.20 | 87.79 |
| **Palliative** | 3800 | 0.73 | 0.64 | 0.06 | 0.79 | 0 | 0.16 | 0.12 | 58.90 | 46.09 | 23.56 | 18.44 |
| | 3800 | 0.73 | 0.64 | 0.06 | 0.84 | 0 | 0.16 | 0.12 | 44.88 | 35.12 | 17.95 | 14.05 |
| | 3800 | 0.73 | 0.64 | 0.06 | 0.89 | 0 | 0.16 | 0.12 | 30.85 | 24.14 | 12.34 | 9.66 |

1) The friction particle size used is the MDAQMD value given for Desert Scrub.

2) MDAQMD provides a table for roughness heights and equivalent u*, but the EPA method was used with the value given in Hodgin (1980).

3) The threshold friction velocity is given by MDAQMD in a table to be 0.38, but methods of determining this shown in Mansell (2006) and Marticorena (1997) provide for a range of values.

4) Again, MDAQMD provides a table for determining this value, but instead the piecewise function defined by *Cowherd, C., G. Muleski, P. Engelhart, and D. Gillette. 1985. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. EPA/600/8-85/002. NTIS PB85- 192219. Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Washington, DC.*

5) These are incorporated by the MDAQMD method for unpaved roads, where $E_c$ is the value of controlled emissions and E is uncontrolled emissions. C is the the Control Factor listed in Table 4 multiplied by 100%.

$$E_c = E \times \left(\frac{100 - C}{100}\right)$$

# Appendix E

# Noise Analyses

# APPENDIX E-1

# ADDITIONAL CONSTRUCTION NOISE ANALYSIS INFORMATION

## OVERVIEW OF THE CNSTNOIZ MODEL

Noise impacts from construction activity have been estimated using a detailed spreadsheet model (CNSTNOIZ). The CNSTNOIZ model is structured to provide separate analyses for each construction phase. Different versions of the spreadsheet model accommodate from one to five construction phases in a single spreadsheet. In addition to the main data entry sheet for each construction phase, the CNSTNOIZ model provides a summary sheet and chart of noise levels versus distance for each construction phase. The CNSTNOIZ model has an expandable database of 140 equipment entries including heavy equipment, power tools, and other noise sources such as equipment backup beepers and manual hammering. Some equipment types have multiple entries to reflect a range of typical engine sizes. The database provides a default reference noise level at 50 feet, the range of reference noise levels expected for the general equipment type, default atmospheric absorption coefficients, and default operating time factors for hours when the equipment is active. The operating time fractions allow for more realistic modeling of noise from intermittent equipment operations.

The database in the CNSTNOIZ model incorporates data from a wide range of published sources plus some additional data based on direct monitoring data and manufacturer information. Default atmospheric absorption rated included in the database were calculated according to the 1978 American National Standards Institute (ANSI) procedures using available frequency spectrum data for major types of equipment. Data included in the database represent minimum atmospheric absorption rates (typically representing cool temperatures and high relative humidity levels). Database entries for default equipment operating time factors for active hours are generally consistent with default values used in the CNSTEMIS air quality spreadsheet model.

Noise calculations performed by the CNSTNOIZ model employ a conventional distance extrapolation procedure for point sources of noise incorporating a 6-dBA drop-off rate pre doubling of distance plus a minimum atmospheric absorption adjustment.

The primary calculation sheet allows users to replace the program default values with project-specific estimates. The model requires users to specify the number and type of equipment items active in the same general work area for each hour of a 24-hour cycle, thus allowing realistic calculation of various noise metrics, including: hourly average noise levels by time of day; maximum hourly noise levels; average daytime, evening, and nighttime noise levels; 24-hour average noise levels (24-hour Leq); and 24-hour CNEL or Ldn noise levels. The model automatically calculates noise levels at 20 distances from the main activity areas of the construction site (default distances range from 50 feet to 2 miles). The model provides a tabular summary of noise levels at all distances. The model also provides a chart of noise levels at distances out to 3,000 feet, comparing maximum 1-hour Leq, average daytime Leq, and 24-hour CNEL or Ldn level at each distance. The hourly noise contributions from each type of equipment are available in the primary calculation sheet of the model.

## ANALYSES FOR THE PROPOSED PROJECT AND ALTERNATIVES

Alternatives 1, 2, and 3 would use similar equipment for comparable construction phases. Although Alternative 3 might have lower numbers of some equipment items than Alternatives 1 or 2 at the solar farm site, the equipment would typically operate in multiple groups of items that would be similar for all alternatives. Consequently, a single analysis for each of the modeled construction phases would be applicable to all three alternatives.

Overall construction equipment use for each phase of construction was consistent with the construction emissions analyses summarized in Appendix D-2. The CNSTNOIZ analyses considered various equipment groupings likely to occur during each phase of construction. The grouping producing the greatest noise impact was used to represent noise impacts from each construction phase.

## NOISE LEVEL CHARTS FOR MAJOR CONSTRUCTION PHASES OF PROJECT COMPONENTS

The following tables and charts summarize the results of the construction noise analysis for major construction phases at the solar farm, Gen-Tie Line, and Red Bluff Substation.  .

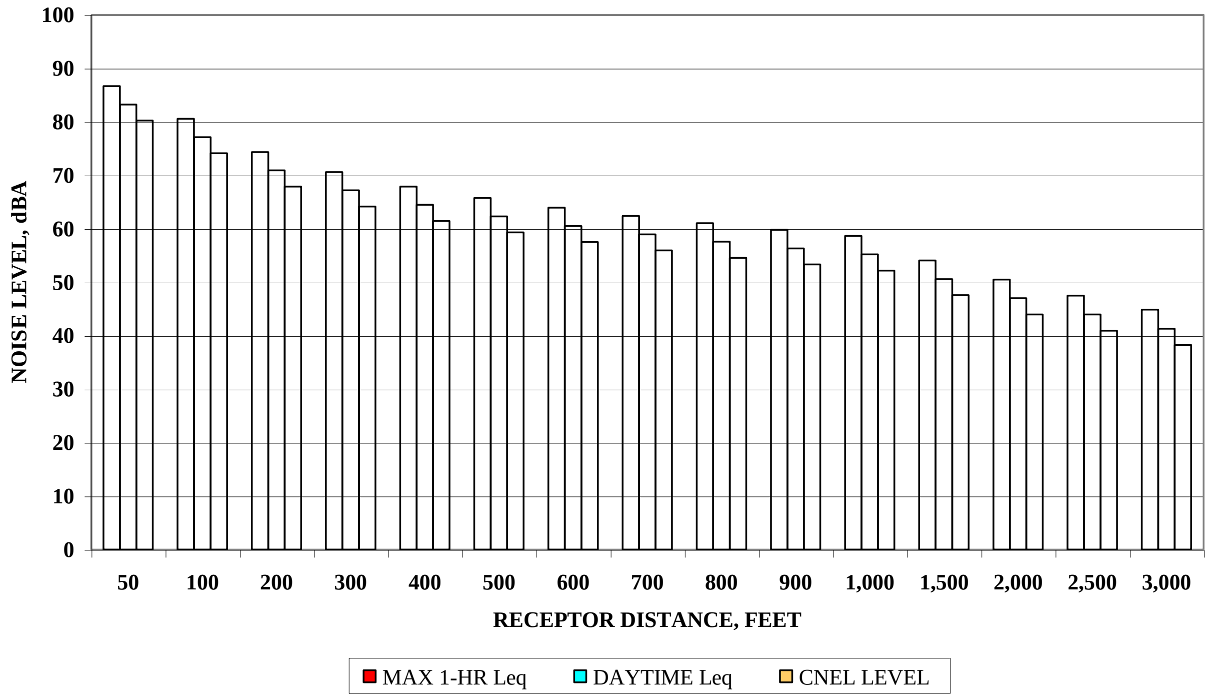
## SOLAR FARM CONSTRUCTION

### Site Clearing Phase

**Table E1-1.**
**Equipment Group Analyzed for the Site Clearing Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Brush Cutters | 2 | 8 | 6.8 | 81 | 0.75 |
| Tracked Dozer | 1 | 2 | 0.5 | 88 | 0.75 |
| Wheeled Tractor | 1 | 4 | 3.4 | 80 | 0.75 |
| Wheeled Loader | 1 | 2 | 1.5 | 80 | 0.50 |
| Wood Chipper | 1 | 2 | 0.5 | 91 | 0.75 |
| ATVs | 1 | 4 | 2.6 | 70 | 0.50 |
| Water Truck | 1 | 2 | 1.3 | 80 | 0.50 |
| Dump Truck | 1 | 2 | 0.5 | 80 | 032 |

SOLAR FARM CONSTRUCTION NOISE IMPACTS
SITE CLEARING OPERATIONS

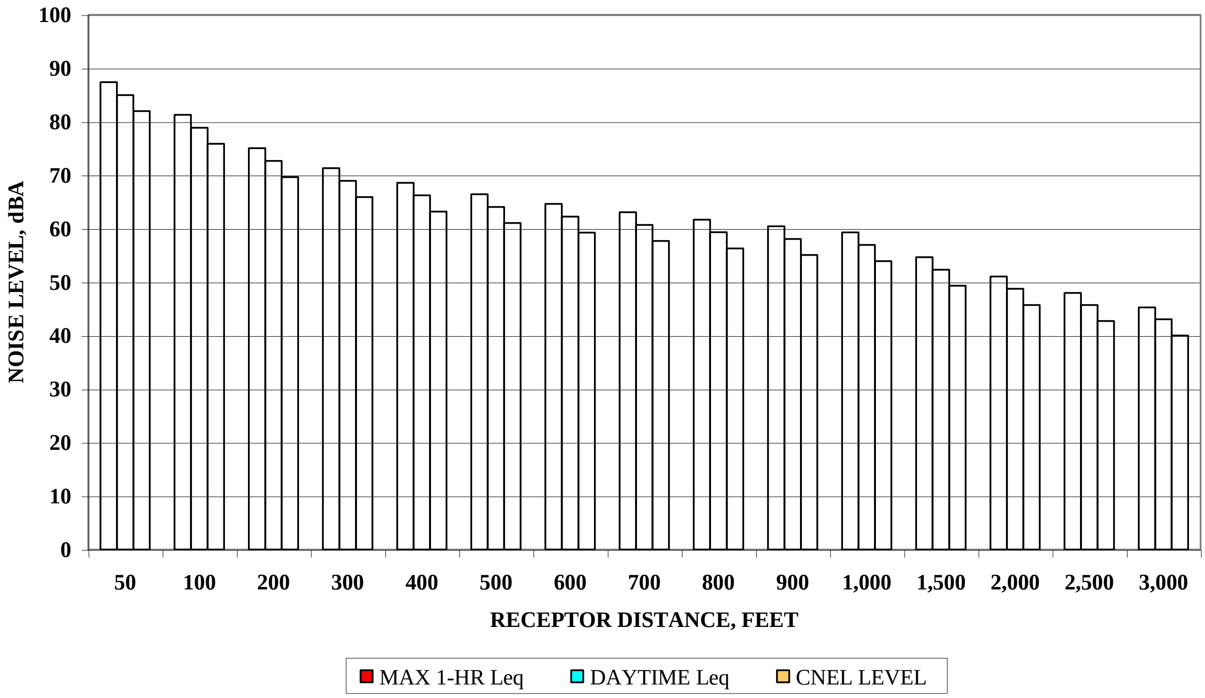



## Site Grading Phase

**Table E1-2.**
**Equipment Group Analyzed for the Site Grading Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Scraper | 1 | 8 | 6.8 | 85 | 0.75 |
| Tracked Dozer | 1 | 4 | 3.4 | 88 | 0.75 |
| Grader | 1 | 4 | 3.4 | 82 | 0.75 |
| Roller-Compactor | 1 | 4 | 3.4 | 73 | 0.45 |
| ATVs | 1 | 4 | 2.6 | 70 | 0.50 |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |

**SOLAR FARM CONSTRUCTION NOISE IMPACTS**
**SITE GRADING OPERATIONS**

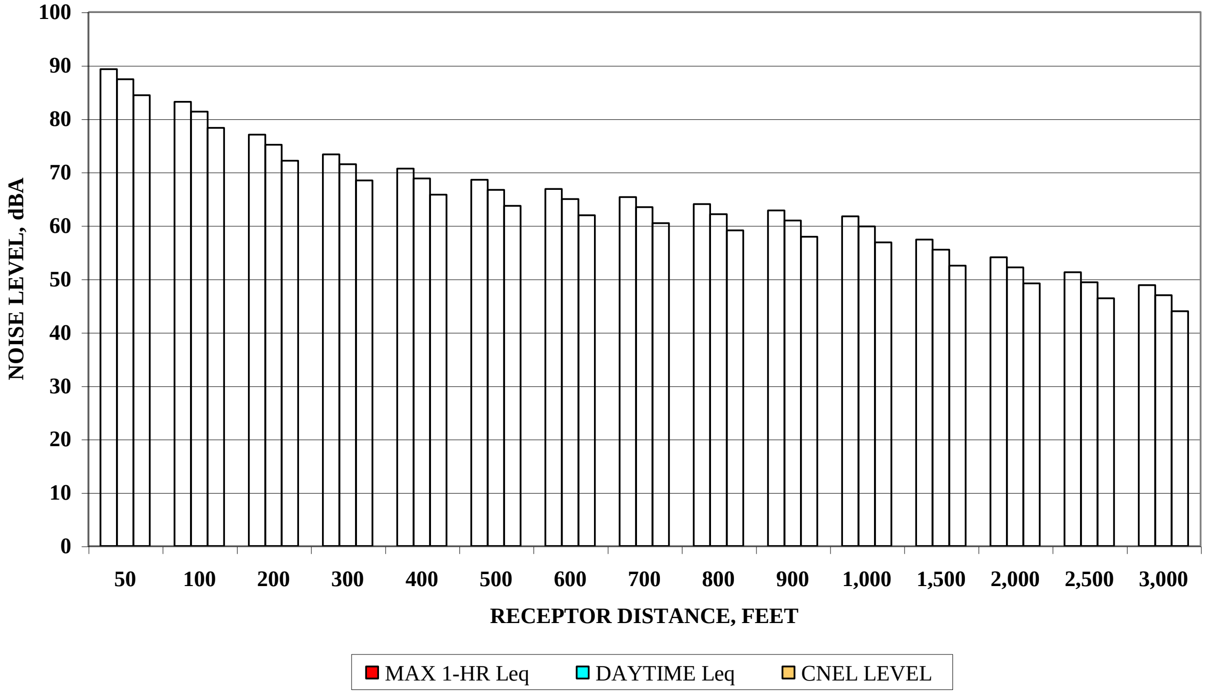



## Array Support Post Phase

**Table E1-3.**
**Equipment Group Analyzed for the Array Support Post Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Auger Rig | 1 | 8 | 3.6 | 85 | 0.66 |
| Vibratory Pile Driver | 2 | 8 | 8.0 | 85 | 0.54 |
| Forklift | 1 | 4 | 2.6 | 80 | 0.50 |
| ATVs | 1 | 4 | 2.6 | 70 | 0.50 |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |
| Flatbed Truck | 1 | 2 | 0.5 | 75 | 0.32 |

**SOLAR FARM CONSTRUCTION NOISE IMPACTS**
**INSTALLATION OF ARRAY SUPPORT POSTS**

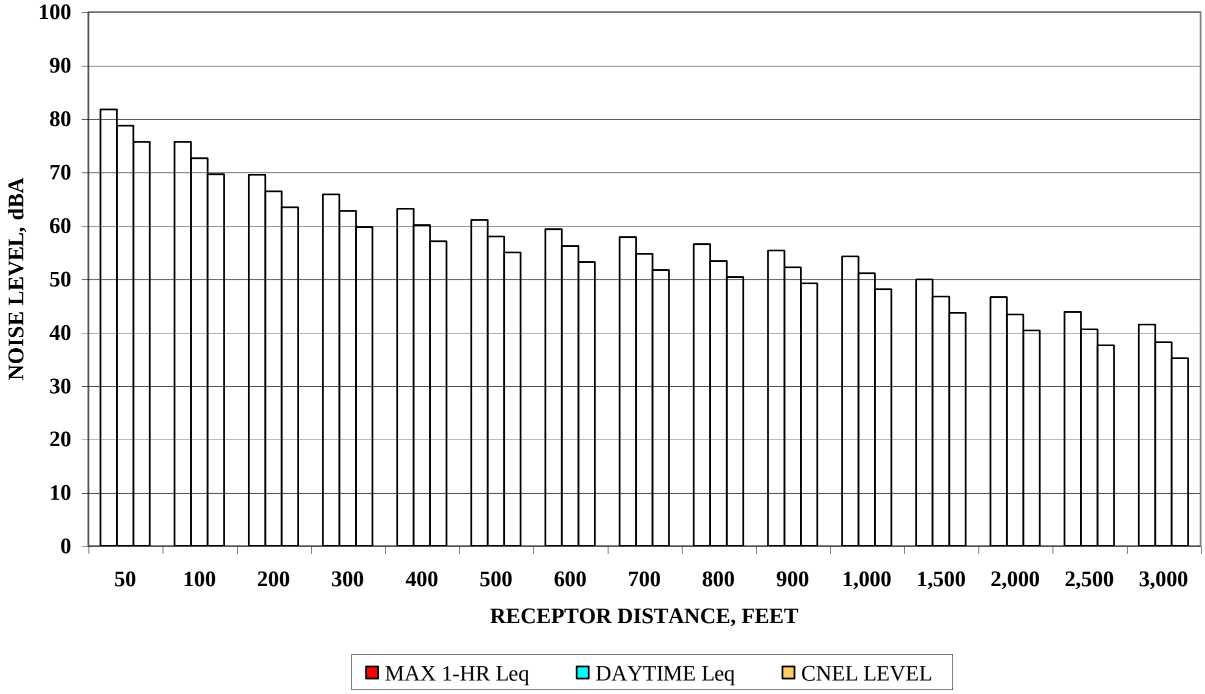



## Trenching and Underground Cable Phase

**Table E1-4.**
**Equipment Group Analyzed for the Trenching and Underground Cable Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Trencher | 1 | 8 | 6.8 | 73 | 0.50 |
| Backhoe-Loader | 1 | 4 | 3.4 | 80 | 0.50 |
| Cable Plow | 1 | 8 | 6.8 | 80 | 0.75 |
| ATVs | 1 | 8 | 5.2 | 70 | 0.50 |
| Water Truck | 1 | 3 | 1.3 | 80 | 0.50 |
| Dump Truck | 1 | 4 | 1.0 | 80 | 0.32 |
| Flatbed Truck | 1 | 1 | 0.25 | 75 | 0.32 |
| Forklift | 1 | 1 | 0.65 | 80 | 0.50 |

**SOLAR FARM CONSTRUCTION NOISE IMPACTS**
**TRENCHING AND UNDERGROUND CABLE INSTALLATION**

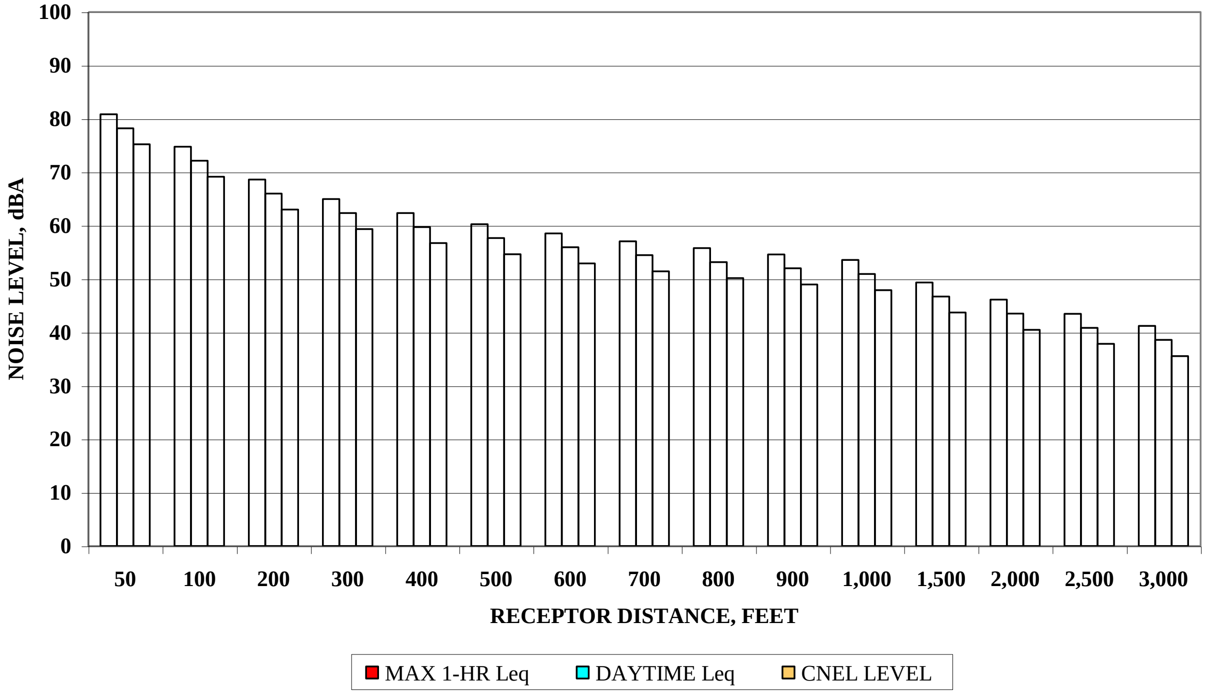



## Soil Compaction Phase

**Table E1-5.**
**Equipment Group Analyzed for the Soil Compaction Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Roller-Compactor | 2 | 6 | 5.1 | 77 | 0.45 |
| ATVs | 1 | 8 | 5.2 | 70 | 0.50 |
| Water Truck | 1 | 8 | 5.2 | 80 | 0.50 |

SOLAR FARM CONSTRUCTION NOISE IMPACTS
SOIL COMPACTION PHASE

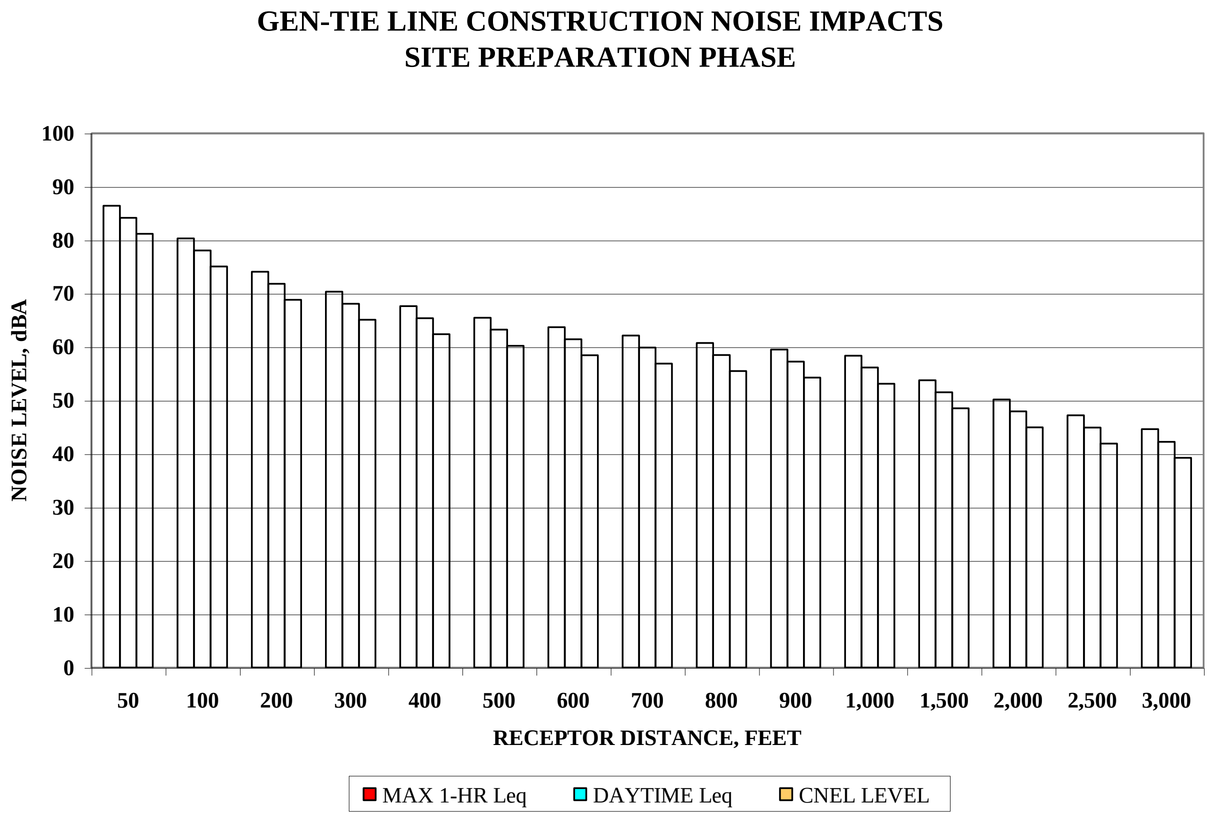


## GEN-TIE LINE CONSTRUCTION

### Site Preparation Phase

**Table E1-6.**
**Equipment Group Analyzed for the Site Preparation Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Tracked Dozer | 1 | 8 | 6.8 | 86 | 0.75 |
| Grader | 1 | 2 | 1.7 | 82 | 0.75 |
| Roller-Compactor | 1 | 6 | 5.1 | 73 | 0.45 |
| Wheeled Loader | 1 | 4 | 3.0 | 78 | 0.50 |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |
| Dump Truck | 1 | 1 | 0.25 | 80 | 0.32 |



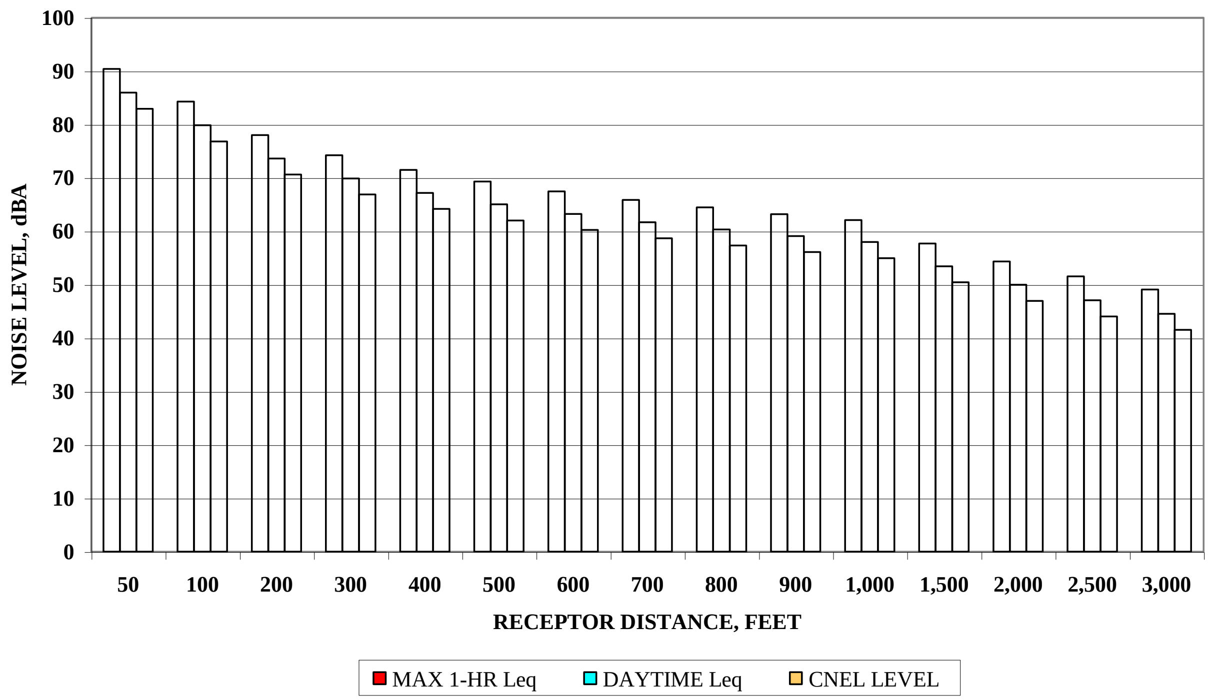

## Tower Foundation Phase

**Table E1-7.**
**Equipment Group Analyzed for the Tower Foundation Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Tracked Dozer | 1 | 2 | 1.7 | 86 | 0.75 |
| Wheeled Loader | 1 | 4 | 3.0 | 78 | 0.50 |
| Backhoe-Loader | 1 | 2 | 1.7 | 80 | 0.50 |
| Fork Lift | 1 | 4 | 2.6 | 80 | 0.50 |
| Mobile Crane | 1 | 4 | 2.6 | 82 | 0.50 |
| Mobile Crane | 1 | 2 | 1.3 | 82 | 0.50 |
| Auger Rig | 1 | 2 | 0.9 | 85 | 0.66 |

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Drill Rig | 1 | 4 | 4.0 | 87 | 0.66 |
| Compressor | 1 | 4 | 4.0 | 81 | 0.66 |
| Pump | 1 | 2 | 2.0 | 83 | 0.41 |
| Portable Mixer | 1 | 2 | 1.8 | 82 | 0.50 |
| Jackhammer | 1 | 2 | 1.5 | 90 | 1.36 |
| Cement Mixer Truck | 1 | 2 | 0.8 | 80 | 0.50 |
| Dump Truck | 1 | 5 | 0.88 | 80 | 0.32 |
| Slurry Truck | 1 | 2 | 1.3 | 80 | 0.50 |
| Specialty Truck | 1 | 2 | 1.3 | 75 | 0.32 |
| Water Truck | 1 | 2 | 1.3 | 80 | 0.50 |

GEN-TIE LINE CONSTRUCTION NOISE IMPACTS
TOWER FOUNDATIONS PHASE

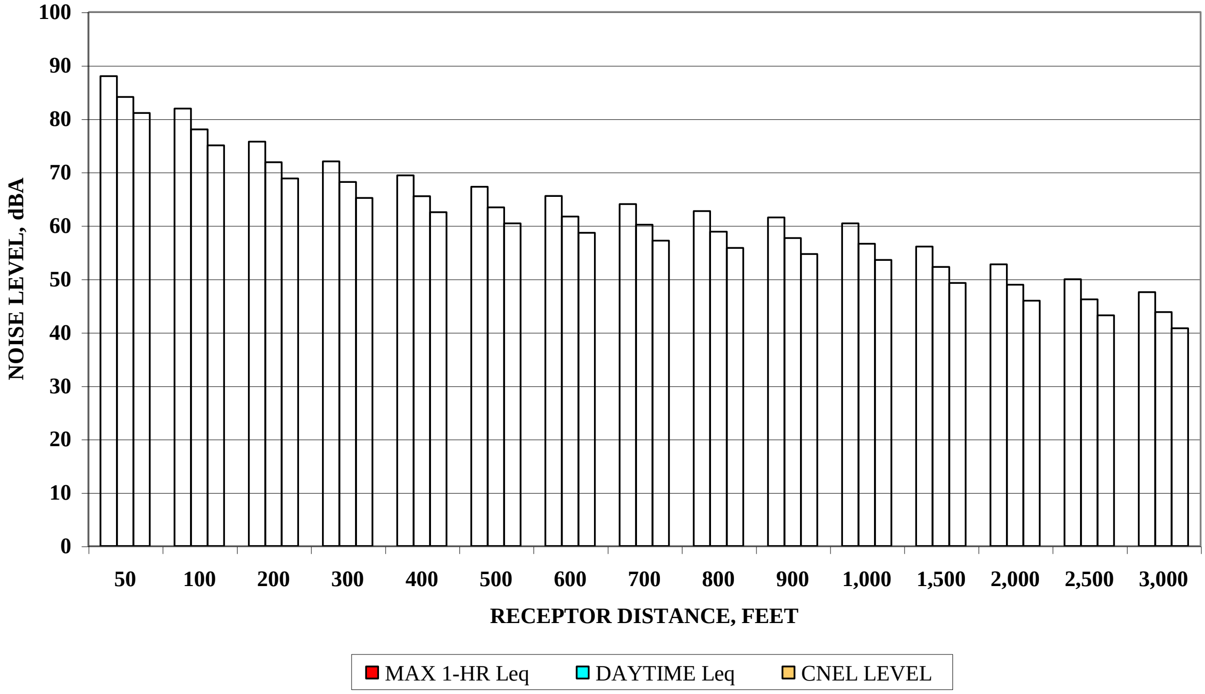



## Tower Assembly and Erection Phase

**Table E1-8**
**Equipment Group Analyzed for the Tower Assembly and Erection Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Forklift | 2 | 4 | 2.6 | 80 | 0.50 |
| Mobile Crane | 2 | 6 | 3.9 | 82 | 0.50 |
| Compressor | 2 | 4 | 4.0 | 81 | 0.66 |
| Flatbed Truck | 1 | 4 | 1.0 | 75 | 0.32 |
| Flatbed Truck | 1 | 4 | 1.0 | 75 | 0.32 |
| Water Truck | 1 | 8 | 5.2 | 80 | 0.50 |

GEN-TIE LINE CONSTRUCTION NOISE IMPACTS
TOWER ASSEMBLY PHASE

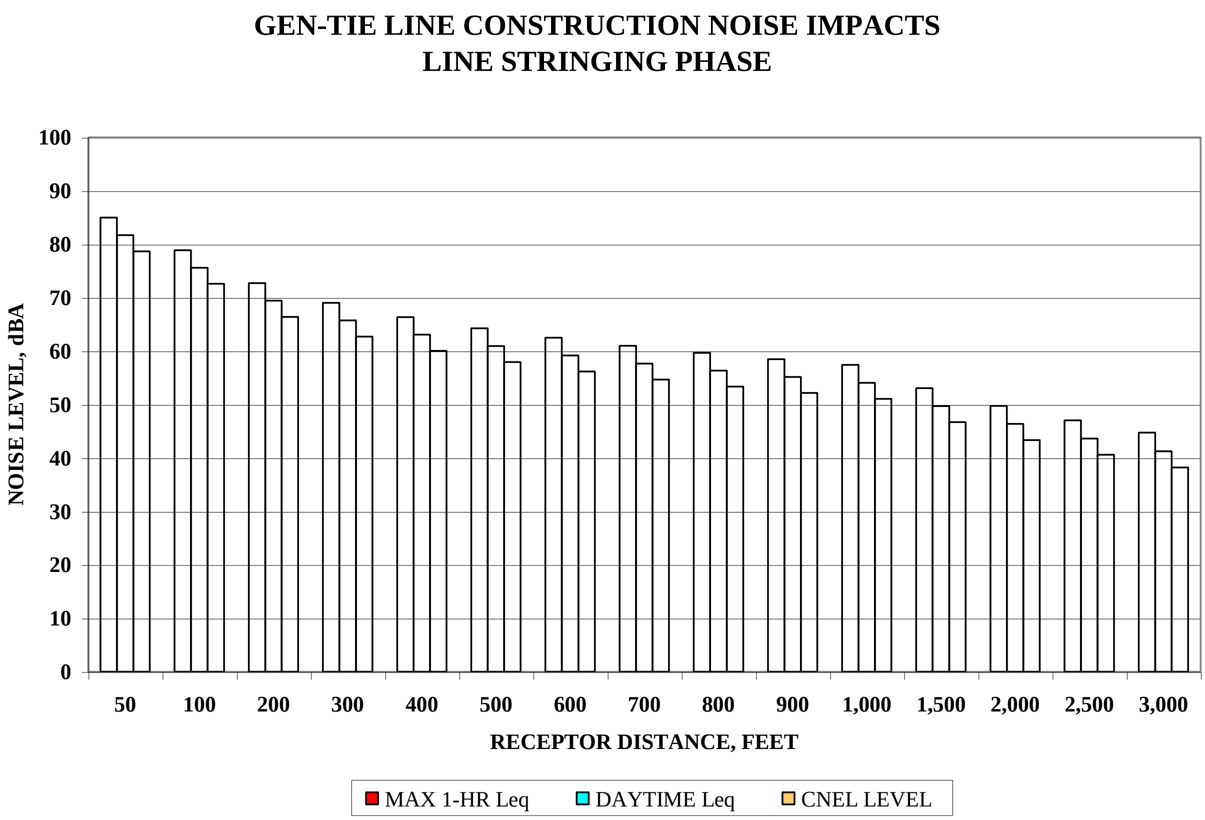



## Line Stringing Phase

**Table E1-9**
**Equipment Group Analyzed for the Line Stringing Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Tracked Dozer | 1 | 2 | 1.7 | 86 | 0.75 |
| Backhoe-Loader | 1 | 6 | 5.1 | 80 | 0.50 |
| Compressor | 1 | 4 | 4.0 | 81 | 0.66 |
| Line Puller | 1 | 4 | 3.0 | 81 | 0.81 |
| Mixed Trucks | 1 | 2 | 0.5 | 80 | 0.32 |
| Specialty Truck | 2 | 5 | 3.25 | 75 | 0.32 |
| Specialty | 2 | 4 | 2.6 | 75 | 0.32 |

| | | | | | |
|---|---|---|---|---|---|
| Truck | | | | | |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |



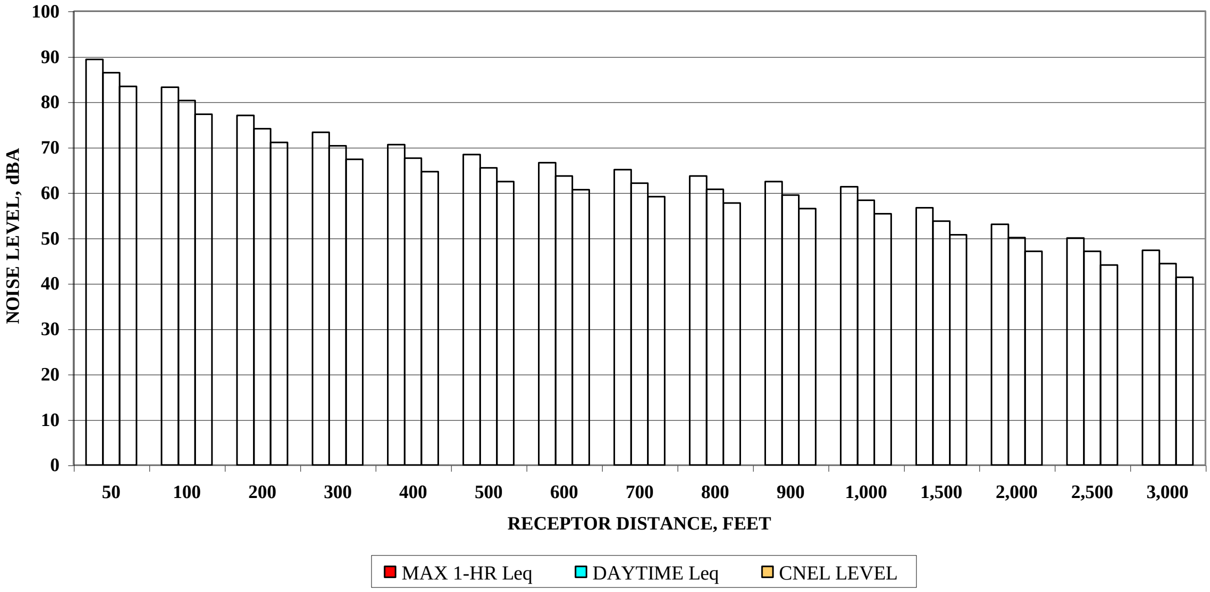
## RED BLUFF SUBSTATION CONSTRUCTION

### Site Clearing Phase

**Table E1-10.**
**Equipment Group Analyzed for the Site Clearing Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Brush Cutters | 2 | 8 | 6.8 | 81 | 0.75 |
| Tracked Dozer | 1 | 8 | 6.8 | 88 | 0.75 |
| Wheeled Tractor | 1 | 8 | 6.8 | 80 | 0.75 |
| Wheeled Loader | 1 | 4 | 3.0 | 80 | 0.50 |
| Wood Chipper | 1 | 4 | 2.6 | 91 | 0.75 |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |

RED BLUFF SUBSTATION CONSTRUCTION NOISE IMPACTS
SITE CLEARING OPERATIONS

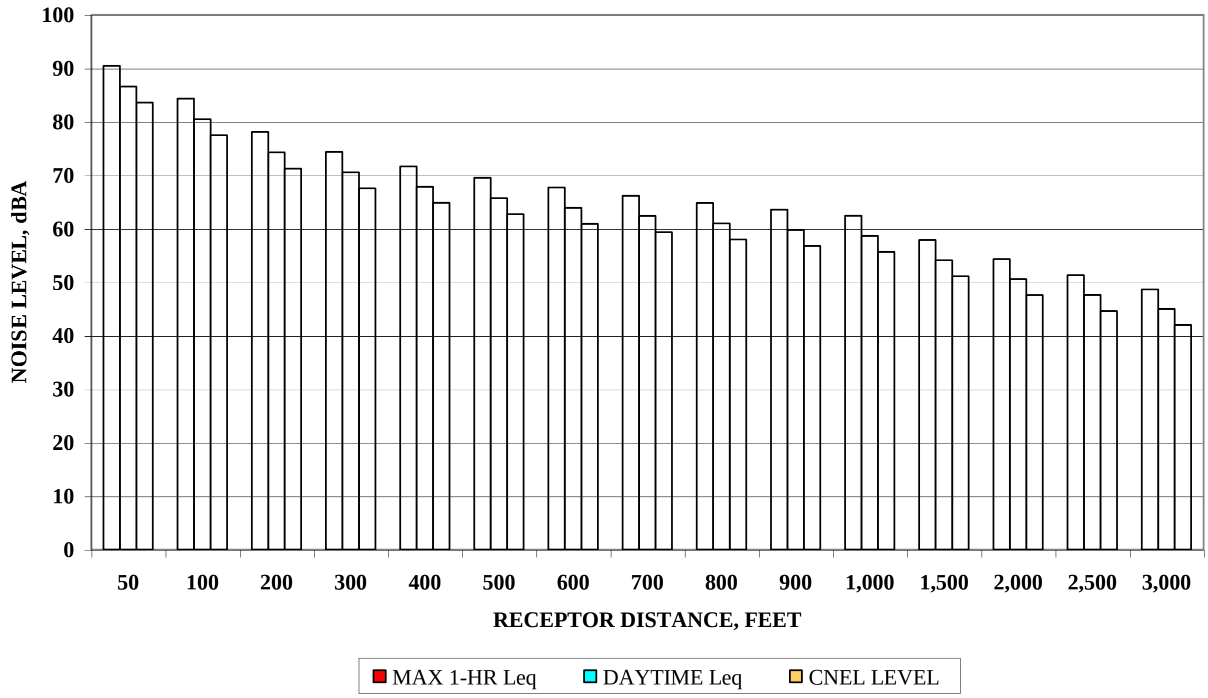



## Site Grading and Compaction Phase

**Table E1-11.**
**Equipment Group Analyzed for the Site Grading and Compaction Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Scraper | 1 | 7 | 5.1 | 85 | 0.75 |
| Tracked Dozer | 1 | 7 | 3.4 | 88 | 0.75 |
| Grader | 1 | 7 | 3.4 | 82 | 0.75 |
| Roller-Compactor | 1 | 8 | 6.8 | 75 | 0.45 |
| Wheeled Loader | 1 | 8 | 6.0 | 80 | 0.50 |
| Backhoe-Loader | 1 | 8 | 6.8 | 80 | 0.50 |
| Water Truck | 1 | 4 | 2.6 | 80 | 0.50 |

**RED BLUFF SUBSTATION CONSTRUCTION NOISE IMPACTS**
**SITE GRADING AND COMPACTION OPERATIONS**



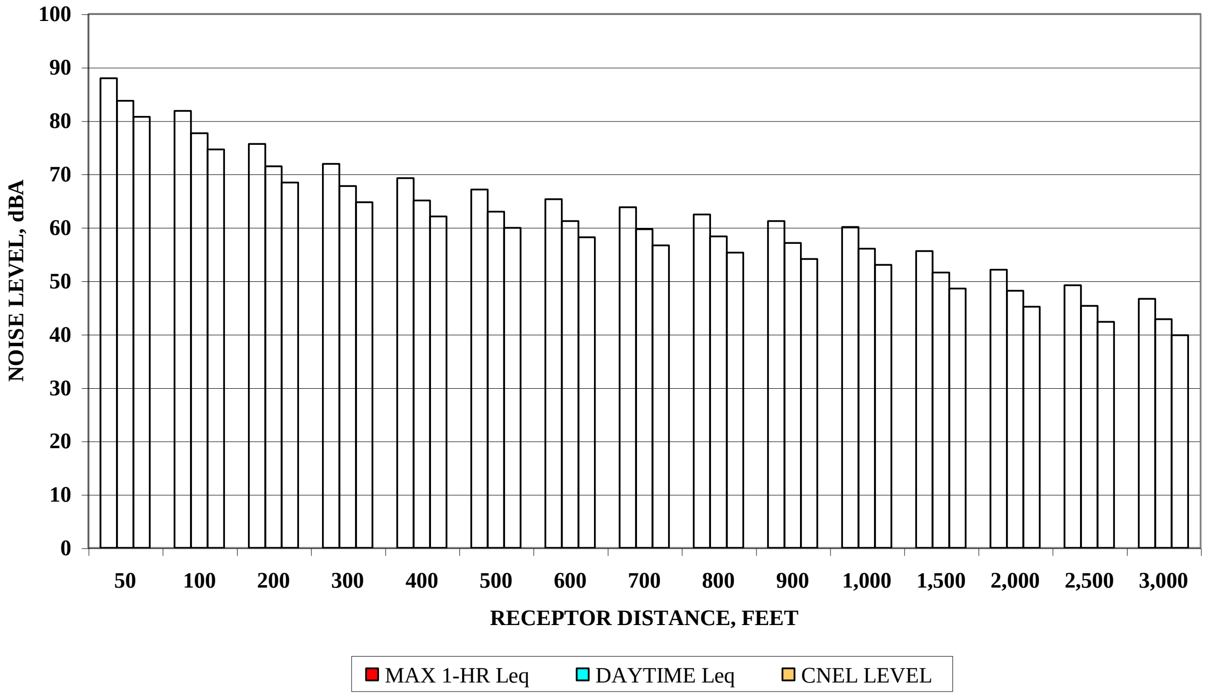

## Trenching and Foundations Phase

**Table E1-12.**
**Equipment Group Analyzed for the Trenching and Foundations Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Excavator | 1 | 6 | 3.4 | 80 | 0.75 |
| Backhoe-Loader | 1 | 6 | 5.1 | 80 | 0.50 |
| Skid-Steer Loader | 1 | 6 | 4.5 | 70 | 0.50 |
| Wheeled Loader | 1 | 6 | 4.5 | 80 | 0.50 |
| Auger Rig | 1 | 6 | 2.25 | 85 | 0.66 |

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Tracked Dozer | 1 | 2 | 1.7 | 88 | 0.75 |
| Cement Mixer Truck | 1 | 2 | 0.8 | 80 | 0.50 |
| Water Truck | 1 | 6 | 3.9 | 80 | 0.50 |

**RED BLUFF SUBSTATION CONSTRUCTION NOISE IMPACTS**
**TRENCHING AND FOUNDATIONS PHASE**

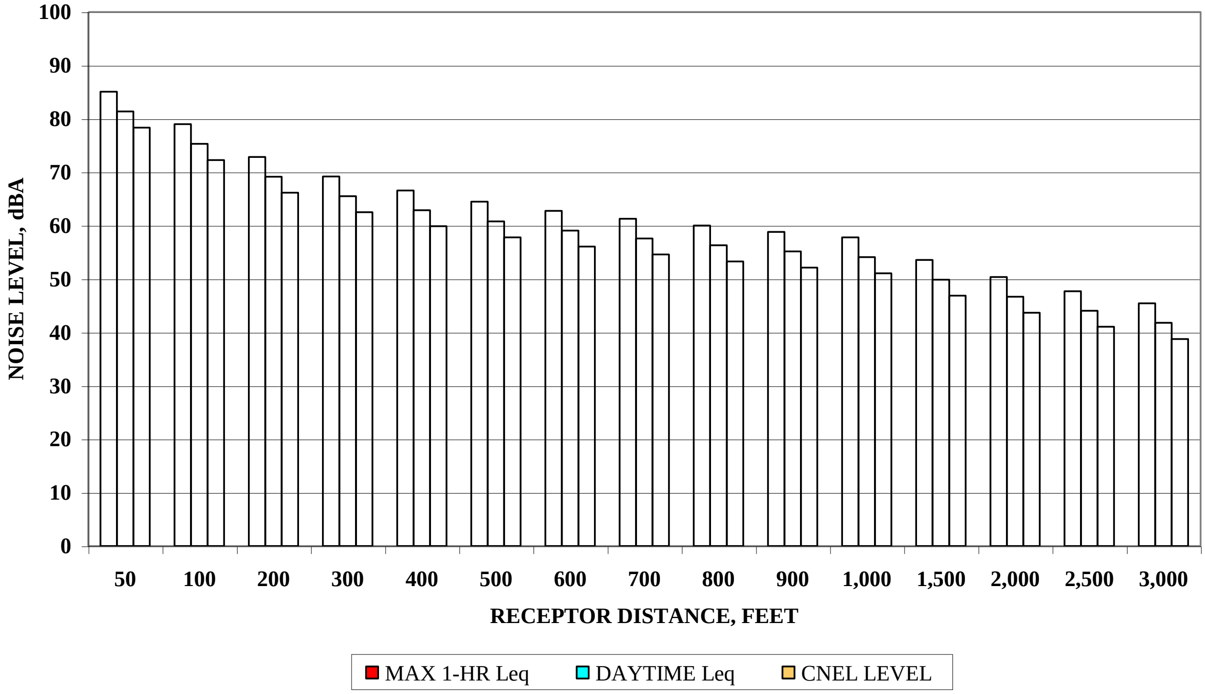


**Equipment Pads Phase**

**Table E1-13.**
**Equipment Group Analyzed for the Equipment Pads Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Wheeled Loader | 1 | 6 | 3.0 | 80 | 0.50 |
| Mobile Crane | 1 | 2 | 1.3 | 82 | 0.50 |
| Forklift | 1 | 6 | 2.6 | 80 | 0.50 |
| Flatbed Truck | 1 | 2 | 0.5 | 75 | 0.32 |
| Dump Truck | 2 | 6 | 1.5 | 80 | 0.32 |
| Cement Mixer Truck | 2 | 6 | 2.4 | 80 | 0.50 |
| Water Truck | 1 | 6 | 3.9 | 80 | 0.50 |

RED BLUFF SUBSTATION CONSTRUCTION NOISE IMPACTS
EQUIPMENT PADS PHASE

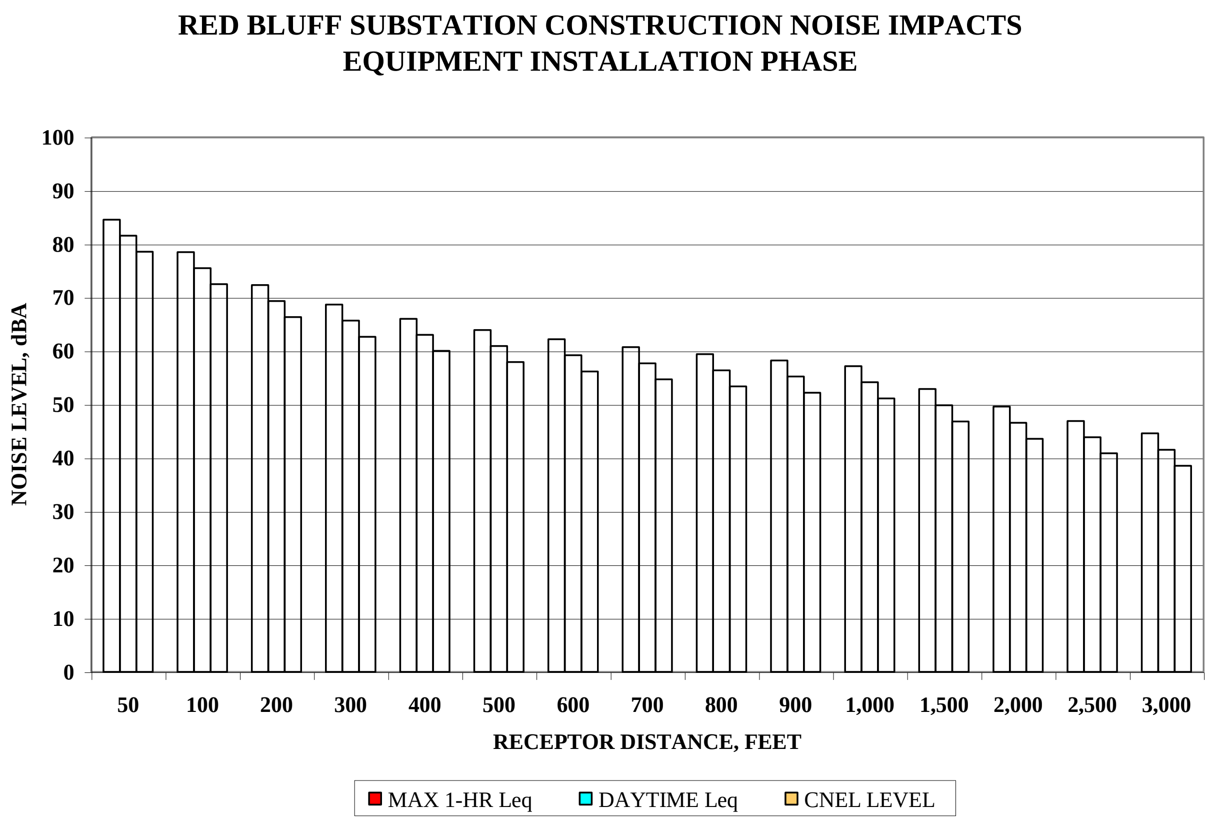



## Substation Equipment Installation Phase

**Table E1-14.**
**Equipment Group Analyzed for the Substation Equipment Installation Phase**

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Compressor | 1 | 8 | 8.0 | 81 | 0.66 |
| Mobile Crane | 1 | 2 | 1.3 | 82 | 0.50 |
| Forklift | 1 | 8 | 5.2 | 80 | 0.50 |
| Wheeled Loader | 1 | 7 | 4.5 | 80 | 0.50 |
| Dump Truck | 1 | 6 | 1.0 | 80 | 0.32 |
| Specialty Truck | 1 | 6 | 3.9 | 75 | 0.32 |
| | 1 | 6 | 3.9 | 80 | 0.50 |

| Equipment Item | Number Active at One Time | Active Hours Per Day | Net Daily Operating Hours Per Item | Noise Level at 50 Feet (dBA) | Atmospheric Absorption, dB per 100 Meters |
|---|---|---|---|---|---|
| Water Truck | | | | | |



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# APPENDIX E-2

# ADDITIONAL TRAFFIC NOISE ANALYSIS INFORMATION

## OVERVIEW OF THE FHWACNEL MODEL

Noise impacts from local highway traffic have been estimated using a spreadsheet model (FHWACNEL) originally designed as a batch mode implementation of the 1978 Federal Highway Administration (FHWA) traffic noise prediction model (subsequently released as the STAMINA model). The FHWA STAMINA model and the more recent FHWA TNM traffic noise model are designed to analyze noise levels from highway traffic for a single hour, using highway geometrics and traffic condition data input on a lane-by-lane basis. In contrast, the FHWACNEL spreadsheet model used for this analysis is designed to model traffic noise on an hourly basis over a 24-hour period, providing a direct calculation of CNEL or Ldn noise levels. In addition, the FHWACNEL spreadsheet model is designed to accommodate highway segments defined on either a single lane or a multi-lane basis.

The FHWACNEL spreadsheet model has been programmed using Lotus 1-2-3 spreadsheet software, which allows spreadsheet programming using sophisticated keystroke macros. The spreadsheet allows users to select from the original FHWA noise algorithms, alternative algorithms developed by the California Department of Transportation (Caltrans), alternative algorithms developed by the Ontario Department of Transportation, or the Caltrans algorithms with supplemental correction factors that adjust model results to values that are consistent with the more recent FHWA TNM traffic noise model. The Caltrans algorithms with TNM correction factors provide the default setup for the FHWACNEL model.

The FHWA traffic noise models define vehicle types according to the number of axles and tires on the vehicle. The 1978 FHWA traffic noise prediction model used three vehicle classes (light duty vehicles, medium trucks, and heavy trucks). The more recent TNM model uses five vehicle classes: light duty vehicles, motorcycles, medium trucks, buses, and heavy trucks. Light duty vehicles are all vehicles with two axles and four tires. Motorcycles are vehicles with two axles, either two or three tires, and an open driver compartment. Medium trucks are cargo vehicles with two axles and six tires. Buses are vehicles which have either two or three axles and which are designed to carry 9 or more passengers. Heavy trucks are cargo vehicles with three or more axles. For use in the FHWACNEL model, the TNM classes of light duty vehicles and motorcycles are merged, and the TNM classes of medium trucks and buses are merged. For practical purposes, motor homes are presently treated as buses in the FHWACNEL model.

The FHWACNEL model incorporates separate sets of TNM correction factors for light duty vehicles, medium duty trucks, and heavy duty trucks. The TNM correction factors for each vehicle type vary based on vehicle speed and receptor distance. The TNM correction factor values were derived from parallel analyses using the TNM 2.5 Lookup program and the FHWACNEL spreadsheet with the original Caltrans algorithms. The TNM correction factors cover a speed range of 0 to 75 mph and a receptor distance range of 50 to 950 feet. The default TNM correction factors assume that 3.7% of light duty vehicles are motorcycles (the California statewide average) and that 37.1% of medium duty trucks are buses and motor homes (the

California statewide average). A separate spreadsheet generates replacement TNM correction factor values for user-specified motocycle and bus/motor home percentages.

The FHWACNEL model analyzes hourly traffic volumes over a 24-hour period for a road network of up to 30 highway segments (single or multi-lane, one-way or bi-directional) and up to 40 receptor locations. Users input the receptor coordinates, highway segment centerline coordinates, highway width, average daily traffic volume, nominal free-flow speed, and hourly vehicle capacity for each highway segment. In addition, users input an hourly distribution pattern for the daily traffic (either project-specific or from a library of typical patterns), the hourly percentage of medium duty trucks (either project-specific or from a library of typical patterns), and the hourly percentage of heavy duty trucks (either project-specific or from a library of typical patterns). The FHWACNEL spreadsheet includes a database of hourly traffic volume and hourly truck percentage patterns for an array of roadway types that can be used directly or modified to provide hourly traffic estimates based on known or predicted ADT values. A spreadsheet macro automatically processes hourly traffic patterns for each highway segment and all receptor locations. The FHWACNEL model adjusts hourly vehicle speeds according to the volume:capacity ratio. The model automatically creates a separate output file for each highway segment; the output files summarize the highway segment contributions to hourly Leq and daily CNEL or Ldn levels at each receptor location. A separate spreadsheet program (LINKSUM) automatically combines results from each highway segment output file to produce total hourly Leq and daily CNEL or Ldn estimates at each receptor location. The LINKSUM spreadsheet automates the creation of summary tables for CNEL, Ldn, maximum hourly Leq, or Leq by clock hour for each receptor across all modeled highway segment. The LINKSUM spreadsheet can also generate a matrix of receptor distances to each highway segment.

## ANALYSES FOR THE PROPOSED PROJECT AND ALTERNATIVES

### Modeled Roadways

Roadways incorporated into the traffic noise modeling analysis included segments of I-10 east and west of the Highway 177 interchange, Highway 177 from I-10 to Kaiser Road, and Kaiser Road between Highway 177 and the solar farm site. For simplicity, I-10 was treated as an east-west roadway and Highway 177 and Kaiser Road were treated as north-south roadways.

### Modeled Receptor Locations

Receptors for the traffic noise modeling analysis were established along three sets of receptor transects perpendicular to Kaiser Road or Highway 177. Each receptor transect had six receptor points east of the relevant roadway and six receptor points west of the relevant roadway. Receptor points were located at distances of 50 feet, 100 feet, 250 feet, 500 feet, 750 feet, and 1,000 feet from the roadway centerline. The southernmost transects were located in Desert Center east and west of Highway 177, south of Ragsdale Road and 550 feet north of the point where the centerlines of Highway 177 and I-10 intersect. The central transects were located east and west of Kaiser Road in the Lake Tamarisk area, about 600 feet north of Oasis Road. The northernmost transects were located east and west of Kaiser Road about midway between the Lake Tamarisk development and the solar farm site.

**Modeled Traffic Volumes**

Existing traffic volumes for Kaiser Road were based on the 24-hour traffic counts provided in the traffic study (Hernandez, Kroone & Associates 2010). The traffic count was conducted north of the Lake Tamarisk development, and showed a daily total volume of 108 vehicles. Existing traffic volumes for the portion of Kaiser Road south of the Lake Tamarisk development were estimated by increasing the daily volume to 150 vehicles. Baseline traffic conditions for Highway 177 and I-10 were developed from 2008 traffic count data and 2007 truck count data downloaded from the Caltrans website (Caltrans 2007, 2008). The traffic count data for Kaiser Road provided hourly auto and truck volume patterns. The hourly auto and truck volume patterns for Highway 177 and I-10 were extrapolated from daily volumes and hourly distribution patterns adjusted to match reported peak hour conditions.

Traffic conditions for 2011 and 2012 were developed by adding project-related traffic volumes to the baseline traffic volumes for each roadway segment. Construction-related traffic would include construction worker commute traffic and heavy truck traffic bringing equipment and materials to the construction sites. Construction worker and construction truck traffic volumes for each alternative were based on estimates generated by the construction emissions model (see Appendices D-1 and D-2). The two solar farm alternatives would have somewhat different construction worker commute volumes and somewhat different construction truck traffic volumes. For analysis purposes, all Gen-Tie Line alternatives were assumed to generate the same volumes of construction worker and construction truck traffic. The traffic volumes for Gen Tie Line A-1 were used for all alternatives. Construction traffic for the two Red Bluff Substation alternatives was not included in the analysis because that traffic would not use Highway 177 or Kaiser Road.

Table E2-1 summarizes the traffic conditions used for the traffic noise modeling analysis.

**Table E2-1.**
**Traffic Conditions Used for Traffic Noise Modeling.**

| Road Segment | Parameter | Existing Conditions | Alt 1 & 2, 2011 | Alt 1 & 2, 2012 | Alt 3, 2011 | Alt 3, 2012 |
|---|---|---|---|---|---|---|
| I-10 West of Highway 177 | Modeled Road Length, ft | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | Combined Traffic Lane Widths, ft | 56 | 56 | 56 | 56 | 56 |
| | Light Vehicle Speed, mph | 65 | 65 | 65 | 65 | 65 |
| | Medium Truck Speed, mph | 65 | 65 | 65 | 65 | 65 |
| | Heavy Truck Speed, mph | 65 | 65 | 65 | 65 | 65 |

| Road Segment | Parameter | Existing Conditions | Alt 1 & 2, 2011 | Alt 1 & 2, 2012 | Alt 3, 2011 | Alt 3, 2012 |
|---|---|---|---|---|---|---|
| | ADT | 23,000 | 23,278 | 23,157 | 23,271 | 23,145 |
| | Medium Truck % of ADT | 5.16% | 5.5% | 5.5% | 5.5% | 5.5% |
| | Heavy Truck % of ADT | 34.29% | 35.4% | 35.4% | 35.3% | 35.4% |
| | Peak Hour Volume | 3,000 | 2,998 | 2,994 | 2,997 | 2,994 |
| | Hourly Capacity | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| | Drop-off Rate, dBA per doubling of distance | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| I-10 East of Highway 177 | Modeled Road Length, ft | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 |
| | Combined Traffic Lane Widths, ft | 56 | 56 | 56 | 56 | 56 |
| | Light Vehicle Speed, mph | 65 | 65 | 65 | 65 | 65 |
| | Medium Truck Speed, mph | 65 | 65 | 65 | 65 | 65 |
| | Heavy Truck Speed, mph | 65 | 65 | 65 | 65 | 65 |
| | ADT | 21,400 | 21,598 | 21,485 | 21,591 | 21,481 |
| | Medium Truck % of ADT | 5.61% | 6.0% | 6.0% | 6.0% | 6.0% |
| | Heavy Truck % of ADT | 37.79% | 40.2% | 40.3% | 40.2% | 40.3% |
| | Peak Hour Volume | 2,800 | 2,790 | 2,786 | 2,789 | 2,786 |
| | Hourly Capacity | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| | Drop-off Rate, dBA per doubling of distance | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| Highway 177 south of Kaiser Road | Modeled Road Length, ft | 1,429 | 1,429 | 1,429 | 1,429 | 1,429 |
| | Combined Traffic Lane Widths, ft | 24 | 24 | 24 | 24 | 24 |
| | Light Vehicle Speed, mph | 50 | 50 | 50 | 50 | 50 |

| Road Segment | Parameter | Existing Conditions | Alt 1 & 2, 2011 | Alt 1 & 2, 2012 | Alt 3, 2011 | Alt 3, 2012 |
|---|---|---|---|---|---|---|
| | Medium Truck Speed, mph | 50 | 50 | 50 | 50 | 50 |
| | Heavy Truck Speed, mph | 50 | 50 | 50 | 50 | 50 |
| | ADT | 2,250 | 2,613 | 2,475 | 2,596 | 2,451 |
| | Medium Truck % of ADT | 4.4% | 5.8% | 5.7% | 5.7% | 5.5% |
| | Heavy Truck % of ADT | 9.6% | 10.9% | 9.5% | 10.4% | 9.2% |
| | Peak Hour Volume | 290 | 304 | 298 | 303 | 296 |
| | Hourly Capacity | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| | Drop-off Rate, dBA per doubling of distance | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| Kaiser Road south of Tamarisk Lake | Modeled Road Length, ft | 9,029 | 9,029 | 9,029 | 9,029 | 9,029 |
| | Combined Traffic Lane Widths, ft | 24 | 24 | 24 | 24 | 24 |
| | Light Vehicle Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | Medium Truck Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | Heavy Truck Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | ADT | 150 | 510 | 372 | 493 | 358 |
| | Medium Truck % of ADT | 20.4% | 20.1% | 24.8% | 20.0% | 24.1% |
| | Heavy Truck % of ADT | 6.5% | 25.4% | 21.5% | 23.1% | 22.5% |
| | Peak Hour Volume | 17 | 140 | 95 | 139 | 88 |
| | Hourly Capacity | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| | Drop-off Rate, dBA per doubling of distance | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| Kaiser Road | Modeled Road Length, ft | 23,133 | 23,133 | 23,133 | 23,133 | 23,133 |

| Road Segment | Parameter | Existing Conditions | Alt 1 & 2, 2011 | Alt 1 & 2, 2012 | Alt 3, 2011 | Alt 3, 2012 |
|---|---|---|---|---|---|---|
| north of Tamarisk Lake | Combined Traffic Lane Widths, ft | 24 | 24 | 24 | 24 | 24 |
| | Light Vehicle Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | Medium Truck Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | Heavy Truck Speed, mph | 45 | 45 | 45 | 45 | 45 |
| | ADT | 108 | 468 | 330 | 451 | 316 |
| | Medium Truck % of ADT | 20.4% | 20.1% | 24.8% | 20.0% | 24.1% |
| | Heavy Truck % of ADT | 6.5% | 25.4% | 21.5% | 23.1% | 22.5% |
| | Peak Hour Volume | 12 | 135 | 90 | 134 | 83 |
| | Hourly Capacity | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| | Drop-off Rate, dBA per doubling of distance | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |

Table E2-2 summarizes hourly vehicle percentage patterns used in the traffic noise model for I-10 west of Highway 177 under Alternatives 1 and 2.

**Table E2-2.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: I-10 West of Highway 177**

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 1.0% | 5.0% | 0.1% | 0.0% | 4.3% | 0.1% | 0.0% | 4.3% |
| 1:00 AM | 0.1% | 1.5% | 6.0% | 0.1% | 0.0% | 4.3% | 0.1% | 0.0% | 4.3% |
| 2:00 AM | 0.2% | 2.0% | 7.0% | 0.2% | 2.2% | 6.5% | 0.2% | 2.2% | 6.5% |
| 3:00 AM | 0.2% | 3.0% | 9.0% | 0.2% | 2.2% | 8.7% | 0.2% | 2.2% | 8.7% |
| 4:00 AM | 0.4% | 3.0% | 12.0% | 0.4% | 3.3% | 12.0% | 0.4% | 3.3% | 12.0% |
| 5:00 AM | 0.6% | 4.5% | 16.0% | 0.6% | 4.3% | 15.9% | 0.6% | 4.3% | 15.9% |
| 6:00 AM | 1.5% | 5.0% | 24.0% | 1.9% | 9.8% | 18.5% | 1.8% | 9.8% | 20.4% |
| 7:00 AM | 3.5% | 5.5% | 30.0% | 3.5% | 5.4% | 30.5% | 3.5% | 5.4% | 30.3% |

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 8:00 AM | 6.0% | 5.8% | 38.0% | 6.0% | 5.8% | 38.3% | 6.0% | 5.8% | 38.2% |
| 9:00 AM | 7.0% | 6.0% | 47.0% | 7.0% | 6.0% | 47.4% | 7.0% | 6.0% | 47.2% |
| 10:00 AM | 8.0% | 6.6% | 50.0% | 8.0% | 6.5% | 50.3% | 8.0% | 6.6% | 50.1% |
| 11:00 AM | 9.0% | 6.4% | 51.0% | 8.9% | 6.3% | 51.3% | 9.0% | 6.4% | 51.1% |
| 12:00 PM | 10.5% | 6.1% | 47.0% | 10.4% | 6.1% | 47.2% | 10.4% | 6.1% | 47.1% |
| 1:00 PM | 13.0% | 5.8% | 42.0% | 12.9% | 5.8% | 42.2% | 12.9% | 5.8% | 42.1% |
| 2:00 PM | 9.0% | 5.6% | 37.0% | 8.9% | 5.6% | 37.2% | 9.0% | 5.6% | 37.1% |
| 3:00 PM | 8.0% | 5.5% | 27.0% | 8.4% | 6.6% | 25.6% | 8.2% | 6.5% | 26.1% |
| 4:00 PM | 7.5% | 5.0% | 22.0% | 7.4% | 5.0% | 22.0% | 7.4% | 5.0% | 22.0% |
| 5:00 PM | 6.0% | 4.0% | 17.0% | 5.9% | 4.0% | 17.0% | 6.0% | 4.0% | 17.0% |
| 6:00 PM | 3.5% | 3.0% | 15.0% | 3.5% | 3.0% | 15.0% | 3.5% | 3.0% | 15.0% |
| 7:00 PM | 2.0% | 2.2% | 14.0% | 2.0% | 2.2% | 13.9% | 2.0% | 2.2% | 13.9% |
| 8:00 PM | 1.7% | 1.8% | 12.0% | 1.7% | 1.8% | 12.0% | 1.7% | 1.8% | 12.0% |
| 9:00 PM | 1.0% | 1.6% | 8.0% | 1.0% | 1.7% | 7.8% | 1.0% | 1.7% | 7.8% |
| 10:00 PM | 0.7% | 1.5% | 7.0% | 0.7% | 1.2% | 6.8% | 0.7% | 1.2% | 6.8% |
| 11:00 PM | 0.5% | 1.0% | 5.0% | 0.5% | 0.9% | 5.2% | 0.5% | 0.9% | 5.2% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-3 summarizes hourly vehicle percentage patterns used in the traffic noise model for I-10 east of Highway 177 under Alternatives 1 and 2.

**Table E2-3.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: I-10 East of Highway 177**

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 1.0% | 6.0% | 0.1% | 0.0% | 4.8% | 0.1% | 0.0% | 4.8% |
| 1:00 AM | 0.1% | 1.5% | 7.0% | 0.1% | 0.0% | 4.8% | 0.1% | 0.0% | 4.8% |
| 2:00 AM | 0.2% | 2.0% | 8.0% | 0.2% | 2.3% | 7.0% | 0.2% | 2.3% | 7.0% |
| 3:00 AM | 0.2% | 3.0% | 10.0% | 0.2% | 2.3% | 9.3% | 0.2% | 2.3% | 9.3% |
| 4:00 AM | 0.4% | 3.5% | 16.0% | 0.4% | 3.5% | 16.3% | 0.4% | 3.5% | 16.3% |
| 5:00 AM | 0.6% | 4.5% | 21.0% | 0.6% | 4.7% | 21.1% | 0.6% | 4.7% | 21.1% |
| 6:00 AM | 1.5% | 5.0% | 29.0% | 1.8% | 6.5% | 24.2% | 1.6% | 6.9% | 26.8% |
| 7:00 AM | 3.5% | 5.5% | 35.0% | 3.5% | 5.4% | 35.4% | 3.5% | 5.5% | 35.2% |
| 8:00 AM | 6.0% | 6.0% | 43.0% | 6.0% | 6.0% | 43.3% | 6.0% | 6.0% | 43.2% |
| 9:00 AM | 7.0% | 6.5% | 52.0% | 7.0% | 6.4% | 52.4% | 7.0% | 6.5% | 52.2% |

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 10:00 AM | 8.0% | 7.0% | 55.0% | 8.0% | 7.0% | 55.3% | 8.0% | 7.0% | 55.2% |
| 11:00 AM | 9.0% | 7.2% | 56.0% | 9.0% | 7.2% | 56.3% | 9.0% | 7.2% | 56.1% |
| 12:00 PM | 10.5% | 7.0% | 52.0% | 10.5% | 7.0% | 52.2% | 10.5% | 7.0% | 52.1% |
| 1:00 PM | 13.0% | 6.8% | 47.0% | 12.9% | 6.8% | 47.2% | 13.0% | 6.8% | 47.1% |
| 2:00 PM | 9.0% | 6.5% | 42.0% | 8.9% | 6.5% | 42.2% | 9.0% | 6.5% | 42.1% |
| 3:00 PM | 8.0% | 6.0% | 32.0% | 8.2% | 6.3% | 30.9% | 8.1% | 6.4% | 31.5% |
| 4:00 PM | 7.5% | 5.4% | 27.0% | 7.4% | 5.4% | 27.0% | 7.5% | 5.4% | 27.0% |
| 5:00 PM | 6.0% | 4.9% | 22.0% | 5.9% | 4.9% | 22.0% | 6.0% | 4.9% | 22.0% |
| 6:00 PM | 3.5% | 3.9% | 19.0% | 3.5% | 3.9% | 19.0% | 3.5% | 3.9% | 19.0% |
| 7:00 PM | 2.0% | 3.0% | 17.0% | 2.0% | 3.0% | 17.1% | 2.0% | 3.0% | 17.1% |
| 8:00 PM | 1.7% | 2.0% | 15.0% | 1.7% | 1.9% | 15.1% | 1.7% | 1.9% | 15.1% |
| 9:00 PM | 1.0% | 1.6% | 10.0% | 1.0% | 1.4% | 9.8% | 1.0% | 1.4% | 9.8% |
| 10:00 PM | 0.7% | 1.5% | 9.0% | 0.7% | 1.3% | 9.3% | 0.7% | 1.3% | 9.3% |
| 11:00 PM | 0.5% | 1.0% | 6.0% | 0.5% | 0.9% | 5.6% | 0.5% | 0.9% | 5.6% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-4 summarizes hourly vehicle percentage patterns used in the traffic noise model for Highway 177 south of Kaiser Road under Alternatives 1 and 2.

**Table E2-4.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Highway 177 South of Kaiser Road**

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 0.3% | 2.0% | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| 1:00 AM | 0.1% | 0.3% | 2.0% | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| 2:00 AM | 0.2% | 0.4% | 2.3% | 0.2% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% |
| 3:00 AM | 0.2% | 0.5% | 2.8% | 0.2% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% |
| 4:00 AM | 0.4% | 0.6% | 3.0% | 0.3% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% |
| 5:00 AM | 0.6% | 1.5% | 3.5% | 0.5% | 0.0% | 0.0% | 0.6% | 0.0% | 0.0% |
| 6:00 AM | 1.5% | 2.0% | 7.0% | 6.0% | 23.4% | 1.3% | 4.6% | 27.4% | 1.8% |
| 7:00 AM | 3.5% | 4.0% | 9.0% | 3.4% | 3.4% | 19.1% | 3.4% | 3.5% | 15.3% |
| 8:00 AM | 6.0% | 4.0% | 10.0% | 5.7% | 3.4% | 18.8% | 5.8% | 3.5% | 15.4% |
| 9:00 AM | 7.0% | 4.5% | 11.0% | 6.7% | 4.0% | 19.0% | 6.7% | 4.2% | 15.6% |
| 10:00 AM | 8.0% | 5.0% | 9.0% | 7.5% | 4.6% | 16.3% | 7.6% | 4.8% | 13.2% |

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 11:00 AM | 9.0% | 5.3% | 7.5% | 8.4% | 5.0% | 14.2% | 8.6% | 5.2% | 11.3% |
| 12:00 PM | 10.5% | 4.8% | 9.0% | 9.6% | 4.4% | 14.7% | 9.9% | 4.5% | 12.2% |
| 1:00 PM | 12.9% | 5.0% | 8.0% | 11.6% | 4.9% | 12.2% | 12.0% | 5.0% | 10.4% |
| 2:00 PM | 9.1% | 3.5% | 7.0% | 8.2% | 3.3% | 11.2% | 8.5% | 3.3% | 9.5% |
| 3:00 PM | 8.0% | 3.0% | 6.0% | 11.6% | 13.5% | 3.6% | 10.5% | 13.5% | 4.2% |
| 4:00 PM | 7.5% | 2.0% | 7.2% | 6.5% | 1.8% | 7.1% | 6.8% | 1.8% | 7.1% |
| 5:00 PM | 6.0% | 1.5% | 7.8% | 5.2% | 1.5% | 7.4% | 5.5% | 1.5% | 7.4% |
| 6:00 PM | 3.5% | 1.0% | 7.3% | 3.0% | 1.3% | 7.6% | 3.2% | 1.3% | 7.6% |
| 7:00 PM | 2.0% | 0.6% | 5.0% | 1.7% | 0.0% | 4.4% | 1.8% | 0.0% | 4.4% |
| 8:00 PM | 1.7% | 0.4% | 3.0% | 1.5% | 0.0% | 2.6% | 1.5% | 0.0% | 2.6% |
| 9:00 PM | 1.0% | 0.3% | 2.5% | 0.9% | 0.0% | 4.3% | 0.9% | 0.0% | 4.3% |
| 10:00 PM | 0.7% | 0.3% | 2.0% | 0.6% | 0.0% | 0.0% | 0.6% | 0.0% | 0.0% |
| 11:00 PM | 0.5% | 0.3% | 2.0% | 0.4% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-5 summarizes hourly vehicle percentage patterns used in the traffic noise model for Kaiser Road south of Lake Tamarisk under Alternatives 1 and 2.

**Table E2-5.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Kaiser Road South of Lake Tamarisk**

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 2:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 3:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 4:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 5:00 AM | 2.8% | 33.3% | 0.0% | 0.6% | 33.3% | 0.0% | 0.9% | 33.3% | 0.0% |
| 6:00 AM | 8.3% | 22.2% | 0.0% | 28.4% | 28.6% | 0.0% | 26.7% | 36.4% | 0.0% |
| 7:00 AM | 9.3% | 20.0% | 0.0% | 4.3% | 10.0% | 50.0% | 4.8% | 12.5% | 37.5% |
| 8:00 AM | 2.8% | 0.0% | 0.0% | 3.6% | 0.0% | 82.4% | 3.3% | 0.0% | 72.7% |
| 9:00 AM | 5.6% | 16.7% | 0.0% | 4.7% | 4.5% | 72.7% | 4.5% | 6.7% | 60.0% |
| 10:00 AM | 8.3% | 33.3% | 11.1% | 5.3% | 12.0% | 68.0% | 5.5% | 16.7% | 55.6% |
| 11:00 AM | 8.3% | 44.4% | 11.1% | 5.3% | 16.0% | 68.0% | 5.5% | 22.2% | 55.6% |

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 PM | 5.6% | 33.3% | 16.7% | 4.7% | 9.1% | 77.3% | 4.5% | 13.3% | 66.7% |
| 1:00 PM | 11.1% | 25.0% | 8.3% | 5.6% | 11.5% | 57.7% | 6.1% | 15.0% | 45.0% |
| 2:00 PM | 8.3% | 11.1% | 11.1% | 4.1% | 5.3% | 57.9% | 4.5% | 6.7% | 46.7% |
| 3:00 PM | 10.2% | 18.2% | 0.0% | 28.8% | 28.1% | 0.0% | 27.3% | 35.6% | 0.0% |
| 4:00 PM | 6.5% | 0.0% | 0.0% | 1.5% | 0.0% | 0.0% | 2.1% | 0.0% | 0.0% |
| 5:00 PM | 2.8% | 0.0% | 0.0% | 0.6% | 0.0% | 0.0% | 0.9% | 0.0% | 0.0% |
| 6:00 PM | 5.6% | 0.0% | 0.0% | 1.3% | 0.0% | 0.0% | 1.8% | 0.0% | 0.0% |
| 7:00 PM | 1.9% | 50.0% | 0.0% | 0.4% | 50.0% | 0.0% | 0.6% | 50.0% | 0.0% |
| 8:00 PM | 0.9% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% |
| 9:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 10:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 11:00 PM | 1.9% | 0.0% | 100.0% | 0.4% | 0.0% | 100.0% | 0.6% | 0.0% | 100.0% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-6 summarizes hourly vehicle percentage patterns used in the traffic noise model for Kaiser Road Between Lake Tamarisk and the solar farm site under Alternatives 1 and 2.

**Table E2-6.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Kaiser Road Between Lake Tamarisk and the Solar Farm Site**

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 2:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 3:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 4:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 5:00 AM | 2.8% | 33.3% | 0.0% | 0.6% | 33.3% | 0.0% | 0.9% | 33.3% | 0.0% |
| 6:00 AM | 8.3% | 22.2% | 0.0% | 28.4% | 28.6% | 0.0% | 26.7% | 36.4% | 0.0% |
| 7:00 AM | 9.3% | 20.0% | 0.0% | 4.3% | 10.0% | 50.0% | 4.8% | 12.5% | 37.5% |
| 8:00 AM | 2.8% | 0.0% | 0.0% | 3.6% | 0.0% | 82.4% | 3.3% | 0.0% | 72.7% |
| 9:00 AM | 5.6% | 16.7% | 0.0% | 4.7% | 4.5% | 72.7% | 4.5% | 6.7% | 60.0% |
| 10:00 AM | 8.3% | 33.3% | 11.1% | 5.3% | 12.0% | 68.0% | 5.5% | 16.7% | 55.6% |
| 11:00 AM | 8.3% | 44.4% | 11.1% | 5.3% | 16.0% | 68.0% | 5.5% | 22.2% | 55.6% |

| Start of Hour | Existing Conditions | | | Alt 1 & 2 Conditions, 2011 | | | Alt 1 & 2 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 PM | 5.6% | 33.3% | 16.7% | 4.7% | 9.1% | 77.3% | 4.5% | 13.3% | 66.7% |
| 1:00 PM | 11.1% | 25.0% | 8.3% | 5.6% | 11.5% | 57.7% | 6.1% | 15.0% | 45.0% |
| 2:00 PM | 8.3% | 11.1% | 11.1% | 4.1% | 5.3% | 57.9% | 4.5% | 6.7% | 46.7% |
| 3:00 PM | 10.2% | 18.2% | 0.0% | 28.8% | 28.1% | 0.0% | 27.3% | 35.6% | 0.0% |
| 4:00 PM | 6.5% | 0.0% | 0.0% | 1.5% | 0.0% | 0.0% | 2.1% | 0.0% | 0.0% |
| 5:00 PM | 2.8% | 0.0% | 0.0% | 0.6% | 0.0% | 0.0% | 0.9% | 0.0% | 0.0% |
| 6:00 PM | 5.6% | 0.0% | 0.0% | 1.3% | 0.0% | 0.0% | 1.8% | 0.0% | 0.0% |
| 7:00 PM | 1.9% | 50.0% | 0.0% | 0.4% | 50.0% | 0.0% | 0.6% | 50.0% | 0.0% |
| 8:00 PM | 0.9% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% |
| 9:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 10:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 11:00 PM | 1.9% | 0.0% | 100.0% | 0.4% | 0.0% | 100.0% | 0.6% | 0.0% | 100.0% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles

Table E2-7 summarizes hourly vehicle percentage patterns used in the traffic noise model for I-10 west of Highway 177 under Alternative 3.

**Table E2-7.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: I-10 West of Highway 177**

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 1.0% | 5.0% | 0.1% | 0.0% | 4.3% | 0.1% | 0.0% | 4.3% |
| 1:00 AM | 0.1% | 1.5% | 6.0% | 0.1% | 0.0% | 4.3% | 0.1% | 0.0% | 4.3% |
| 2:00 AM | 0.2% | 2.0% | 7.0% | 0.2% | 2.2% | 6.5% | 0.2% | 2.2% | 6.5% |
| 3:00 AM | 0.2% | 3.0% | 9.0% | 0.2% | 2.2% | 8.7% | 0.2% | 2.2% | 8.7% |
| 4:00 AM | 0.4% | 3.0% | 12.0% | 0.4% | 3.3% | 12.0% | 0.4% | 3.3% | 12.0% |
| 5:00 AM | 0.6% | 4.5% | 16.0% | 0.6% | 4.3% | 15.9% | 0.6% | 4.3% | 15.9% |
| 6:00 AM | 1.5% | 5.0% | 24.0% | 1.9% | 9.6% | 18.5% | 1.7% | 9.2% | 20.7% |
| 7:00 AM | 3.5% | 5.5% | 30.0% | 3.5% | 5.4% | 30.5% | 3.5% | 5.4% | 30.3% |
| 8:00 AM | 6.0% | 5.8% | 38.0% | 6.0% | 5.8% | 38.3% | 6.0% | 5.8% | 38.2% |
| 9:00 AM | 7.0% | 6.0% | 47.0% | 7.0% | 6.0% | 47.3% | 7.0% | 6.0% | 47.2% |
| 10:00 AM | 8.0% | 6.6% | 50.0% | 7.9% | 6.5% | 50.3% | 8.0% | 6.6% | 50.1% |
| 11:00 AM | 9.0% | 6.4% | 51.0% | 8.9% | 6.3% | 51.3% | 9.0% | 6.4% | 51.1% |
| 12:00 PM | 10.5% | 6.1% | 47.0% | 10.4% | 6.1% | 47.2% | 10.5% | 6.1% | 47.1% |
| 1:00 PM | 13.0% | 5.8% | 42.0% | 12.9% | 5.8% | 42.1% | 12.9% | 5.8% | 42.1% |
| 2:00 PM | 9.0% | 5.6% | 37.0% | 8.9% | 5.6% | 37.1% | 9.0% | 5.6% | 37.1% |

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 3:00 PM | 8.0% | 5.5% | 27.0% | 8.4% | 6.5% | 25.6% | 8.2% | 6.4% | 26.2% |
| 4:00 PM | 7.5% | 5.0% | 22.0% | 7.4% | 5.0% | 22.0% | 7.5% | 5.0% | 22.0% |
| 5:00 PM | 6.0% | 4.0% | 17.0% | 5.9% | 4.0% | 17.0% | 6.0% | 4.0% | 17.0% |
| 6:00 PM | 3.5% | 3.0% | 15.0% | 3.5% | 3.0% | 15.0% | 3.5% | 3.0% | 15.0% |
| 7:00 PM | 2.0% | 2.2% | 14.0% | 2.0% | 2.2% | 13.9% | 2.0% | 2.2% | 13.9% |
| 8:00 PM | 1.7% | 1.8% | 12.0% | 1.7% | 1.8% | 12.0% | 1.7% | 1.8% | 12.0% |
| 9:00 PM | 1.0% | 1.6% | 8.0% | 1.0% | 1.7% | 7.8% | 1.0% | 1.7% | 7.8% |
| 10:00 PM | 0.7% | 1.5% | 7.0% | 0.7% | 1.2% | 6.8% | 0.7% | 1.2% | 6.8% |
| 11:00 PM | 0.5% | 1.0% | 5.0% | 0.5% | 0.9% | 5.2% | 0.5% | 0.9% | 5.2% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-8 summarizes hourly vehicle percentage patterns used in the traffic noise model for I-10 east of Highway 177 under Alternative 3.

**Table E2-8.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: I-10 East of Highway 177**

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 1.0% | 6.0% | 0.1% | 0.0% | 4.8% | 0.1% | 0.0% | 4.8% |
| 1:00 AM | 0.1% | 1.5% | 7.0% | 0.1% | 0.0% | 4.8% | 0.1% | 0.0% | 4.8% |
| 2:00 AM | 0.2% | 2.0% | 8.0% | 0.2% | 2.3% | 7.0% | 0.2% | 2.3% | 7.0% |
| 3:00 AM | 0.2% | 3.0% | 10.0% | 0.2% | 2.3% | 9.3% | 0.2% | 2.3% | 9.3% |
| 4:00 AM | 0.4% | 3.5% | 16.0% | 0.4% | 3.5% | 16.3% | 0.4% | 3.5% | 16.3% |
| 5:00 AM | 0.6% | 4.5% | 21.0% | 0.6% | 4.7% | 21.1% | 0.6% | 4.7% | 21.1% |
| 6:00 AM | 1.5% | 5.0% | 29.0% | 1.8% | 6.5% | 24.2% | 1.6% | 6.7% | 27.0% |
| 7:00 AM | 3.5% | 5.5% | 35.0% | 3.5% | 5.4% | 35.4% | 3.5% | 5.5% | 35.2% |
| 8:00 AM | 6.0% | 6.0% | 43.0% | 6.0% | 6.0% | 43.3% | 6.0% | 6.0% | 43.2% |
| 9:00 AM | 7.0% | 6.5% | 52.0% | 7.0% | 6.4% | 52.3% | 7.0% | 6.5% | 52.2% |
| 10:00 AM | 8.0% | 7.0% | 55.0% | 8.0% | 7.0% | 55.3% | 8.0% | 7.0% | 55.2% |
| 11:00 AM | 9.0% | 7.2% | 56.0% | 9.0% | 7.2% | 56.3% | 9.0% | 7.2% | 56.1% |
| 12:00 PM | 10.5% | 7.0% | 52.0% | 10.5% | 7.0% | 52.2% | 10.5% | 7.0% | 52.1% |
| 1:00 PM | 13.0% | 6.8% | 47.0% | 12.9% | 6.8% | 47.1% | 13.0% | 6.8% | 47.1% |
| 2:00 PM | 9.0% | 6.5% | 42.0% | 8.9% | 6.5% | 42.1% | 9.0% | 6.5% | 42.1% |
| 3:00 PM | 8.0% | 6.0% | 32.0% | 8.2% | 6.3% | 30.9% | 8.1% | 6.3% | 31.6% |
| 4:00 PM | 7.5% | 5.4% | 27.0% | 7.4% | 5.4% | 27.0% | 7.5% | 5.4% | 27.0% |
| 5:00 PM | 6.0% | 4.9% | 22.0% | 5.9% | 4.9% | 22.0% | 6.0% | 4.9% | 22.0% |
| 6:00 PM | 3.5% | 3.9% | 19.0% | 3.5% | 3.9% | 19.0% | 3.5% | 3.9% | 19.0% |

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 7:00 PM | 2.0% | 3.0% | 17.0% | 2.0% | 3.0% | 17.1% | 2.0% | 3.0% | 17.1% |
| 8:00 PM | 1.7% | 2.0% | 15.0% | 1.7% | 1.9% | 15.1% | 1.7% | 1.9% | 15.1% |
| 9:00 PM | 1.0% | 1.6% | 10.0% | 1.0% | 1.4% | 9.8% | 1.0% | 1.4% | 9.8% |
| 10:00 PM | 0.7% | 1.5% | 9.0% | 0.7% | 1.3% | 9.3% | 0.7% | 1.3% | 9.3% |
| 11:00 PM | 0.5% | 1.0% | 6.0% | 0.5% | 0.9% | 5.6% | 0.5% | 0.9% | 5.6% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-9 summarizes hourly vehicle percentage patterns used in the traffic noise model for Highway 177 south of Kaiser Road under Alternative 3.

**Table E2-9.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Highway 177 South of Kaiser Road**

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.1% | 0.3% | 2.0% | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| 1:00 AM | 0.1% | 0.3% | 2.0% | 0.1% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| 2:00 AM | 0.2% | 0.4% | 2.3% | 0.2% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% |
| 3:00 AM | 0.2% | 0.5% | 2.8% | 0.2% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% |
| 4:00 AM | 0.4% | 0.6% | 3.0% | 0.3% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% |
| 5:00 AM | 0.6% | 1.5% | 3.5% | 0.5% | 0.0% | 0.0% | 0.6% | 0.0% | 0.0% |
| 6:00 AM | 1.5% | 2.0% | 7.0% | 6.0% | 22.3% | 1.3% | 4.3% | 26.4% | 1.9% |
| 7:00 AM | 3.5% | 4.0% | 9.0% | 3.4% | 3.4% | 18.2% | 3.4% | 3.6% | 14.3% |
| 8:00 AM | 6.0% | 4.0% | 10.0% | 5.7% | 3.4% | 17.7% | 5.8% | 3.5% | 14.8% |
| 9:00 AM | 7.0% | 4.5% | 11.0% | 6.6% | 4.1% | 18.0% | 6.8% | 4.2% | 15.1% |
| 10:00 AM | 8.0% | 5.0% | 9.0% | 7.5% | 4.6% | 15.5% | 7.7% | 4.8% | 12.8% |
| 11:00 AM | 9.0% | 5.3% | 7.5% | 8.4% | 5.1% | 13.4% | 8.6% | 5.2% | 10.9% |
| 12:00 PM | 10.5% | 4.8% | 9.0% | 9.6% | 4.4% | 14.0% | 10.0% | 4.5% | 11.9% |
| 1:00 PM | 12.9% | 5.0% | 8.0% | 11.6% | 5.0% | 11.6% | 12.1% | 5.1% | 9.8% |
| 2:00 PM | 9.1% | 3.5% | 7.0% | 8.2% | 3.3% | 10.3% | 8.5% | 3.3% | 8.6% |
| 3:00 PM | 8.0% | 3.0% | 6.0% | 11.7% | 12.9% | 3.6% | 10.3% | 12.7% | 4.4% |
| 4:00 PM | 7.5% | 2.0% | 7.2% | 6.5% | 1.8% | 7.1% | 6.9% | 1.8% | 7.1% |
| 5:00 PM | 6.0% | 1.5% | 7.8% | 5.2% | 1.5% | 7.4% | 5.5% | 1.5% | 7.4% |
| 6:00 PM | 3.5% | 1.0% | 7.3% | 3.0% | 1.3% | 7.6% | 3.2% | 1.3% | 7.6% |
| 7:00 PM | 2.0% | 0.6% | 5.0% | 1.7% | 0.0% | 4.4% | 1.8% | 0.0% | 4.4% |
| 8:00 PM | 1.7% | 0.4% | 3.0% | 1.5% | 0.0% | 2.6% | 1.6% | 0.0% | 2.6% |
| 9:00 PM | 1.0% | 0.3% | 2.5% | 0.9% | 0.0% | 4.3% | 0.9% | 0.0% | 4.3% |

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 10:00 PM | 0.7% | 0.3% | 2.0% | 0.6% | 0.0% | 0.0% | 0.7% | 0.0% | 0.0% |
| 11:00 PM | 0.5% | 0.3% | 2.0% | 0.4% | 0.0% | 0.0% | 0.4% | 0.0% | 0.0% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-10 summarizes hourly vehicle percentage patterns used in the traffic noise model for Kaiser Road south of Lake Tamarisk under Alternative 3.

**Table E2-10.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Kaiser Road South of Lake Tamarisk**

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 2:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 3:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 4:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 5:00 AM | 2.8% | 33.3% | 0.0% | 0.7% | 33.3% | 0.0% | 0.9% | 33.3% | 0.0% |
| 6:00 AM | 8.3% | 22.2% | 0.0% | 29.3% | 27.3% | 0.0% | 25.6% | 35.8% | 0.0% |
| 7:00 AM | 9.3% | 20.0% | 0.0% | 4.2% | 10.5% | 47.4% | 5.1% | 12.5% | 37.5% |
| 8:00 AM | 2.8% | 0.0% | 0.0% | 3.3% | 0.0% | 80.0% | 3.5% | 0.0% | 72.7% |
| 9:00 AM | 5.6% | 16.7% | 0.0% | 4.4% | 5.0% | 70.0% | 4.7% | 6.7% | 60.0% |
| 10:00 AM | 8.3% | 33.3% | 11.1% | 5.1% | 13.0% | 65.2% | 5.7% | 16.7% | 55.6% |
| 11:00 AM | 8.3% | 44.4% | 11.1% | 5.1% | 17.4% | 65.2% | 5.7% | 22.2% | 55.6% |
| 12:00 PM | 5.6% | 33.3% | 16.7% | 4.4% | 10.0% | 75.0% | 4.7% | 13.3% | 66.7% |
| 1:00 PM | 11.1% | 25.0% | 8.3% | 5.3% | 12.5% | 54.2% | 6.3% | 15.0% | 45.0% |
| 2:00 PM | 8.3% | 11.1% | 11.1% | 3.8% | 5.9% | 52.9% | 4.7% | 6.7% | 46.7% |
| 3:00 PM | 10.2% | 18.2% | 0.0% | 29.7% | 26.9% | 0.0% | 26.3% | 34.9% | 0.0% |
| 4:00 PM | 6.5% | 0.0% | 0.0% | 1.6% | 0.0% | 0.0% | 2.2% | 0.0% | 0.0% |
| 5:00 PM | 2.8% | 0.0% | 0.0% | 0.7% | 0.0% | 0.0% | 0.9% | 0.0% | 0.0% |
| 6:00 PM | 5.6% | 0.0% | 0.0% | 1.3% | 0.0% | 0.0% | 1.9% | 0.0% | 0.0% |
| 7:00 PM | 1.9% | 50.0% | 0.0% | 0.4% | 50.0% | 0.0% | 0.6% | 50.0% | 0.0% |
| 8:00 PM | 0.9% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% |
| 9:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 10:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 11:00 PM | 1.9% | 0.0% | 100.0% | 0.4% | 0.0% | 100.0% | 0.6% | 0.0% | 100.0% |

VPH = vehicles per hour

ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

Table E2-11 summarizes hourly vehicle percentage pattens used in the traffic noise model for Kaiser Road Between Lake Tamarisk and the solar farm site under Alternative 3.

**Table E2-11.**
**Hourly Traffic Distributions Used for Traffic Noise Modeling: Kaiser Road Between Lake Tamarisk and the Solar Farm Site**

| Start of Hour | Existing Conditions | | | Alt 3 Conditions, 2011 | | | Alt 3 Conditions, 2012 | | |
|---|---|---|---|---|---|---|---|---|---|
| | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH | VPH % ADT | MT % VPH | HT % VPH |
| 12:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 1:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 2:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 3:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 4:00 AM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 5:00 AM | 2.8% | 33.3% | 0.0% | 0.7% | 33.3% | 0.0% | 0.9% | 33.3% | 0.0% |
| 6:00 AM | 8.3% | 22.2% | 0.0% | 29.3% | 27.3% | 0.0% | 25.6% | 35.8% | 0.0% |
| 7:00 AM | 9.3% | 20.0% | 0.0% | 4.2% | 10.5% | 47.4% | 5.1% | 12.5% | 37.5% |
| 8:00 AM | 2.8% | 0.0% | 0.0% | 3.3% | 0.0% | 80.0% | 3.5% | 0.0% | 72.7% |
| 9:00 AM | 5.6% | 16.7% | 0.0% | 4.4% | 5.0% | 70.0% | 4.7% | 6.7% | 60.0% |
| 10:00 AM | 8.3% | 33.3% | 11.1% | 5.1% | 13.0% | 65.2% | 5.7% | 16.7% | 55.6% |
| 11:00 AM | 8.3% | 44.4% | 11.1% | 5.1% | 17.4% | 65.2% | 5.7% | 22.2% | 55.6% |
| 12:00 PM | 5.6% | 33.3% | 16.7% | 4.4% | 10.0% | 75.0% | 4.7% | 13.3% | 66.7% |
| 1:00 PM | 11.1% | 25.0% | 8.3% | 5.3% | 12.5% | 54.2% | 6.3% | 15.0% | 45.0% |
| 2:00 PM | 8.3% | 11.1% | 11.1% | 3.8% | 5.9% | 52.9% | 4.7% | 6.7% | 46.7% |
| 3:00 PM | 10.2% | 18.2% | 0.0% | 29.7% | 26.9% | 0.0% | 26.3% | 34.9% | 0.0% |
| 4:00 PM | 6.5% | 0.0% | 0.0% | 1.6% | 0.0% | 0.0% | 2.2% | 0.0% | 0.0% |
| 5:00 PM | 2.8% | 0.0% | 0.0% | 0.7% | 0.0% | 0.0% | 0.9% | 0.0% | 0.0% |
| 6:00 PM | 5.6% | 0.0% | 0.0% | 1.3% | 0.0% | 0.0% | 1.9% | 0.0% | 0.0% |
| 7:00 PM | 1.9% | 50.0% | 0.0% | 0.4% | 50.0% | 0.0% | 0.6% | 50.0% | 0.0% |
| 8:00 PM | 0.9% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% | 0.3% | 0.0% | 0.0% |
| 9:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 10:00 PM | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| 11:00 PM | 1.9% | 0.0% | 100.0% | 0.4% | 0.0% | 100.0% | 0.6% | 0.0% | 100.0% |

VPH = vehicles per hour
ADT = average daily traffic
MT = medium trucks (2 axles, 6 wheels)
HT = heavy trucks (3 or more axles)

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# Appendix F

# Geotechnical Studies

# Geotechnical Engineering

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FIRST SOLAR ELECTRIC, LLC
1111 BROADWAY, 4TH FLOOR
OAKLAND, CALIFORNIA 94607

**GEOTECHNICAL ENGINEERING SERVICES**
**DESERT SUNLIGHT SOLAR FARM**
**550 MW PHOTOVOLTAIC SYSTEM**
**DESERT CENTER AREA OF**
**RIVERSIDE COUNTY, CALIFORIA**

January 19, 2010
Revised June 16, 2010



File No.: 11666-01
Doc. No.: 10-01-733R

**Earth Systems**
Southwest

79-811B Country Club Drive
Bermuda Dunes, CA 92203
(760) 345-1588
(800) 924-7015
FAX (760) 345-7315

January 19, 2010 File No.: 11666-01
Revised June 16, 2010 Doc. No.: 10-01-733R

First Solar Electric, LLC
1111 Broadway, 4th Floor
Oakland, California 94607

Attention: Mr. Peter Seidel
Project Manager

Project: **Desert Sunlight; 550 MW Photovoltaic Solar Farm**
County Route R2 at Power Line Road
Desert Center area of Riverside County, California

Subject: **Geotechnical Engineering Services**

We take pleasure in presenting this revised geotechnical engineering report prepared for the proposed 550-MW-AC Solar Photovoltaic System to be located on the west side of County Route R2 at Power Line Road in the Desert Center area of Riverside County, California.

This report presents our findings and recommendations for site grading and foundation design criteria, incorporating the information provided to our office. The site appears to be suitable for the proposed development, provided the recommendations in this report are followed in design and construction. This report should stand as a whole and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with First Solar Purchase Order No. 650001. Other services that may be required, such as plan review and grading observation, are additional services and will be billed according to our Fee Schedule in effect at the time services are provided. Unless requested in writing, the client is responsible for distributing this report to the appropriate governing agency or other members of the design team.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
**EARTH SYSTEMS SOUTHWEST**

Craig S. Hill
CE 38234

SER/csh/ajm

Distribution: 6/First Solar Electric, LLC
2/BD File

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## EXECUTIVE SUMMARY

Earth Systems Southwest has prepared this executive summary solely to provide a general overview of the report. The report itself should be relied upon for information about the findings, conclusions, recommendations, and other concerns.

The proposed Desert Sunlight PV Solar Farm is to be located approximately 7 miles north of I-10, on the east side of County Route R2, Desert Center area of Riverside County, California. The proposed project will have a gross area of approximately 4830 acres; approximately 3010 acres will be developed with a 550-MW-AC solar photovoltaic system. The proposed solar system will consist photovoltaic [PV] panels mounted on W6 x 7.2 W-section posts (piles), spaced about 10 feet apart. Typical pile embedment ranges from 4 to 6 feet; however this may be varied to conform to the subsurface conditions, anticipated depth of scour/erosion, design wind speeds, methodology of site development, or other factors.

Site development is mostly flat and generally less than 1% gradient from north to south and will require clearing of vegetation, some site leveling in approved areas during the construction of PV solar panels and ground support systems, underground connective conduit utility installation, access roads, and construction of several pad-mounted structures including inverter transformers and PV interconnection switch gear. A new transmission line will be constructed probably along County Route R2 to connect to the existing transmission line located south of I-10.

The proposed project may be constructed as planned, provided that the recommendations in this report are incorporated in the final design and construction. Based on the fairly uniform and medium stiff to stiff nature of the near surface soils, only minor remedial site grading is anticipated to support spread foundations for structures. Site soils are classified as having a very low expansion potential.

Laboratory testing of the site soils indicate low levels of sulfate, therefore normal concrete mixes may be used. Test results of resistivity testing indicates on-site, near surface, soils exhibit a range of low to very severe resistivity resulting in a potential for electrochemical corrosion potential for metal in contact with the soil. Underground utilities and metal pipes will require corrosion protection from the surrounding soil or added sacrificial thickness.

We consider the most significant geologic hazard to the project to be the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed structures. Structures should be designed in accordance with the values and parameters given within the 2007 California Building Code [CBC] and ASCE 7-05. The seismic design parameters are presented in the following table and within the report.

The recommendations and conclusions provided herein were based on design wind speed of 85 mph. The following results for lateral resistance are relative to the existing grade and the possible deflection of the top of the pile is dependent upon the length of pile above finish grade. A total of 24 test locations (48 test piles) were driven to depths that ranged from 34 inches to 60 inches below existing grade.

Tension: The pile load tests indicate that in all areas tested that the tension capacity of the 48 W-section piles resisted at least twice the assumed maximum in uplift force of 664 lbs with all piles except PT-7A, which yielded ¼-inch deflection at 750 pounds (driven to a depth of 36 inches).

Lateral: The lateral capacity at ½-inch deflection or less for all piles ranged from a low of 100 pounds at a pile depth of 36 inches to the maximum imposed load of 3450 pounds. Approximately 20% of the lateral loads tests did not meet, or are borderline, to the maximum imposed load (including a factor of safety of 2.0).

## SUMMARY OF RECOMMENDATIONS

| Design Item | Recommended Parameter | Reference Section No. |
| --- | --- | --- |
| **Foundations** | | |
| Allowable Bearing Pressure | 2,500 psf (Buildings and Equipment Supports) | 5.3 |
| Foundation Types | Continuous/Spread Footings (Buildings and Equipment Supports)<br>W-section Piles (PV Panels) | 5.3 |
| Bearing Materials | Compacted subgrade (Buildings and Equipment Supports) | 5.3 |
| Allowable Passive Pressure | 250 psf | 5.3 |
| Allowable Coefficient of Friction | 0.35 | 5.3 |
| Soil Expansion | Very Low (non-expansive) | 3.3.3 |
| **Geologic and Seismic Hazards** | | |
| Liquefaction Potential | Very Low to Nil | 3.3.2 |
| Significant Fault and Magnitude | San Andreas, 7.2M | 3.3.1 |
| Fault Distance | 37 miles | 3.3.1 |
| Seismic Design Category | D | 5.6 |
| Site Class | D | 5.6 |
| **Maximum Considered Earthquake [MCE]** | | |
| Short Period Spectral Response, $S_s$ | 0.77 g | 5.6 |
| Second Spectral Response, $S_1$ | 0.33 g | 5.6 |
| Site Coefficient, $F_a$ | 1.19 | 5.6 |
| Site Coefficient, $F_v$ | 1.75 | 5.6 |
| **Slabs** | | |
| Building Floor Slabs | On engineered fill | 5.4 |
| Modulus of Subgrade Reaction | 150 pci | 5.4 |
| **Existing Site Conditions** | | |
| Soil Corrosivity | Low sulfates<br>Low chlorides<br>Resistivity (Low to Very Severe) | 5.6 |
| Groundwater Depth | Believed to be deeper than 50 feet (from public water well data) | 3.2 |

The recommendations contained within this report are subject to the limitations presented in Section 6 of this report. We recommend that all individuals using this report read the limitations.

GEOTECHNICAL ENGINEERING SERVICES
DESERT SUNLIGHT SOLAR FARM
550 MW PHOTOVOLTAIC SYSTEM
DESERT CENTER AREA OF
RIVERSIDE COUNTY, CALIFORIA

## Section 1
## INTRODUCTION

### 1.1 Project Description

This revised geotechnical engineering report has been prepared for the Desert Sunlight PV Solar Plant to be located approximately 7 miles north of I-10 (and the community of Desert Center), east of County Route R2, Riverside County, California. The proposed project will have a gross area of approximately 4830-acres; approximately 3010-acres will be developed with a 550-MW-AC solar photovoltaic system. Site development will include clearing of vegetation, site grading in approved areas, construction of PV solar panels and ground support systems, underground connective conduit utility installation, access roads, and construction of several pad-mounted structures including inverter transformers and PV interconnection switch gear. A new transmission line will be constructed probably along County Route R2 to connect to the existing transmission line located south of the I-10 Freeway. On-site roads will likely be improved to a minor degree to provide all-weather access. No improvements to the off-site roads surrounding the site are planned. Following clearing and/or mowing of vegetation, changes to grade, if any, are expected to be a maximum of 1-foot from the existing topography, except within existing drainages approved for infill. The maximum burial depth for underground utility conduits is expected to be about 2 feet.

The proposed solar system will consist of photovoltaic [PV] panels mounted on driven W6 x 7.2 steel W-section posts (piles), spaced about 10 feet apart. The typical pile embedment ranges from 4 to 6 feet; however this may be varied to conform to the subsurface conditions encountered. Ultimate uplift pile loads of 664 pounds for Case A north row and 582 pounds for Case A south row, and ultimate lateral pile loads of 382 pounds for Case A north row and 345 pounds for Case A south row, were assumed as a basis for our recommendations for the driven W-section posts.

Conventional continuous and spread (pad) foundations, with concrete slabs-on-grade, are anticipated for support of the proposed structures, and for the transformers and other equipment associated with the switching station. Structural loading of support equipment is assumed to be less than 1500 psf although the native soils are capable of supporting more. All loading is assumed to be dead plus live load. If actual structural loading exceeds these assumed values, it will be necessary to reevaluate the recommendations contained in this report.

### 1.2 Site Description

The project site is an irregular-shaped piece within the jurisdiction the Bureau of Land Management. The site is east of County Route R2, and mostly south of an unimproved east/west dirt road that provides access to one of the Eagle Mountain Mine well sites. The approximate site location is shown on Figure 1 in Appendix A.

The topography of the site is flat exhibiting generally less than 1% gradient in a northwest (high) to southeast (low) direction. The site consists of open desert with numerous drainages oriented in a northwest to southeast direction. Elevations range from a high of about 840 feet mean sea level [msl] in the northwest corner of Section 9 to a low of about 617 feet msl in the southeast corner of the Section 24.

The history of past use and previous development of the property was not investigated as part of our scope of services. Buried remnants, such as old foundations, slabs, utilities, septic systems, leach lines, and irrigation systems may exist on the site.

### 1.3 Purpose and Scope of Services

The purpose for our services was to evaluate the site soil conditions and to provide professional opinions and recommendations regarding the proposed development of the site. The scope of work for this report included the following:

- A general reconnaissance of the site
- Subsurface exploration consisting of excavating and sampling of 5 exploratory backhoe pits to a maximum of 10 feet below existing grade.
- Pile driving and extraction observations of the test piles.
- Tension and lateral load tests on 48 test piles at 24 locations.
- Laboratory testing of selected soil samples obtained from the exploratory borings.
- Engineering analysis and evaluation of the acquired data from the exploration and testing programs.
- A summary of our findings and recommendations in this written report.

This report contains the following:

- Discussions on subsurface soil and groundwater conditions.
- Discussions on regional and local geologic conditions.
- Discussions on geologic and seismic hazards.
- Graphic and tabulated results of laboratory tests and field studies.
- Recommendations regarding:
  - Site development and grading criteria.
  - Excavation conditions and buried utility installations.
  - Solar panel pile supports.
  - Allowable bearing capacities for shallow foundations for support structures.
  - Concrete slabs-on-grade.
  - Lateral earth pressures and coefficients for foundations.
  - Preliminary evaluation of the potential adverse effects of site soils to concrete and buried metal objects.
  - Seismic design parameters.

<u>Not Within the Scope of This Report</u>: Although available through Earth Systems Southwest, the current scope of our services does not include:

- An environmental assessment.
- An investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

## Section 2
## METHODS OF INVESTIGATION

### 2.1 Field Exploration

On December 10, 2009, a total of 5 exploratory backhoe pits were excavated on the site to a maximum of 10 feet below the existing ground surface [BEG]. The backhoe pits were excavated with a John Deere 310, equipped with a 24-inch wide bucket. The approximate locations of the backhoe pits are shown on the Site Exploration Map (Figure 2) in Appendix A. The locations shown are approximate, and were established in the field by handheld GPS coordinates (accurate to within 10 to 15 feet) and by sighting from prominent features.

Subsurface conditions encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-06. Bulk samples were obtained from the spoil piles.

Logs of the test pits are presented in Appendix A, along with a Log Legend. The logs represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The stratification lines represent the approximate boundaries between soil types, although the transitions may be gradational. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the soil characteristics as observed during drilling/excavating. These include, but are not limited to, the presence of cementation, variations in soil moisture, presence of groundwater, and other factors. Consequently, the logger must exercise judgment in interpreting soil characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

### 2.2 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Test results are presented in graphic and tabular form in Appendix C of this report. The tests were conducted in general accordance with the procedures of the American Society for Testing and Materials [ASTM] or other standardized methods as referenced below. Our testing program consisted of the following:

- Particle Size Analysis to classify and evaluate soil composition. The gradation characteristics of selected samples were made by hydrometer and sieve analysis procedures.

- Chemical Analyses (Soluble Sulfates and Chlorides, pH, and Electrical Resistivity) to evaluate the potential adverse effects of the soil on concrete and steel.

### 2.3 Pile Load Testing

Driven W6 x 7.2 W-sections were used for the test piles to support the proposed PV panels and resist the anticipated vertical and lateral loads. On December 14 through December 18, 2009, representatives of ESSW conducted load tests on the driven piles at 24 locations across the project site. The locations of the tests are shown on the 2 Site Exploration Map (Figure 2) in

Appendix A. The W-sections were driven 34 to 60 inches into the ground by representatives of Highway Technologies Construction of Las Vegas, Nevada.

The tests were conducted in general accordance with ASTM D 3689 and D 3966, but were modified for the small piles and field conditions. Initially, tension loading was applied by a hydraulic 12-ton capacity jack against a 12-foot long reaction beam frame with a 10,000 lb. capacity. Dial gauges accurate to 0.001-in were used to measure deflections due to loading with respect to reference beams.

After tension testing was completed, lateral loads were applied using a John Deere 310 backhoe as a reaction mass. The proposed W6 x 7.2 W-section has a cross section of approximately 4 inches by 6 inches; the lateral loads were applied to the 6-inch side of the beam. As the amount of movement associated with the uplift test is generally small, in our opinion, the potential for an adverse effect on the lateral load test is relatively small.

The loading sequence was performed with increments of 15 to 30 seconds between load applications. This is a significant departure from ASTM D 3689 and D 3966; the “quick” test (Procedure A) of these methods requires 4 to 15 minutes between load increments. In our opinion, the rapid loading sequence is unlikely to alter significantly the findings of the load tests. In addition, the rapid loading sequence more closely approximates field conditions due to short duration wind gust or seismic loading. However, a 5-minute hold on the vertical test was performed at the ultimate load for each pile. The threshold for this test is 0.04”. Four piles (PT-1B, PT-5A, PT-16A, and PT-18B) exceeded the 0.04” threshold. It is our opinion that densifying the soil near the surface will improve the performance of these piles below the threshold.

The testing was performed in increments of 200 pounds per in$^2$ (pressure reading from the Enerpac dial gauge) with a test load range of 1800 to 3450 lbs for lateral and 850 to 5000 lbs for tension. The calibrated relationship between the pressure and the applied force in pounds is linear but not a 1:1 relationship. Therefore, the change in the axial load between readings increases as the pressure increases. The “Summary of Pile Load Test Results” presents the results as a deflection at the maximum applied load, and as pounds necessary to move the pile the established threshold.

## Section 3
## DISCUSSION

### 3.1 Soil Conditions

The units encountered consist of undifferentiated younger alluvium, younger alluvium with interspersed areas of weak desert pavement, and older alluvium with moderate to strong desert pavement. The older alluvium was moist and in a medium dense to dense condition while the younger alluvium were generally soft and dry. The soils encountered were dry to slightly moist with considerable variance in density.

### 3.2 Groundwater

Water was not encountered to the depths explored. The depth to groundwater in the area is believed to be in excess of 50 feet based on well data obtained from 2 sources within 2 miles of the site. However, there is uncertainty in the accuracy of short-term water level measurements whereby water may become trapped on less permeable layers. Groundwater levels may fluctuate with precipitation, irrigation, and drainage. Groundwater should not be a factor in design or construction at this site.

### 3.3 Geologic Setting

Regional Geology: The site lies within Chuckwalla Valley, a part of the Mojave Desert geomorphic province which is a vast area where broad desert valleys are separated by isolated mountain ranges. The Chuckwalla Valley is bounded on the west by the Eagle Mountains, on the east by the Palen Mountains, and to the north by the Coxcomb Mountains. The Chuckwalla Mountains are to the south. The Chuckwalla Valley contains a thick sequence of Quaternary sedimentary deposits including Pleistocene fan deposits and Holocene alluvium. The bordering mountains expose primarily Precambrian metamorphic and Mesozoic granitic rocks. The Blue Cut and Pinto Mountain fault zones, located north-northwest of the site are the nearest significant faults. The San Andreas fault is located approximately 37 miles southwest of the site.

Local Geology: The project site is located in the northwestern reaches of Chuckwalla Valley. Predominant geologic units include Pleistocene older alluvium and Holocene alluvium. Older alluvium (Qoa), characterized as uplifted Pleistocene fan surfaces with well –developed desert pavement and incised drainage courses, is located primarily in the western portion of the property. Holocene alluvium (Qal) is represented by the more recent braided stream channel deposits within the multitude of intermittent drainage channels that cross the property (see Figure 3). No active faults are currently mapped in the site vicinity. One un-named fault has been mapped by the California Geologic Survey trending in an east-west direction through the southern portion of the property. This fault is shown as buried, is poorly defined, and is not considered active or a significant source of seismic activity.

Geologic Hazards: Geologic hazards that may affect the region include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

### 3.3.1 Primary Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 62 miles (100 kilometers) of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is strong ground shaking from earthquakes along the Pinto Mountain fault, San Andreas fault, and the multitude of faults within the Eastern California shear zone. The Mean Magnitude Earthquake listed is from published geologic information available for each fault (CGS, 2008).

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (Hart, 1997). Well-delineated fault lines cross through this region as shown on California Geological Survey [CGS] maps (Jennings, 1994); however, no active faults are mapped in the immediate vicinity of the site. Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Historic Seismicity: Approximately 32 magnitude 5.5+ earthquakes have occurred within 70 miles of the site since 1800. These include the 1948 Desert Hot Springs earthquake (M6.0), the 1949 Pinto Mountains earthquake (M5.0), the 1981 Westmorland earthquake (M5.9), and the 1992 Joshua Tree earthquake (M6.1).

Seismic Risk: While accurate earthquake predictions are not possible, various agencies have conducted statistical risk analyses. In 2008, the California Geological Survey [CGS] and the United States Geological Survey [USGS] completed probabilistic seismic hazard maps. We have used these maps in our evaluation of the seismic risk at the site. The recent Working Group of California Earthquake Probabilities (WGCEP, 2008) estimated a 58% conditional probability that a magnitude 6.7 or greater earthquake may occur between 2008 and 2038 along the southern segment of the San Andreas fault.

The primary seismic risk at the site is a potential earthquake along the San Andreas fault that is about 37 miles from the site and is considered as fault Type A (CGS). Geologists believe that the San Andreas fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas fault. The last rupture occurred about 1680 AD, based on dating by the USGS near Indio (WGCEP, 2008). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995).

### 3.3.2 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far inland, so the hazard from tsunamis is non-existent. At the present time, no water storage reservoirs are located in the immediate vicinity of the site. Therefore, hazards from seiches are considered negligible at this time.

Soil Liquefaction: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction.

The potential for liquefaction to occur at this site is considered negligible because the depth of groundwater beneath the site is thought to exceed 50 feet. No free groundwater was encountered in our test pits. However, the project lies in a zone designated by Riverside County for susceptible sediments, but undocumented depths to groundwater resulting in assumed moderate liquefaction potential. Water level data from a well located approximately two miles southwest of the site suggests static water levels in excess of 100 feet with historic shallow water levels greater than 60 feet.

Ground Subsidence: The site is within a Riverside County designated "susceptible" subsidence zone. Dry sands tend to settle and densify when subjected to strong earthquake shaking. The amount of subsidence is dependent on relative density of the soil, ground motion, and earthquake duration. Uncompacted fill areas may be susceptible to seismically induced settlement.

Slope Instability: The site has relatively gentle topography, such that the potential for large-scale landslides is considered negligible. The occurrence of local surficial failures and debris flows within and along incised drainage channels is considered likely

Flooding: The project site is in an area where sheet flooding and erosion could occur with localized flooding within the defined drainage channels during seasonal precipitation and flash flood events. Appropriate project design, construction, and maintenance can minimize the site flooding potential.

Tsunamis and Seiches: The site is far inland, and there are no water storage reservoirs on or near the site, so the hazards from tsunamis and seiches are nil.

3.3.3 Other Geologic Hazards

Slope Instability: The site is relatively level to gently sloping, and there are no significant slopes on or adjacent to the site. Therefore, the potential for slope instability, landslides or debris flows to affect the site is considered to be nil.

Erosion

The site is relatively flat and with the previous farming operation site drainage paths are poorly defined to non-existent with drainage by sheet flow in a north-northwest direction. There are "blue line" drainage areas, predominately in the southwest portion of the site and generally out of the influence of the proposed development.

Site Acceleration: The potential intensity of ground motion may be estimated by the horizontal peak ground acceleration (PGA), measured in "g" forces. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations are also dependent upon attenuation by rock and soil deposits, direction of rupture, and type of fault. For these reasons, ground motions may vary considerably in the same general area. This variability can be expressed statistically by a standard deviation about a mean relationship. Important factors influencing the structural performance are the duration and frequency of strong ground motion, local subsurface conditions, soil-structure interaction, and structural details.

The following table provides the probabilistic estimate of the PGA taken from the 2002 CGS/USGS seismic hazard maps/data.

**Estimate of PGA from 2002 CGS/USGS Probabilistic Seismic Hazard Maps/Data**

| Risk | Equivalent Return Period (years) | PGA (g) [1] |
|---|---|---|
| 10% exceedance in 50 years | 475 | ≈ 0.24 |

Notes:
[1] Based on Site Class B/C and soil amplification factor of 1.0 for Site Class D.

2007 CBC Seismic Coefficients: The California Building Code [CBC] seismic design parameters criteria are based on a Design Earthquake that has an earthquake ground motion $^2/_3$ of the lesser of 2% probability of occurrence in 50 years or 150% of mean deterministic limit. The PGA estimate given above is provided for information on the seismic risk inherent in the CBC design.

Seismic Hazard Zones: The site lies in a moderate liquefaction potential zone designated by Riverside County because of high susceptibility sediments. This portion of Riverside County has not been mapped by the California Seismic Hazard Mapping Act (Ca. PRC 2690 to 2699).

### 3.4 Seismic Design Criteria

This site is subject to strong ground shaking due to potential fault movements along regional faults including the San Andreas, Pinto Mountain, and Blue Cut faults. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The *minimum* seismic design should comply with the 2007 edition of the California Building Code and ASCE 7-05 using the seismic coefficients given in the table below.

**2007 CBC (ASCE 7-05) Seismic Parameters**

| | | Reference |
|---|---|---|
| Seismic Category: | D | Table 1613.5.6 |
| Site Class: | D | Table 1613.5.2 |
| **Maximum Considered Earthquake [MCE] Ground Motion** | | |
| Short Period Spectral Response $S_s$: | 0.77 g | Figure 1613.5 |
| 1 second Spectral Response, $S_1$: | 0.33 g | Figure 1613.5 |
| Site Coefficient, $F_a$: | 1.19 | Table 1613.5.3(1) |
| Site Coefficient, $F_v$: | 1.75 | Table 1613.5.3(2) |
| **Design Earthquake Ground Motion** | | |
| Short Period Spectral Response, $S_{DS}$ | 0.61 g | |
| 1 second Spectral Response, $S_{D1}$ | 0.34 g | |

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed*. The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable.

Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Estimated peak horizontal site accelerations based upon a probabilistic analysis (10% probability of occurrence in 50 years) is approximately 0.24 g for a stiff soil site. Actual accelerations may be more or less than estimated. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations, but can equal or exceed the horizontal accelerations, depending upon the local site effects and amplification.

### 3.5 Pile Load Test Results

Table 2 within Appendix C provides a summary of the tension and lateral load tests on the test piles conducted on the site. The full pile load test results are also provided in Appendix C.

The test results provided herein were based on assumed wind speed of 85 mph. The following results for lateral resistance are relative to the existing grade and the possible deflection of the top of the pile is dependent upon the length of pile above finish grade. A total of 48 piles were driven to depths that ranged from 34 to 60 inches below existing grade.

<u>Tension:</u> The pile load tests indicate that in all areas tested that the tension capacity of the 48 W-section piles resisted at least twice the assumed maximum in uplift force of 664 lbs with all piles except PT-7A, which yielded ¼-inch deflection at 750 pounds at a depth of 36 inches.

<u>Lateral:</u> The lateral capacity at ½-inch deflection or less for all piles ranged from a low of 150 pounds at a pile depth of 36 inches to the maximum imposed load of 3450 pounds. Approximately 20% of the lateral loads tests did not meet, or are borderline, the maximum imposed load including a factor of safety of 2.0. However, a 5-minute hold on the vertical test was performed at the ultimate load for each pile. The threshold for this test is 0.04". Four piles (PT-1B, PT-5A, PT-16A, and PT-18B) exceeded the 0.04" threshold. It is our opinion that densifying the soil near the surface will improve the performance of these piles below the threshold.

<u>Equivalent Lateral Load:</u> The test piles may be evaluated on the basis of an equivalent lateral load using the Brom's method. In general, equivalent test load:

$$Tt = [(e + Le)T + Ma]/(e\text{-test} + Le)$$

> where "e" is point of application above grade, T = lateral load, Ma =unbalanced moment, e-test = point of application from test load, and Le = effective length of pile.

The Brom's Method assumes effective length equal total length, L with lateral soil reaction and point of rotation at tip of pile Actual point of rotation if rigid is at about 0.6 to 0.7 L where lateral reactions counterbalance each other; pile flexibility decreases this effective length even more. If actual point of rotation is considered this would increase the equivalent lateral test load from the Brom's method.

## Section 4
## CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

- From a geotechnical perspective, the site is suitable for the proposed development, provided the recommendations in this report are followed in the design and construction of this project.

Geotechnical Constraints and Mitigation:

- The primary geologic hazard is moderate ground shaking from earthquakes originating on regional faults. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas.

- The underlying geologic condition for seismic design is Site Class D. A qualified professional should design any permanent structure constructed on the site. The *minimum* seismic design should comply with the 2007 California Building Code.

- Other geologic hazards, including fault rupture, liquefaction, seismically-induced subsidence, tsunamis, seiches and slope instability are considered generally low to nil on this site.

- The site soils are considered to be non-expansive. Conventional foundations for shallow foundation used for the support of equipment should meet at least code minimums or as specified by the project structural engineer, whichever is more stringent. Slabs-on-grade for these structures should be provided with a cushion of nonexpansive soils.

- A site should be addressed by the project civil engineer for potential flooding. Preventative measures to reduce the effects of seasonal flooding and erosion should be incorporated into site grading plans.

- The near surface soils are non-uniform and highly effected by the presence of rodent and reptile borrows and by the geologic deposition of the soils. Areas to receive permanent structures will require over excavation and recompaction to support proposed structures. Areas to receive pile used to support the arrays would benefit from some surficial compaction to enhance the lateral stability and support of the W-section piles.

- Tension: The pile load tests indicate that in all areas tested that the tension capacity of the 48 W-section piles resisted at least twice the assumed maximum in uplift force of 664 lbs with all piles except PT-7A, which yielded ¼-inch deflection at 750 pounds at a depth of 36 inches. Uplift should yield a factor safety of at least 2.0 by being driven to a depth of at least 48 inches. Compacting the upper soils in the immediate vicinity of the pile will increase the vertical resistance to uplift allowing a shallower pile to support the modules.

However, a 5-minute hold on the vertical test was performed at the ultimate load for each pile. The threshold for this test is 0.04". Four piles (PT-1B, PT-5A, PT-16A, and PT-18B) exceeded the 0.04" threshold. It is our opinion that densifying the soil near the surface will improve the performance of these piles below the threshold.

- Lateral: The lateral capacity at ½-inch deflection or less for all piles ranged from a low of 100 pounds at a pile depth of 36 inches to the maximum imposed load of 3450 pounds. Approximately 20% of the lateral loads tests did not meet, or are borderline, the maximum imposed load including a factor of safety of 2.0. Due to the variability of the upper soils and since some of the pile exhibited excessive lateral movement even when driven to a depth of 60 inches, the options would be to drive the piles deeper, go to a pile that has a higher stiffness modulus, densify the upper soils in the vicinity of the W-sections, or a combination of these.

- In general, groundwater levels may fluctuate with precipitation, irrigation, drainage, regional pumping from wells, and site grading. Groundwater should not be a factor in design or construction at this site.

**Section 5**
**RECOMMENDATIONS**

## SITE DEVELOPMENT AND GRADING

### 5.1 Site Development – Grading

A representative of ESSW should observe site clearing, grading, and the bottoms of excavations before placing fill. Local variations in soil conditions may warrant increasing the depth of recompaction and over-excavation.

<u>Clearing and Grubbing</u>: At the start of site grading, existing vegetation, trees, large roots, pavement, foundations, non-engineered fill, construction debris, trash, and abandoned underground utilities should be removed from the proposed building, structural, and pavement areas. The surface should be stripped of organic growth and removed from the construction area. Areas disturbed during demolition and clearing should be properly backfilled and compacted as described below.

<u>Building Area Preparation</u>: The existing soils within the building areas should be over-excavated to depth of 3 feet below the bottom of the footings or 4 feet below existing grade, whichever is deeper. The resulting surface should be moisture conditioned and compacted to at least 90% relative compaction. Previously removed soils may be placed in thin (6" to 8") lifts and compacted as stated above.

<u>Access Road or Pavement Area Preparation</u>: In access road areas or areas to receive pavement, the subgrade should be scarified, moisture conditioned, and compacted to at least 95% relative compaction (ASTM D 1557) for a depth of two feet below subgrade. Compaction should be verified by testing.

<u>Fill or Flatwork Area Preparation</u>: In areas to receive fill or flatwork, the subgrade should be scarified, moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 1-foot below subgrade. Compaction should be verified by testing.

<u>Engineered Fill Soils</u>: The native soil is suitable for use as engineered fill and utility trench backfill *within* areas to receive foundations and slabs-on-grade, to 18 inches below bottom of slab elevation, provided it is free of significant organic or deleterious matter. The native soil is suitable for use as engineered fill and utility trench backfill *beyond* areas to receive foundations and slabs-on-grade to pavement subgrade or finish grade. Within areas to receive foundations and slabs-on-grade, the final 18 inches of fill should be nonexpansive. Nonexpansive materials are defined as being classified in the GW, GP, GM, GC, SP, SW, SC, or SM categories per ASTM D 2487, and that have an expansion index of 10 or less (ASTM D 4829). The 4 to 6-inch sand or gravel cushion that is typically placed below slabs-on-grade is considered to be part of the recommended 18 inches of nonexpansive materials, not in addition to it.

Nonexpansive soils may be imported to the site, or they may be derived from selective grading of the site soils. Proposed nonexpansive soils should be observed by a representative of ESSW and tested for expansion potential before being used.

All fill should be placed in maximum 8-inch lifts (loose thickness) and compacted to at least 90% relative compaction (ASTM D 1557). The upper foot of subgrade, and all aggregate base, in access road areas should be compacted to a minimum of 95 percent of maximum dry density. Compaction should be verified by testing. In general, rocks larger than 6 inches in greatest dimension should be removed from fill or backfill material. Rocks larger than 3 inches in greatest dimension should be removed from fill or backfill material in the upper 3 feet below finish grade in areas to receive structures or utility lines.

All soils should be moisture conditioned prior to application of compactive effort. Moisture conditioning of soils refers to adjusting the soil moisture to or just above optimum moisture content. If the soils are overly moist so that instability occurs, or if the minimum recommended compaction cannot be readily achieved, it may be necessary to aerate or to use other methods to dry the soil to optimum moisture content as follows:

Site Drainage: Positive drainage should be maintained away from the structures (5% for 5 feet minimum) to prevent ponding and subsequent saturation of the foundation soils. Gutters and downspouts should be considered as a means to convey water away from foundations if adequate drainage is not provided. Drainage should be maintained for paved areas. Water should not pond on or near paved areas.

### 5.2 Excavations and Utility Trenches

Excavations: All excavations should be made in accordance with OSHA requirements. Using the OSHA standards and general soil information obtained from the field exploration, classification of the near surface on-site soils will likely be characterized as Type B and C. Actual classification of site specific soil type per OSHA specifications as they pertain to trench safety should be based on real-time observations and determinations of exposed soils by the Competent Person during grading and trenching operations.

Our site exploration and knowledge of the general area indicates there is a potential for caving of site excavations (utilities, footings, etc.). Excavations within sandy soil should be kept moist, but not saturated, to reduce the potential of caving or sloughing. Where excavations over 4 feet deep are planned, lateral bracing or cut slopes of 1.5:1 (horizontal to vertical) or flatter should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope and equal to the depth of the excavation.

Utility Trenches: Backfill of utilities within roads or public right-of-ways should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.). Utility trench backfill within private property should be placed in conformance with the provisions of this report. In general, service lines extending inside of property may be backfilled with native soils compacted to a minimum of 90% relative compaction. A minimum of 95% relative compaction, however, should be obtained where trench backfill comprises the upper 12 inches of subgrade beneath access roads. A minimum of 85% relative compaction should be attained in areas where minor settlement of the trench backfill will not be detrimental. Backfill operations should be observed and tested to monitor compliance with these recommendations.

## STRUCTURES

In our professional opinion, foundations for the Substation/Switching Station equipment can be supported on shallow foundations bearing in properly prepared and compacted soils placed as recommended in Section 5.1. The recommendations that follow are based on very low expansion category soils in the upper 4 feet of subgrade.

### 5.3 Foundations

Foundation design is the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report. A representative of ESSW should observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete.

Bearing Capacity - Conventional Foundations: A minimum footing depth of 21 inches below lowest adjacent grade should be maintained. Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected).

- Continuous wall foundations, 12-inch minimum width and 21 inches minimum below grade:
  2000 psf for dead plus design live loads
  Allowable increases of 300 psf per each foot of additional footing width and 300 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3500 psf.

- Isolated pad foundations, 2 x 2 foot minimum in plan and 21 inches minimum below grade:
  2500 psf for dead plus design live loads
  Allowable increases of 300 psf per each foot of additional footing width and 300 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3500 psf.

Frictional and Lateral Coefficients: Lateral loads may be resisted by soil friction on the base of foundations and by passive resistance of the soils acting on foundation walls. An allowable coefficient of friction of 0.35 of dead load may be used. An allowable passive equivalent fluid pressure of 250 pcf may also be used. *These values include a factor of safety of 1.5.* Passive resistance and frictional resistance may be used in combination if the friction coefficient is reduced by one-third. Lateral passive resistance is based on the assumption that backfill next to foundations is properly compacted.

Bearing Capacity and Passive Pressure – Wind and Seismic Forces: A one-third (⅓) increase in the bearing and passive pressures may be used when calculating resistance to wind or seismic loads. The allowable bearing values indicated are based on the anticipated maximum loads stated in Section 1.1 of this report. If the anticipated loads exceed these values, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.

Minimum Foundation Reinforcement: Minimum reinforcement for continuous footings should be two No. 4 steel reinforcing bars, one placed near the top and one placed near the bottom of the footing. This reinforcing is not intended to supersede any structural requirements provided by the structural engineer.

Expected Settlement: Estimated total static settlement should be less than ¾-inch, based on footings founded on firm soils as recommended. Differential settlement between exterior and interior bearing members should be less than ½-inch, expressed in a post-construction angular distortion ratio of 1:480 or less.

Driven W-sections (W6 X 7.2) Piles for Support of Solar Panels: Driven steel W6 x 7.2 can be used to support the proposed vertical and lateral loads. The proposed W-section is approximately 4 inches by 6 inches, whereby the lateral load will be applied to the 6-inch side of the support. We understand the maximum axial tension is 664 lbs for Case A north row, and the maximum lateral load is 382 lbs for Case A north row, and maximum moment at the base of the pile is 1,902 ft-lbs for Case B north row.

### 5.4 Slabs-on-Grade

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture sensitive floor coverings, an appropriate vapor retarder should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas, a vapor retarder (minimum 10-mil thickness) should underlie the floor slabs. If a Class A vapor retarder (ASTM E 1745) is specified, the retarder can be placed directly on the nonexpansive soil. The retarder should be covered with a minimum 2 inches of *clean* sand. If a less durable vapor retarder is specified (i.e. ASTM E 1745, Class B or C), a minimum of 4 inches of clean sand should be provided, and the retarder should be placed in the center of the clean sand layer. Clean sand is defined as a well or poorly graded sand (ASTM D 2488) of which less than 3 percent passes the No. 200 sieve. The site soils do not fulfill the criteria to be considered clean sand. Clean sand, if utilized, is considered to be part of the minimum 18-inch thickness of nonexpansive materials recommended in Section 5.1 of this report to be placed below slabs-on-grade, not in addition to it. The sand should be lightly moistened just prior to placing the concrete. Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, the method of overlapping, its protection during construction, and the successful sealing of the membrane around utility lines.

***The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superseding any structural design. The design engineer and/or project architect should ensure compliance with SB800 with regards to moisture and moisture vapor.***

Slab Thickness and Reinforcement: Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 200 pci (psi/inch) can be used in concrete slab design.

Conventional capacity concrete slabs and flatwork should be a minimum of 4 inches thick; heavy duty slabs should be a minimum of 5 inches thick. These recommended minimum thicknesses are actual dimensions, not nominal values. Concrete slabs should be reinforced with a minimum of No. 3 rebars at 18-inches on center each way, placed at slab mid-height, to reduce the potential for cracking. Concrete floor slabs may either be monolithically placed with the foundations or doweled after footing placement, as per the requirements of the structural engineer. The thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer.

Control Joints: Control joints should be provided in all concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness (12 feet maximum on-center, each way) as recommended by the American Concrete Institute (ACI, 2004). All joints should form approximately square patterns to reduce the potential for randomly oriented shrinkage cracks. Construction joints in the slabs should be tooled at the time of the concrete placement or saw cut (¼ of slab depth) as soon as practical but not more than 8 hours from concrete placement. Construction (cold) joints should consist of thickened butt joints with ½-inch dowels at 18 inches on center or a thickened keyed-joint to resist vertical deflection at the joint. All construction joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks, but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential for curling of slabs by using proper batching, placement, and curing methods. Curing is highly affected by temperature, wind, and humidity. Quality control procedures that *may* be used include trial batch mix designs, batch plant inspection, and on-site special inspection and testing. However, depending on the concrete strength used by the structural engineer, many of these quality control procedures would not be required by the building code (CBC, 2007).

### 5.5 Soil Corrosivity

Selected chemical analyses for corrosivity were conducted on four soil samples from the project site as shown in Appendix B.

Sulfate and other salts can attack the cement within concrete causing weakening of the cement matrix and eventual deterioration by raveling. This attack can be in the form of a physical attack or chemical attack whereby there may be a chemical reaction between the sulfate and the cement used in the concrete. According to ACI 318 as referenced by the 2007 California Building Code, if sulfate concentrations exceed 1000 ppm there will be special requirements. For this project, the results of those samples tested suggest a low to moderate sulfate ion concentration (20 to 289 ppm. Normal concrete mixes may be used.

Electrical resistivity is a process whereby metal (ferrous) objects in direct contact with soil may be subject to attack by electrochemical corrosion. This typically pertains to buried metal pipes, valves, culverts, etc. made of ferrous metal. To avoid this type of corrosion or to slow the process, buried metal objects are generally protected with waterproof resistant barriers, i.e. epoxy corrosion inhibitors, asphalt coatings, cathodic protection, or encapsulating with densely consolidated concrete. Electrical resistivity testing of the soil suggests that the site soils range from low to very severe potential for metal loss from electrochemical corrosion processes.

Chloride ions can cause corrosion of reinforcing steel. For this project, the results of those samples tested suggest a moderate chloride ion concentration (32 to 1011 ppm). ACI 318 is referenced by the California Building Code, and provides commentary relative to the effects of chlorides present in the soil; from both internal and external sources. It is possible that long term saturation of foundations with chloride rich water could allow the chloride access to the reinforcing steel.

A minimum concrete cover of cast-in-place concrete should be in accordance with Section 7.7 of the 2007 edition of ACI 318. Additionally, the concrete should be thoroughly vibrated during placement.

The information provided above should be considered preliminary. These values can potentially change based on several factors, such as importing soil from another job site and the quality of construction water used during grading and subsequent landscape irrigation.

Earth Systems does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site to provide mitigation of corrosive effects, if further guidance is desired.

### 5.6 Seismic Design Criteria

This site is subject to moderate ground shaking due to potential fault movements along regional faults. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The *minimum* seismic design should comply with the 2007 California Building Code and ASCE 7-05 using the seismic coefficients given in the table below. Based on the size of the site, two sets of criteria are offered for your use. Based on the current proposed locations for the Topaz substation, PG&E switching station, maintenance facility, and visitor's center, specific seismic parameters have been calculated. The remainder of the site, north and east of these proposed improvements should be designed using the higher values.

**2007 CBC (ASCE 7-05) Seismic Parameters**

| | | Reference |
|---|---|---|
| Seismic Category: | D | Table 1613.5.6 |
| Site Class: | D | Table 1613.5.2 |
| **Maximum Considered Earthquake [MCE] Ground Motion** | | |
| Short Period Spectral Response $S_s$: | 0.77 g | Figure 1613.5 |
| 1 second Spectral Response, $S_1$: | 0.33 g | Figure 1613.5 |
| Site Coefficient, $F_a$: | 1.19 | Table 1613.5.3(1) |
| Site Coefficient, $F_v$: | 1.75 | Table 1613.5.3(2) |
| **Design Earthquake Ground Motion** | | |
| Short Period Spectral Response, $S_{DS}$ | 0.61 g | |
| 1 second Spectral Response, $S_{D1}$ | 0.34 g | |

### 5.7 Access Roads, Driveways and Parking Areas

Based on our local knowledge of this area, the ability of access roads on the site to support construction traffic and maintenance vehicles in areas of low cohesive soils will be dependent on soil moisture contents. Construction traffic and maintenance vehicles should be able to traverse most portions of the site, either on- or off-road, during the dry months of the year. At a minimum, access roads should be improved with a surface of at least 6 inches of aggregate base (virgin or recycled), gravel or other locally available appropriate materials.

**PRELIMINARY RECOMMENDED PAVEMENTS SECTIONS**

R-Value Subgrade Soils - 50 (assumed) Design Method – CALTRANS

| Traffic Index (Assumed) | Pavement Use | Flexible Pavements | |
|---|---|---|---|
| | | Asphaltic Concrete Thickness (Inches) | Aggregate Base Thickness (Inches) |
| 5.0 | Autos and pickups | 3.0 | 4.0 |
| 7.0 | Heavier Trucks | 4.0 | 4.5 |

Notes:
1. Asphaltic concrete should be Caltrans, Type B, ½-in. or ¾-in. maximum-medium grading and compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D 1559) or equivalent.
2. Aggregate base should be Caltrans Class 2 (¾ in. maximum) and compacted to a minimum of 95% of ASTM D1557 maximum dry density near its optimum moisture.
3. All pavements should be placed on 12 inches of moisture-conditioned subgrade, compacted to a minimum of 90% of ASTM D 1557 maximum dry density near its optimum moisture.
4. Portland cement concrete should have a minimum of 3250 psi compressive strength at 28 days.
5. Equivalent Standard Specifications for Public Works Construction (Greenbook) may be used instead of Caltrans specifications for asphaltic concrete and aggregate base.

The subgrade should access road, driveways and pavement areas should be cleared of vegetation, moisture conditioned to or just above optimum moisture content, and compacted to at least 95% relative compaction (ASTM D1557) for a depth of one foot below subgrade. Compaction should be verified by testing.

Weak subgrade areas can be identified by proof rolling with heavy, rubber-tired equipment, such as a loaded water truck. Periodic moisture conditioning may be required to maintain the compaction of the subgrade. Daily moisture conditioning during construction may be necessary. Traffic speed should be restricted to 15 mph to reduce the potential for “wash boarding” and further restricted to 5 mph at turns to avoid rutting.

Unpaved access roads should be graded with a 2% crown. Positive drainage should be maintained away from the access roadways. Water should not pond on or near roadways areas. Periodic maintenance and regrading the surface should be anticipated.

## Section 6
## LIMITATIONS AND ADDITIONAL SERVICES

### 6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time, whether they are from natural processes or works of man, on this or adjoining properties. In addition, changes in applicable standards occur, whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

In the event that any changes in the nature, design, or location of structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing.

This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

As the Geotechnical Engineer of Record for this project, ESSW has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is express or implied. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

ESSW should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If ESSW is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

Although available through ESSW, the current scope of our services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

### 6.2 Additional Services

This report is based on the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining ESSW as the geotechnical consultant from beginning to end of the project will provide continuity of services. *The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements, but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to, the following:

- Consultation during the final design stages of the project.
- A review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design.
- Observation and testing during site preparation, grading, and placement of engineered fill as required by CBC Sections 1704.7 and the local grading ordinances.
- Consultation as needed during construction.

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Appendices as cited are attached and complete this report.

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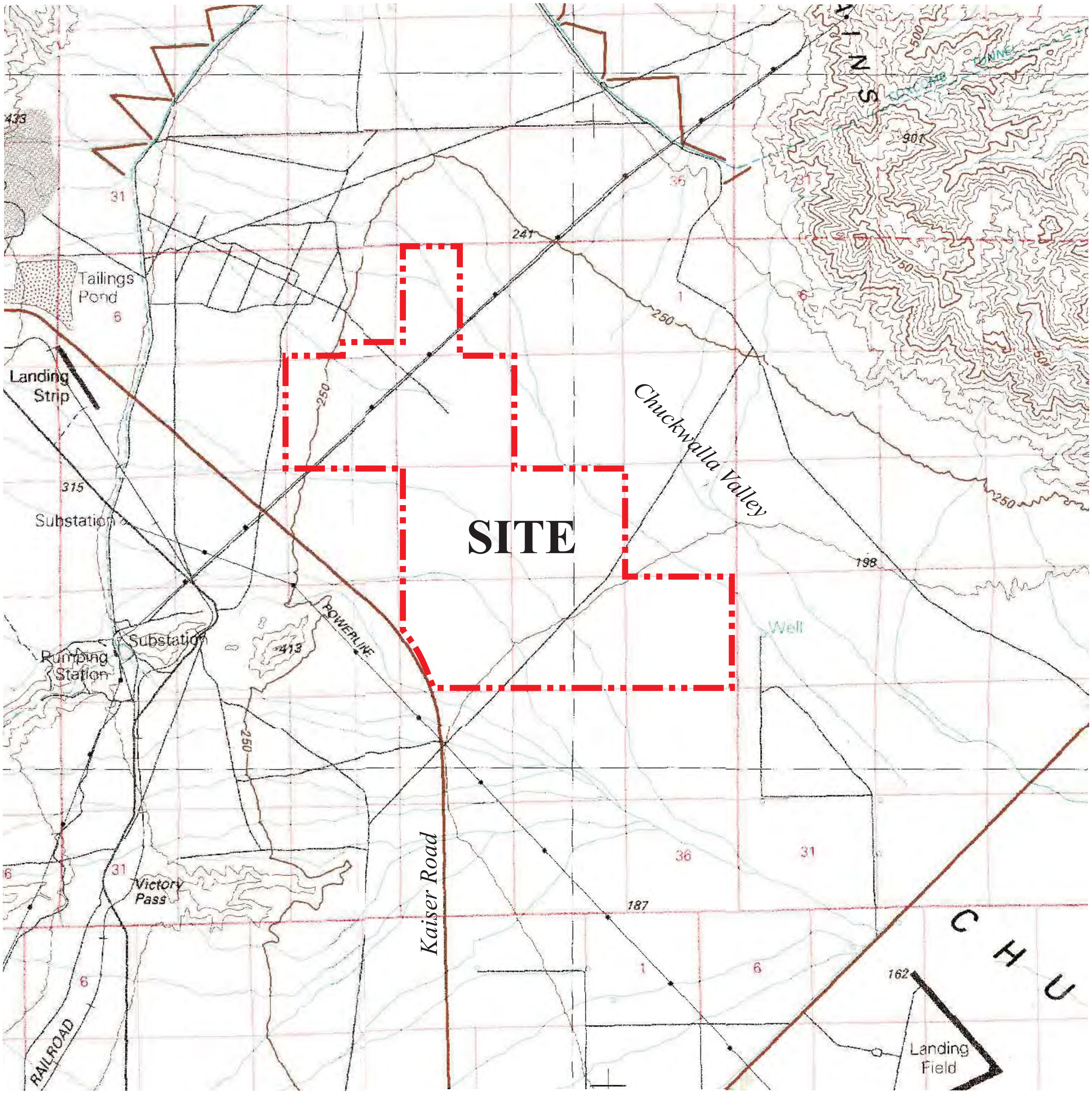
**APPENDIX A**

Figure 1 – Site Location Map
Figure 2 – Site Exploration Map
Figure 3 – Geologic Map
Fault Parameters
Test Pit Logs




Base Map: U.S.G.S. 30 x 60 Minute *Eagle Mountain, Calif., Quadrangle*, 1986
*Eagle_Mountain_F33115E1.geo.pdf* from usgs.gov

N

Scale in Miles

0 1 2

**Figure 1**
**Site Location**

Desert Sunlight Project
Proposed 550 MW Solar Farm
Desert Center, Riverside County, California

**Earth Systems**
**Southwest**

06/16/2010 | File No.: 11666-01

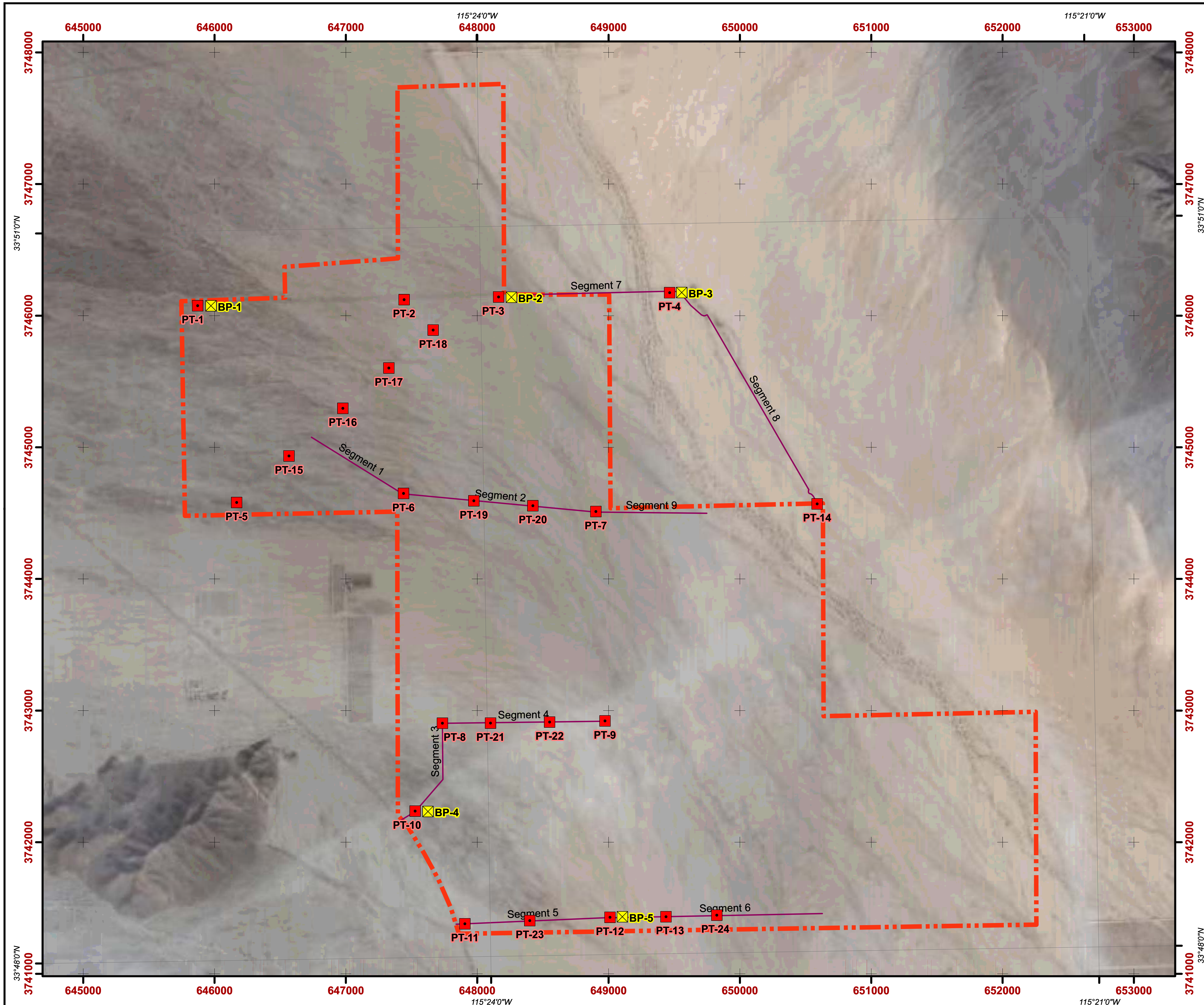
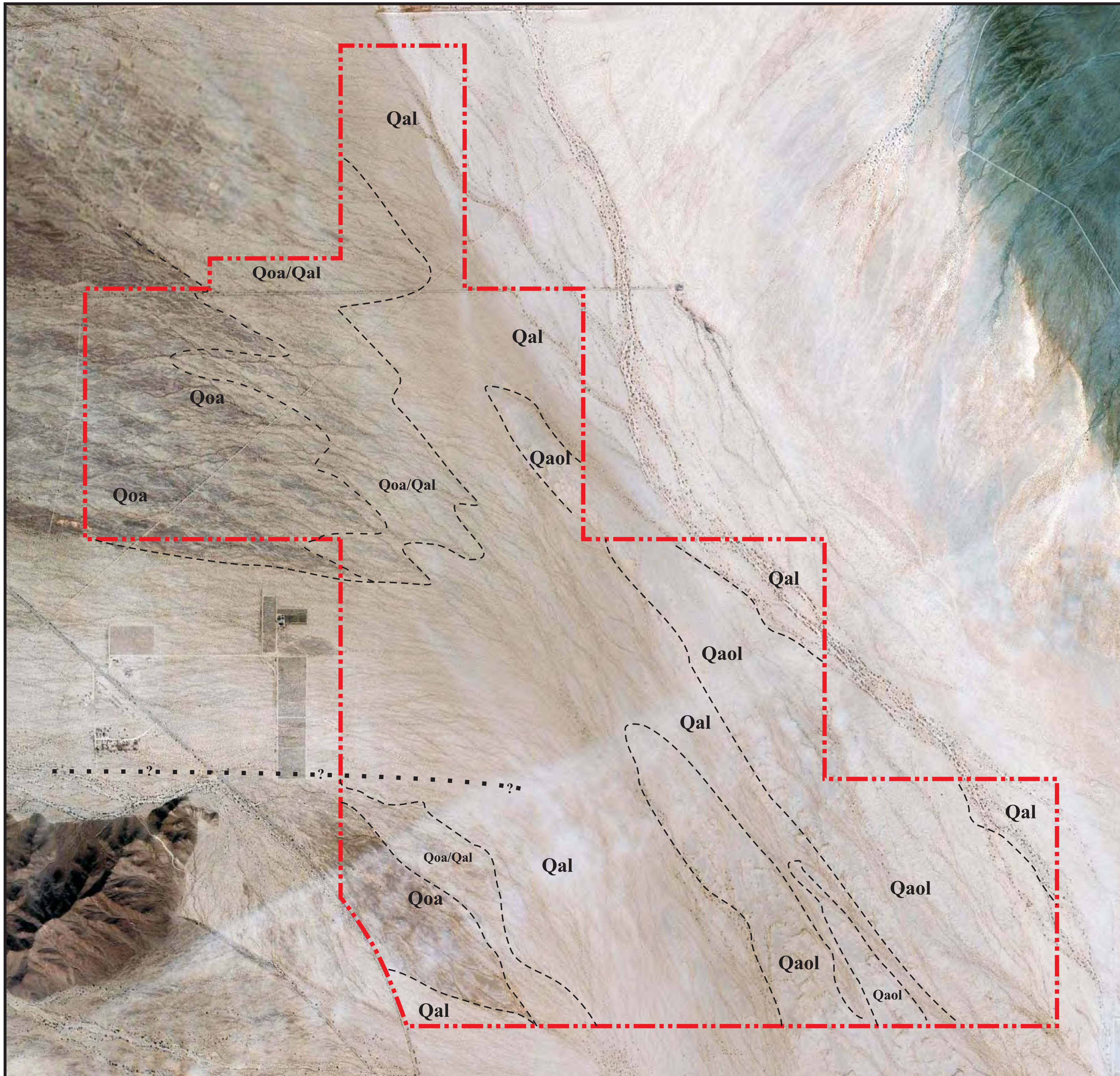



**Figure 2**
**Test Locations**

Desert Sunlight Project
Proposed 550 MW Solar Farm
Desert Center, Riverside County, California

**Earth Systems Southwest**

| 06/16/10 | File No.: 11666-01 |
|---|---|




## LEGEND

Property Boundary

**Qal -** Quaternary Younger Alluvium, Undifferentiated

**Qaol -** Quaternary Younger Alluvium with interspersed areas of weak desert pavement

**Qoa -** Quaternary Older Alluvium typically with moderate to strong desert pavement.

Fault: Dotted where concealed and conjectural.

Contact: Dashed where approximate.

Note: Qoa/Qal denotes transition zone with interspersed areas of younger alluvium without significant desert pavement and areas with weak desert pavement.

Approximate Scale in Miles

0 0.5 1

Base Map: Desert Sunlight Aerial Photograph, 2009

**Figure 3**
**Geologic Map-Revised**

Desert Sunlight Project
Proposed 550 MW Solar Farm
Desert Center, Riverside County, California

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**Earth Systems Southwest**

06/16/10 File No.: 11666-01

## Fault Parameters

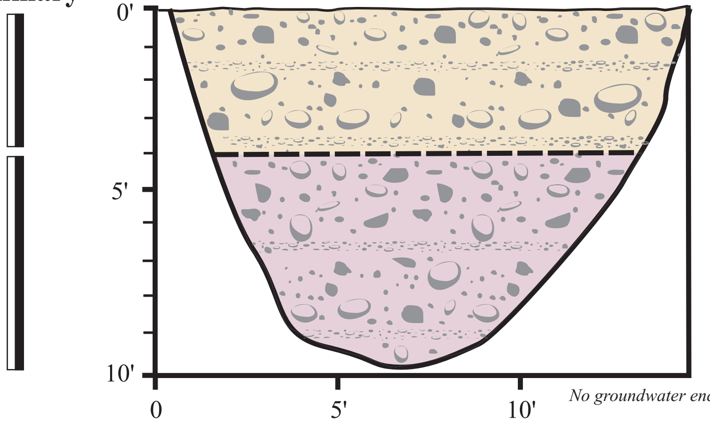
| Fault Section Name | Distance (miles) | Distance (km) | Avg Dip Angle (deg.) | Avg Dip Direction (deg.) | Avg Rake (deg.) | Trace Length (km) | Fault Type | **Mean Mag** | Mean Return Interval (years) | Slip Rate (mm/yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| Blue Cut | 7.2 | 11.6 | 90 | 177 | na | 79 | B' | **7.1** | | |
| Pinto Mtn | 35.9 | 57.8 | 90 | 175 | 0 | 74 | B | **7.2** | | 2.5 |
| Brawley (Seismic Zone), alt 1 | 36.8 | 59.2 | 90 | 250 | na | 60 | B' | **7.0** | | |
| San Andreas (Coachella) rev | 36.8 | 59.2 | 90 | 224 | 180 | 69 | A | **7.2** | 69 | 20 |
| Brawley (Seismic Zone), alt 2 | 38.0 | 61.2 | 90 | 250 | na | 61 | B' | **7.0** | | |
| Pisgah-Bullion Mtn-Mesquite Lk | 40.0 | 64.4 | 90 | 60 | 180 | 88 | B | **7.3** | | 0.8 |
| Elmore Ranch | 44.2 | 71.1 | 90 | 310 | 0 | 29 | B | **6.6** | | 1 |
| San Andreas (San Gorgonio Pass-Garnet Hill) | 48.2 | 77.6 | 58 | 20 | 180 | 56 | A | **7.6** | 219 | 10 |
| San Andreas, (North Branch, Mill Creek) | 48.2 | 77.6 | 76 | 204 | 180 | 106 | A | **7.5** | 110 | 17 |
| Calico-Hidalgo | 48.6 | 78.2 | 90 | 52 | 180 | 117 | B | **7.4** | | 1.8 |
| So Emerson-Copper Mtn | 49.5 | 79.6 | 90 | 51 | 180 | 54 | B | **7.0** | | 0.6 |
| Ludlow | 49.6 | 79.8 | 90 | 239 | na | 70 | B' | **7.0** | | |
| Joshua Tree (Seismicity) | 51.6 | 83.1 | 90 | 271 | na | 17 | B' | **6.5** | | |
| Eureka Peak | 54.3 | 87.3 | 90 | 75 | 180 | 19 | B | **6.6** | | 0.6 |
| San Jacinto (Clark) rev | 56.5 | 90.9 | 90 | 214 | 180 | 47 | A | **7.6** | 211 | 14 |
| Burnt Mtn | 56.8 | 91.4 | 67 | 265 | 180 | 21 | B | **6.7** | | 0.6 |
| Superstition Hills | 61.6 | 99.1 | 90 | 220 | 180 | 36 | A | **7.4** | 199 | 4 |
| Landers | 62.4 | 100.4 | 90 | 60 | 180 | 95 | B | **7.4** | | 0.6 |
| San Jacinto (Borrego) | 62.8 | 101.0 | 90 | 223 | 180 | 34 | A | **7.0** | 146 | 4 |
| San Jacinto (Coyote Creek) | 63.2 | 101.8 | 90 | 223 | 180 | 43 | A | **7.3** | 259 | 4 |
| Imperial | 63.5 | 102.1 | 82 | 55 | 180 | 46 | A | **6.8** | 89 | 20 |
| Superstition Mountain | 65.9 | 106.1 | 37 | 37 | 37 | 37 | B | **7.0** | | 0.1 |
| San Jacinto (Superstition Mtn) | 66.0 | 106.3 | 90 | 210 | 180 | 26 | B' | **6.6** | | |
| Hector Mine | 66.3 | 106.8 | 90 | 246 | na | 28 | B' | **6.7** | | |
| Mission Creek | 67.7 | 109.0 | 65 | 5 | 180 | 31 | B' | **6.9** | | |
| San Jacinto (Anza) rev | 67.9 | 109.3 | 90 | 216 | 180 | 46 | A | **7.6** | 151 | 18 |
| Johnson Valley (No) | 68.5 | 110.3 | 90 | 51 | 180 | 35 | B | **6.8** | | 0.6 |
| North Frontal (East) | 71.8 | 115.6 | 41 | 187 | 90 | 27 | B | **6.9** | | 0.5 |
| Earthquake Valley (So Extension) | 76.2 | 122.7 | 90 | 204 | 180 | 9 | B' | **6.3** | | |
| Earthquake Valley | 78.4 | 126.1 | 90 | 217 | 180 | 20 | B | **6.7** | | 2 |
| San Gorgonio Pass | 79.0 | 127.1 | 60 | 11 | na | 29 | B' | **6.9** | | |
| Lenwood-Lockhart-Old Woman Springs | 79.1 | 127.2 | 90 | 43 | 180 | 145 | B | **7.5** | | 0.9 |
| Elsinore (Coyote Mountain) | 79.7 | 128.3 | 82 | 35 | 180 | 39 | A | **7.1** | 322 | 3 |
| Laguna Salada | 81.4 | 131.0 | 90 | 41 | 180 | 99 | A | **6.8** | 89 | 3.5 |
| San Andreas (San Bernardino S) | 81.4 | 131.0 | 90 | 210 | 180 | 43 | A | **7.6** | 150 | 16 |
| Earthquake Valley (No Extension) | 81.6 | 131.3 | 90 | 221 | 180 | 33 | B' | **6.9** | | |
| Elsinore (Julian) | 82.1 | 132.1 | 84 | 36 | 180 | 75 | A | **7.6** | 725 | 3 |
| Cerro Prieto | 82.7 | 133.1 | 90 | 221 | na | 84 | B' | **7.2** | | |
| San Jacinto (San Jacinto Valley, stepover) | 86.0 | 138.4 | 90 | 224 | 180 | 24 | A | **7.4** | 199 | 9 |
| San Jacinto (Anza, stepover) | 86.8 | 139.6 | 90 | 224 | 180 | 25 | A | **7.6** | 151 | 9 |

Reference: USGS OFR 2007-1437 (CGS SP 203)

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2007-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

## BP-1

**Sampling Summary**



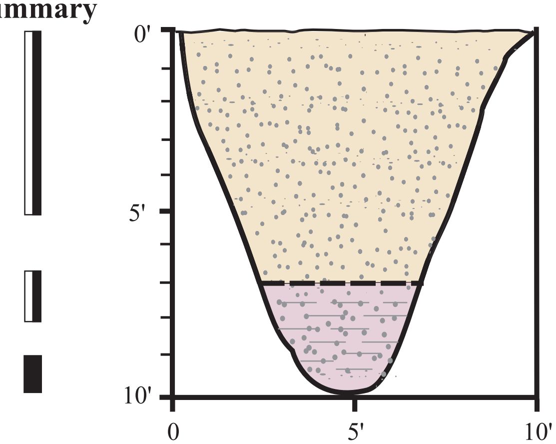

*No groundwater encountered*

Light brown, fine to medium grained **sand** with fine to coarse gravel **[SW-SM]**, thinly bedded (horizontal), uncemented, trace roots, with occasional silt layers to two inches thick, damp to approximately 8 inches. Calcified zone at 12 inches - 3 inches thick, alluvial deposition.

Reddish brown gravelly fine to coarse sand [SP-GP], iron oxide stain, very dense, damp, becomes yellowish brown at approximately 6', occasional silt layers (2-inch thick or less).

## BP-2

**Sampling Summary**




*No groundwater encountered*

Light brown fine to coarse sand [SW-SM], trace to some silt and fine to coarse gravel, uncemented, medium dense, damp to 1 foot, dry below, moderately to poorly bedded, apparent mix of alluvial deposition.

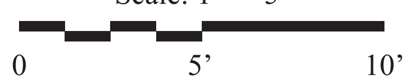
Reddish brown fine to coarse sand with silt and clay [SM], Ped development evident, calcified, iron oxide stained, very dense, dry, trace fine to coarse gravel and cobbles, older fan surface, apparent alluvial deposition.

**LEGEND**

Bulk Sample

Grab Sample

Horizontal and Vertical
Scale: 1" = 5’



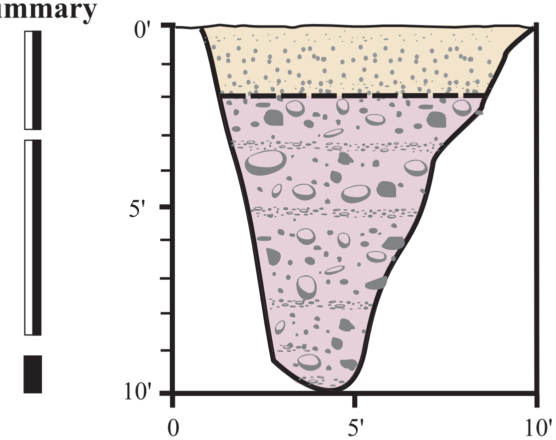

**Backhoe Pit Logs**

Desert Sunlight
Desert Center, Riverside County, California

Earth Systems
Southwest

06/16/2010 | File No.: 11666-01

**Sampling Summary**



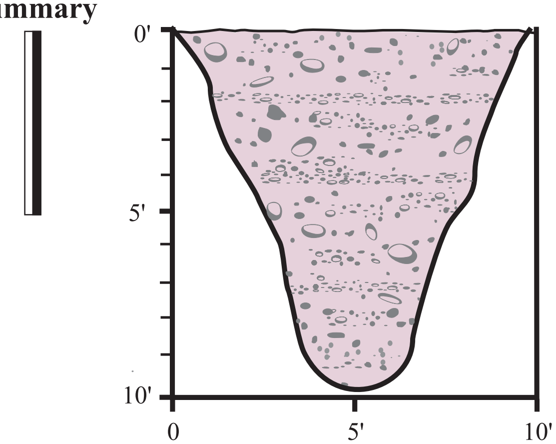

*No groundwater encountered*

## BP-3

Light brown, fine to medium grained **sand** with fine to coarse gravel **[SP]**, thinly bedded (horizontal), uncemented, trace roots, with occasional silt layers to two inches thick, damp to approximately 8 inches. Calcified zone at 12 inches - 3 inches thick, alluvial deposition.

Reddish brown gravelly fine to coarse sand [SW-SM], iron oxide stain, very dense, damp, becomes yellowish brown at approximately 6', occasional silt layers (2-inch thick or less).

**Sampling Summary**




*No groundwater encountered*

## BP-4

Light brown to reddish brown fine gravelly fine to coarse **sand [SW-SM]**, moderate to well bedded, occasional gravel layers with cobbles, dry very dense, apparent alluvial deposition, older fan surface, increasing cementation with depth beginning at 3-1/2 feet, ped development below 3 feet.

**LEGEND**

Bulk Sample

Grab Sample

Horizontal and Vertical
Scale: 1" = 5’

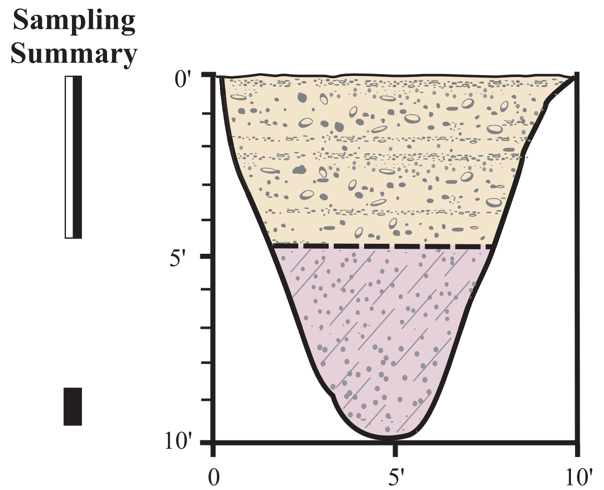
0 5’ 10’

**Backhoe Pit Logs**

Desert Sunlight
Desert Center, Riverside County, California

Earth Systems
Southwest

06/16/2010 File No.: 11666-01




*No groundwater encountered*

## BP-5

Light brown to reddish brown fine gravelly fine to coarse **sand and silt [SW-SM]**, damp to 8 inches, dry below, dense, medium to thickly bedded, lightly to moderately cemented, alluvial deposition.

Reddish brown clayey fine to coarse **sand** with silt **[SC]**, trace fine to coarse gravel, ped development evident, moderate to highly cemented, iron oxide stained, very dense, dry, older fan surface, apparent alluvial deposition.

**LEGEND**

- Bulk Sample
- Grab Sample

Horizontal and Vertical
Scale: 1" = 5’

0 5’ 10’

**Backhoe Pit Logs**

Desert Sunlight
Desert Center, Riverside County, California

Earth Systems
Southwest

06/16/2010 | File No.: 11666-01

**APPENDIX B**

Laboratory Test Results

File No.: 11666-01

January 19, 2010

Lab No.: 09-0292

# PARTICLE SIZE ANALYSIS

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-1 @ 0-4 feet**

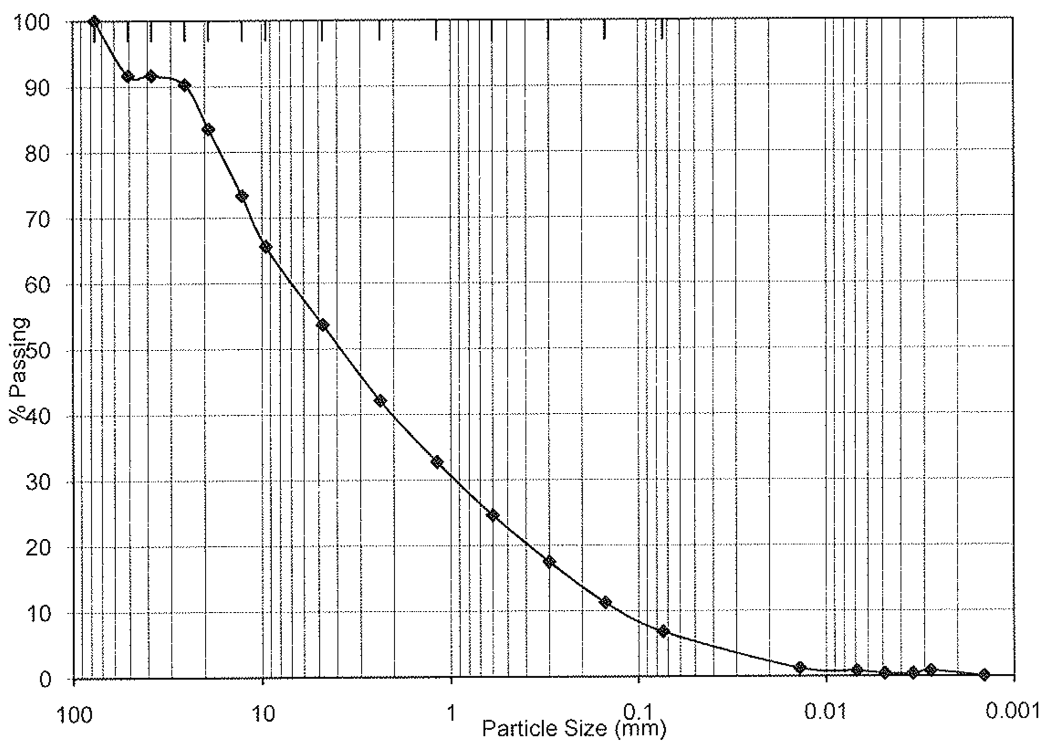
Description: **Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 92 |
| 1-1/2" | 92 |
| 1" | 90 |
| 3/4" | 84 |
| 1/2" | 73 |
| 3/8" | 66 |
| #4 | 54 |
| #8 | 42 |
| #16 | 33 |
| #30 | 25 |
| #50 | 17 |
| #100 | 11 |
| #200 | 7 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 63 Micron | 4 |
| 24 Micron | 2 |
| 14 Micron | 1 |
| 7 Micron | 1 |
| 5 Micron | 0 |
| 3.4 Micron | 0 |
| 2.8 Micron | 1 |
| 1.4 Micron | 0 |

| | |
|---|---|
| **% Gravel:** | **46** |
| **% Sand:** | **47** |
| **% Silt:** | **6** |
| **% Clay (3 micron):** | **1** |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

# PARTICLE SIZE ANALYSIS

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-2 @ 0-5 feet**

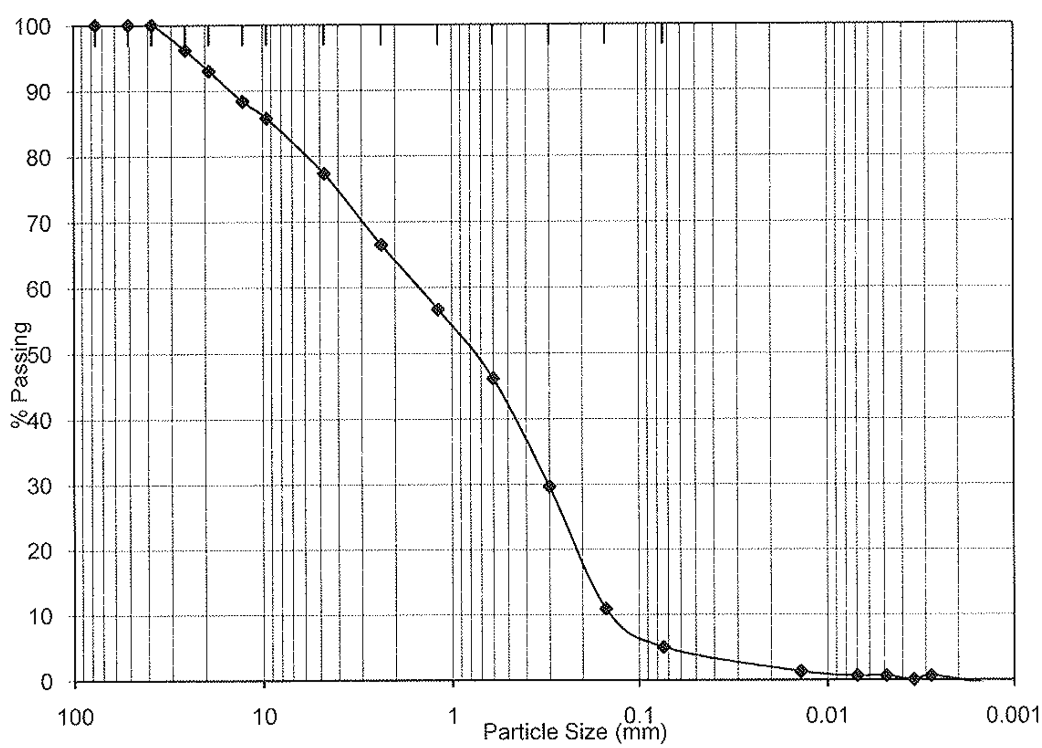
Description: **Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 100 |
| 1-1/2" | 100 |
| 1" | 96 |
| 3/4" | 93 |
| 1/2" | 88 |
| 3/8" | 86 |
| #4 | 77 |
| #8 | 66 |
| #16 | 57 |
| #30 | 46 |
| #50 | 30 |
| #100 | 11 |
| #200 | 5 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 65 Micron | 2 |
| 24 Micron | 1 |
| 14 Micron | 1 |
| 7 Micron | 1 |
| 5 Micron | 1 |
| 3.5 Micron | 0 |
| 2.8 Micron | 1 |
| 1.5 Micron | -1 |

| | |
|---|---|
| **% Gravel:** | **23** |
| **% Sand:** | **72** |
| **% Silt:** | **4** |
| **% Clay (3 micron):** | **1** |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

# PARTICLE SIZE ANALYSIS

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-3 @ 0-1 1/2 feet**

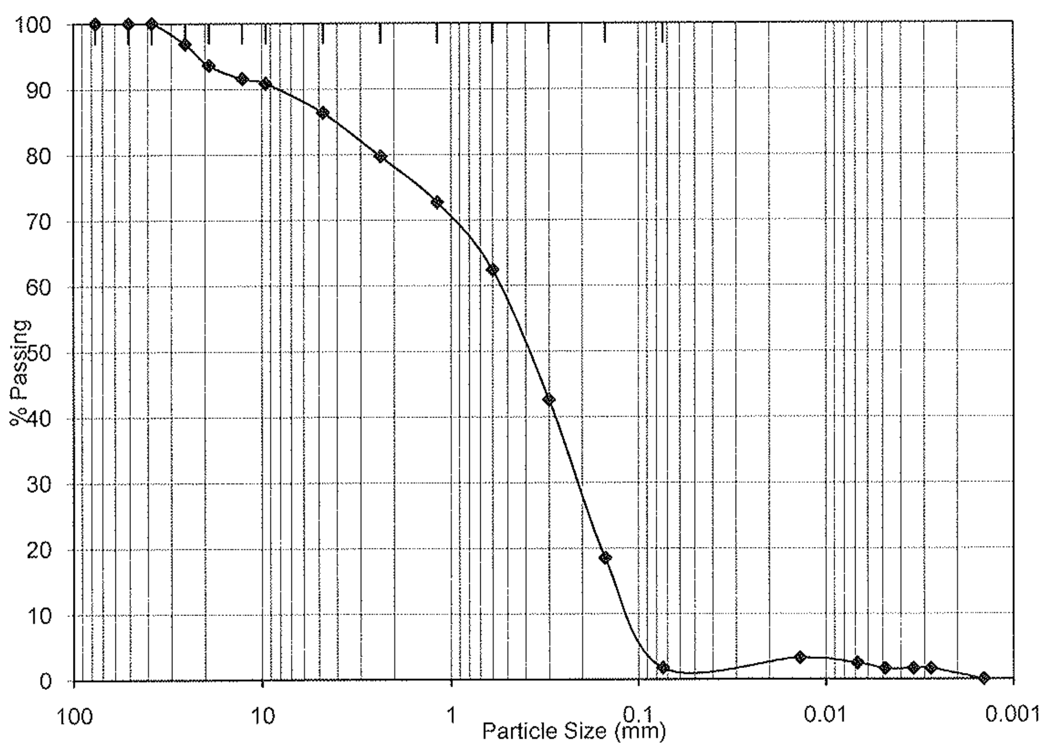
Description: **Brown Fine to Coarse Sand w/Gravel (SP)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 100 |
| 1-1/2" | 100 |
| 1" | 97 |
| 3/4" | 94 |
| 1/2" | 92 |
| 3/8" | 91 |
| #4 | 86 |
| #8 | 80 |
| #16 | 73 |
| #30 | 62 |
| #50 | 43 |
| #100 | 19 |
| #200 | 2 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 63 Micron | 9 |
| 24 Micron | 5 |
| 14 Micron | 3 |
| 7 Micron | 2 |
| 5 Micron | 2 |
| 3.4 Micron | 2 |
| 2.8 Micron | 2 |
| 1.4 Micron | 0 |

| | |
|---|---|
| **% Gravel:** | **14** |
| **% Sand:** | **85** |
| **% Silt:** | **0** |
| **% Clay (3 micron):** | **2** |



File No.: 11666-01

January 19, 2010

Lab No.: 09-0292

# PARTICLE SIZE ANALYSIS

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-3 @ 1 1/2-10 feet**

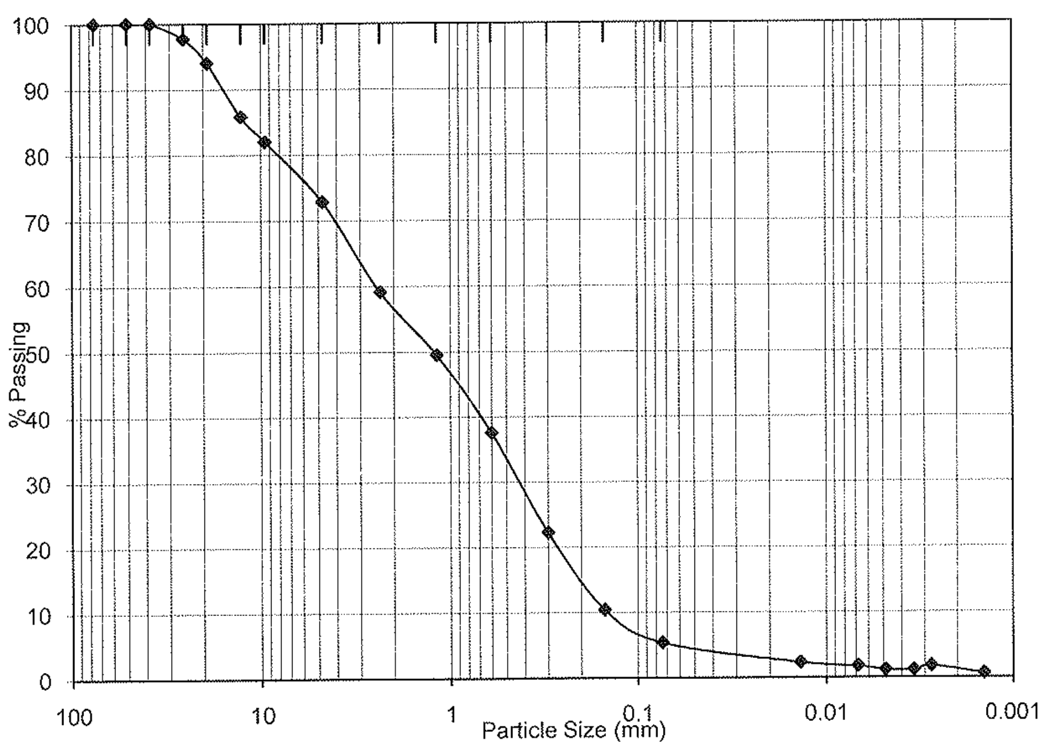
Description: **Reddish Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 100 |
| 1-1/2" | 100 |
| 1" | 98 |
| 3/4" | 94 |
| 1/2" | 86 |
| 3/8" | 82 |
| #4 | 73 |
| #8 | 59 |
| #16 | 49 |
| #30 | 38 |
| #50 | 22 |
| #100 | 10 |
| #200 | 5 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 64 Micron | 4 |
| 24 Micron | 2 |
| 14 Micron | 2 |
| 7 Micron | 2 |
| 5 Micron | 1 |
| 3.4 Micron | 1 |
| 2.8 Micron | 2 |
| 1.4 Micron | 1 |

| | |
|---|---|
| **% Gravel:** | **27** |
| **% Sand:** | **68** |
| **% Silt:** | **3** |
| **% Clay (3 micron):** | **2** |



File No.: 11666-01

January 19, 2010

Lab No.: 09-0292

**PARTICLE SIZE ANALYSIS**

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-4 @ 0-5 feet**

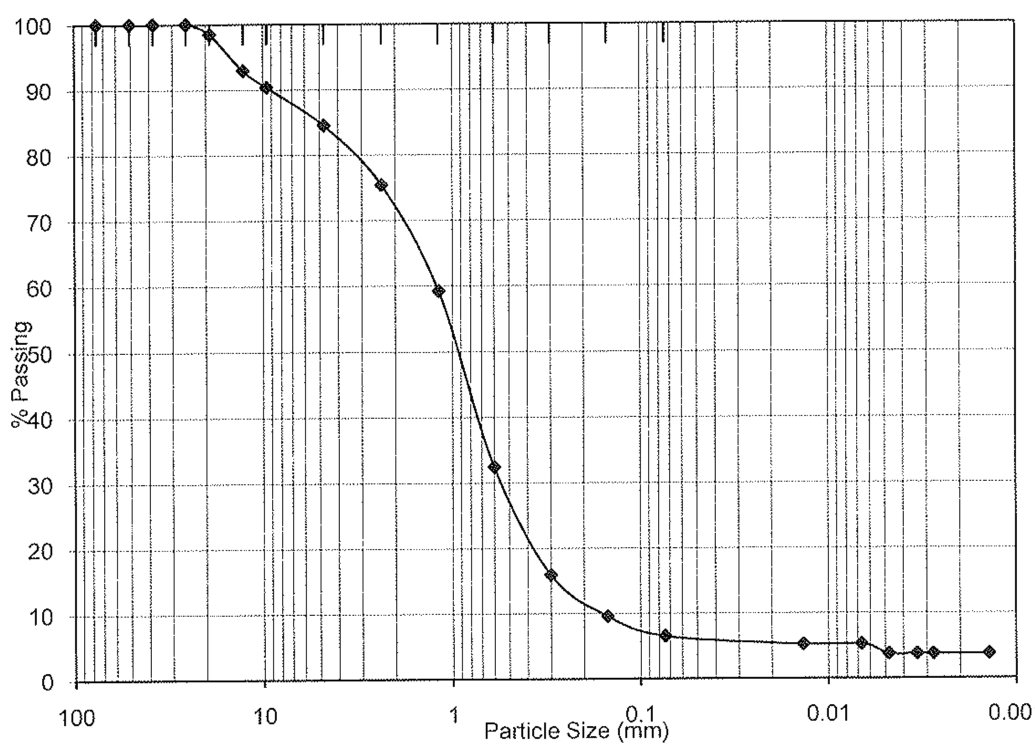
Description: **Brown Well Graded Sand w/Silt (SW-SM)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 100 |
| 1-1/2" | 100 |
| 1" | 100 |
| 3/4" | 98 |
| 1/2" | 93 |
| 3/8" | 90 |
| #4 | 85 |
| #8 | 75 |
| #16 | 59 |
| #30 | 32 |
| #50 | 16 |
| #100 | 10 |
| #200 | 6 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 65 Micron | 5 |
| 24 Micron | 5 |
| 14 Micron | 5 |
| 7 Micron | 5 |
| 5 Micron | 4 |
| 3.4 Micron | 4 |
| 2.8 Micron | 4 |
| 1.4 Micron | 4 |

| | |
|---|---|
| **% Gravel:** | **15** |
| **% Sand:** | **78** |
| **% Silt:** | **2** |
| **% Clay (3 micron):** | **4** |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

# PARTICLE SIZE ANALYSIS

ASTM D-422-63 Reapproved 2007

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: **BP-5 @ 0-4 1/2 feet**

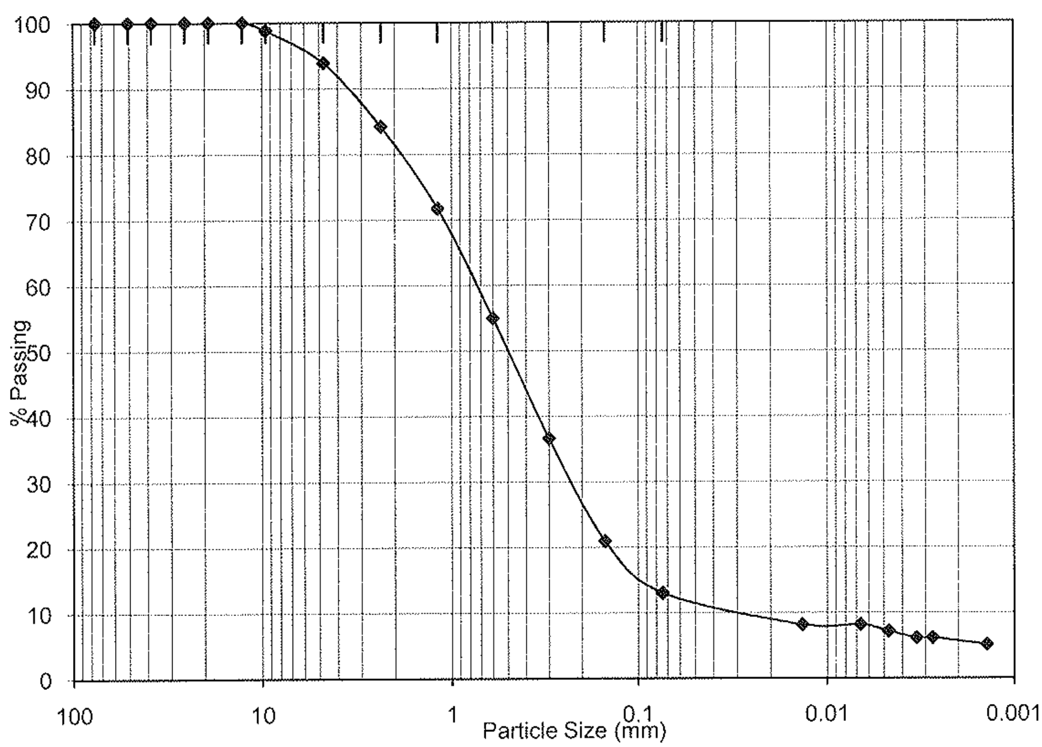
Description: **Brown Well Graded Sand w/Silt (SW-SM)**

| Sieve Size | % Passing |
|---|---|
| 3" | 100 |
| 2" | 100 |
| 1-1/2" | 100 |
| 1" | 100 |
| 3/4" | 100 |
| 1/2" | 100 |
| 3/8" | 99 |
| #4 | 94 |
| #8 | 84 |
| #16 | 72 |
| #30 | 55 |
| #50 | 37 |
| #100 | 21 |
| #200 | 13 |

By Hydrometer Method:

| Particle Size | % Passing |
|---|---|
| 63 Micron | 11 |
| 23 Micron | 9 |
| 14 Micron | 8 |
| 7 Micron | 8 |
| 5 Micron | 7 |
| 3.4 Micron | 6 |
| 2.7 Micron | 6 |
| 1.4 Micron | 5 |

| | |
|---|---|
| **% Gravel:** | **6** |
| **% Sand:** | **81** |
| **% Silt:** | **7** |
| **% Clay (3 micron):** | **6** |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

## MAXIMUM DENSITY / OPTIMUM MOISTURE

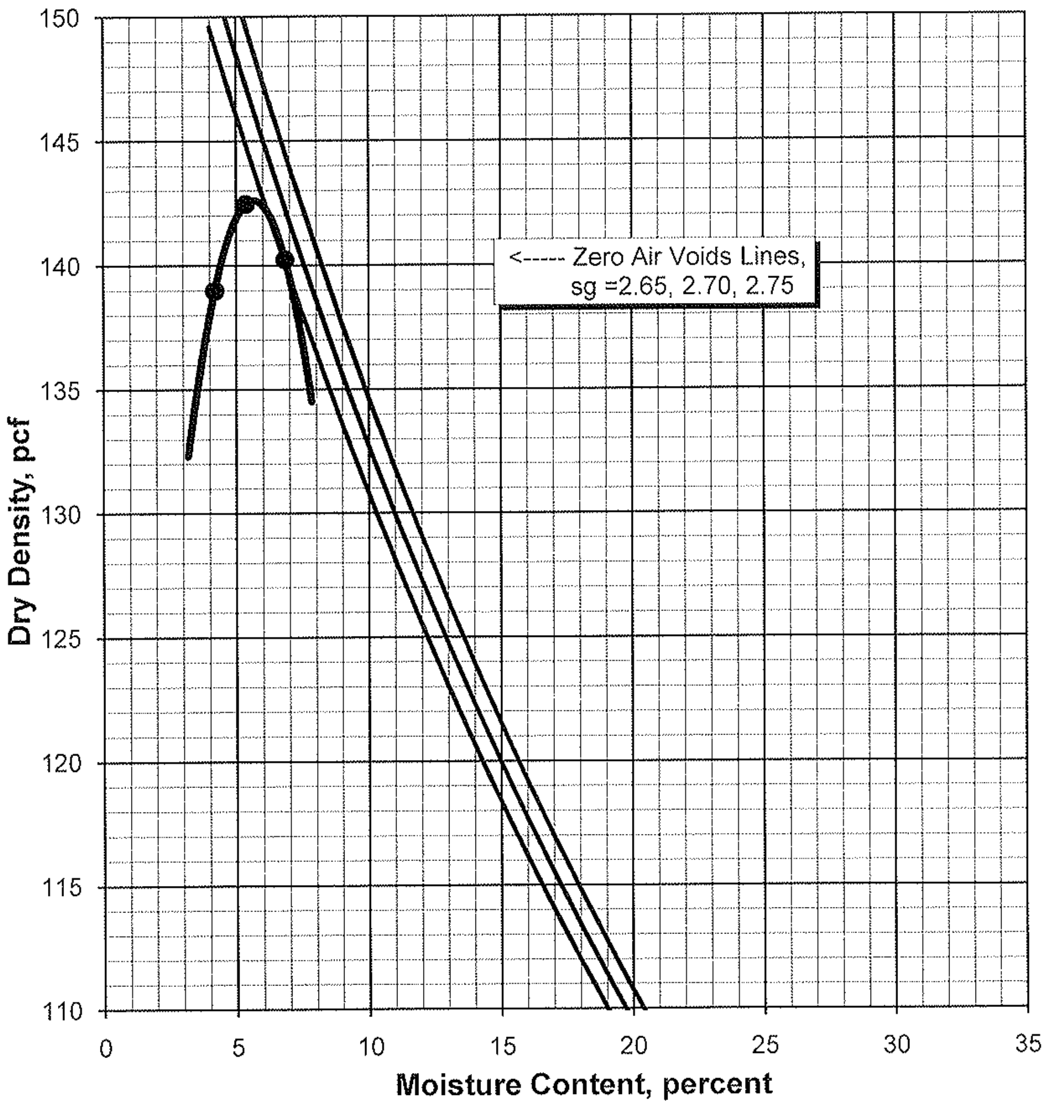
ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA
Sample ID: 1
Location: BP-1 @ 0-4 feet
Description: Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)

Procedure Used: C
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 09-0292

**Maximum Density:** **142.5 pcf**
**Optimum Moisture:** **6%**
Corrected for Oversize (ASTM D4718)

| Sieve Size | % Retained |
|---|---|
| 3/4" | 20.3 |
| 3/8" | 31.8 |
| #4 | 41.9 |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

## MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA

Sample ID: 2

Location: BP-2 @ 0-5 feet

Description: Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)

Procedure Used: B

Preparation Method: Moist

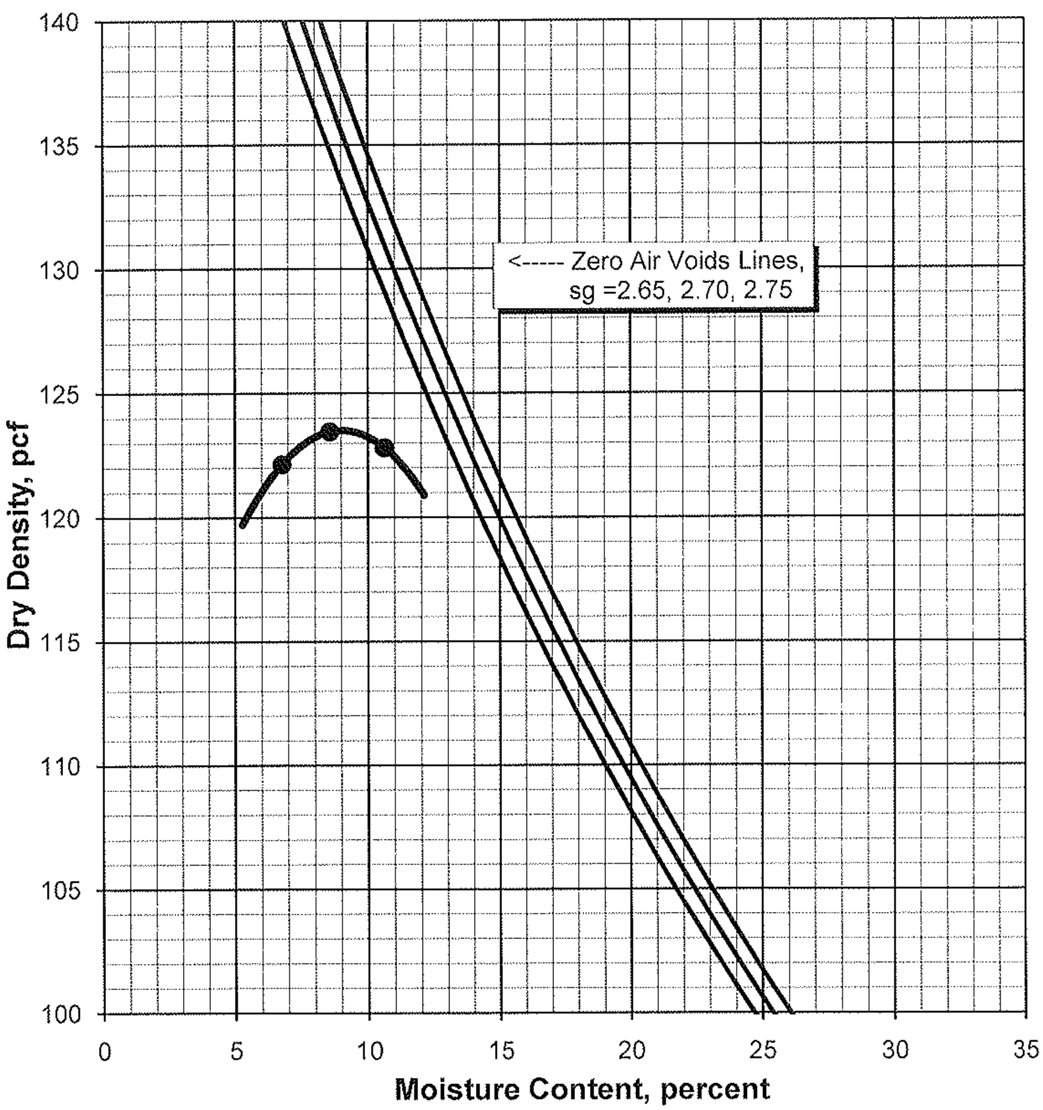
Rammer Type: Mechanical

Lab Numbe 09-0292

| Sieve Size | % Retained |
|---|---|
| 3/4" | 6.9 |
| 3/8" | 12.0 |
| #4 | 19.4 |

**Maximum Density:** **123.5 pcf**

**Optimum Moisture:** **9%**



File No.: 11666-01

January 19, 2010

Lab No.: 09-0292

## MAXIMUM DENSITY / OPTIMUM MOISTURE

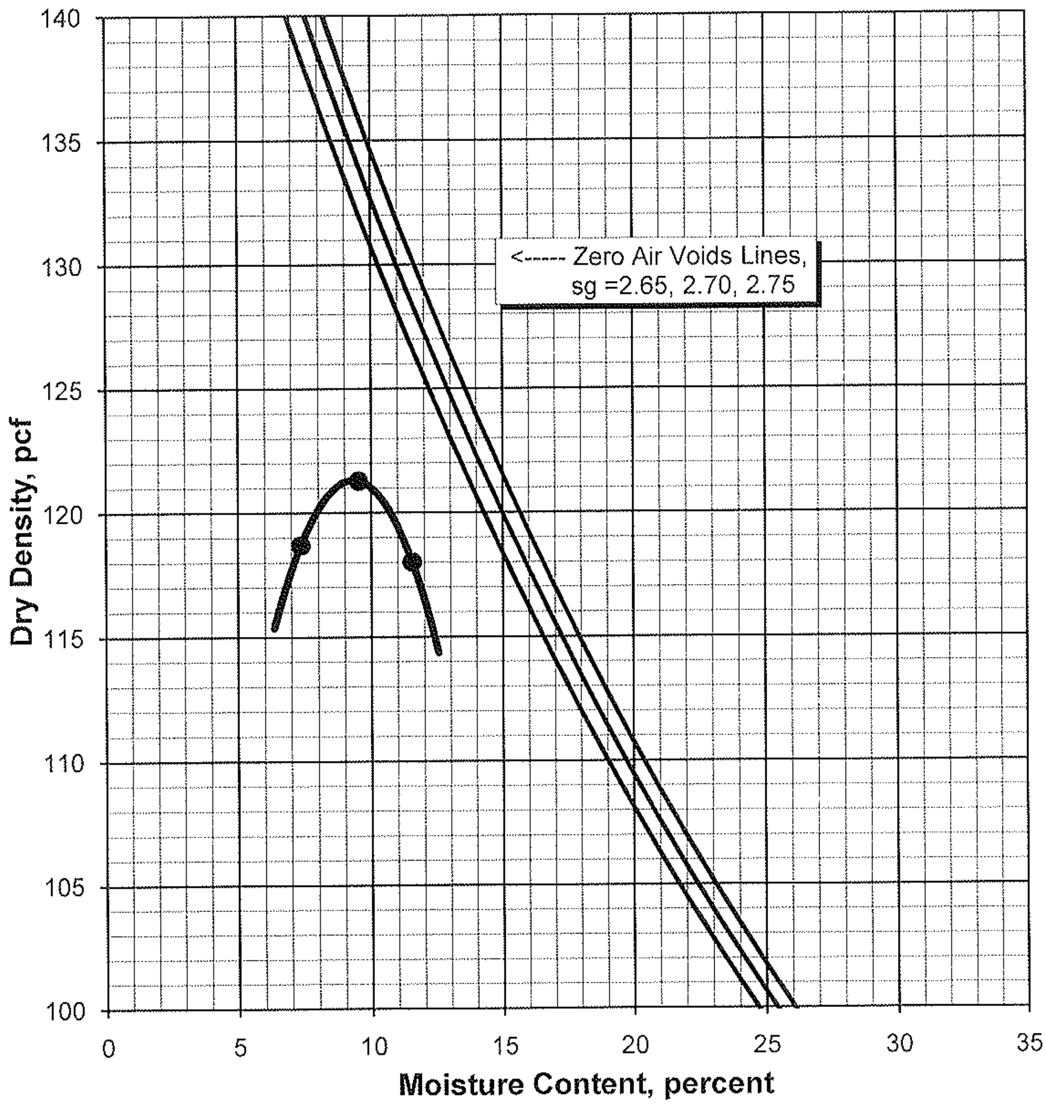
ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA
Sample ID: 3
Location: BPB-3 @ 0-1 1/2 feet
Description: Brown Fine to Coarse Sand w/Gravel (SP)

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 09-0292

**Maximum Density:** **121.5 pcf**
**Optimum Moisture:** **9.5%**

| Sieve Size | % Retained |
|---|---|
| 3/4" | 5.0 |
| 3/8" | 7.8 |
| #4 | 10.8 |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

## MAXIMUM DENSITY / OPTIMUM MOISTURE

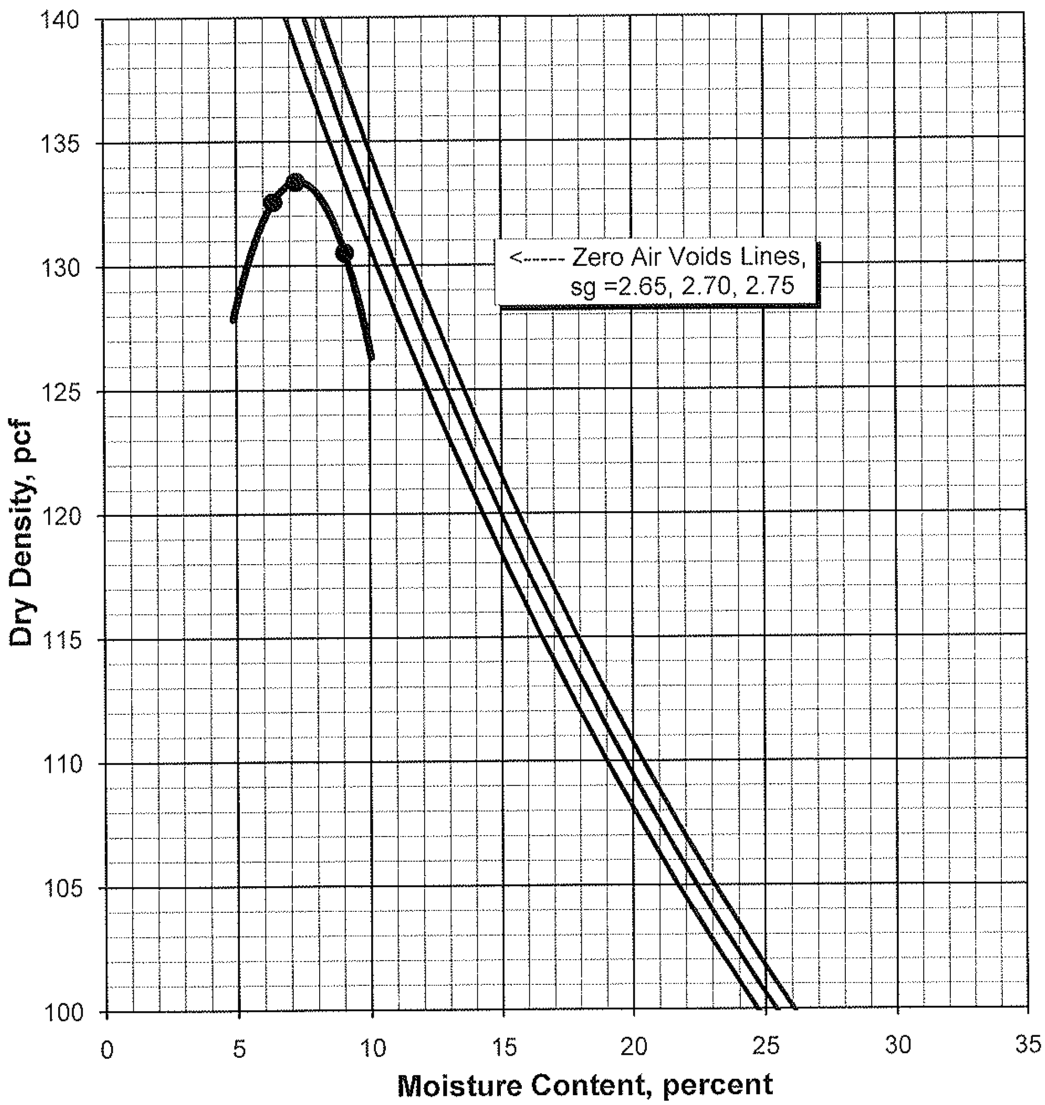
ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA
Sample ID: 4
Location: BP-3 @ 1 1/2-10 feet
Description: Reddish Brown Gravelly Fine to Coarse Sand w/Silt (SW-SM)

Procedure Used: C
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 09-0292

**Maximum Density:** **133.5 pcf**
**Optimum Moisture:** **7.5%**
Corrected for Oversize (ASTM D4718)

| Sieve Size | % Retained |
|---|---|
| 3/4" | 16.5 |
| 3/8" | 19.7 |
| #4 | 27.5 |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

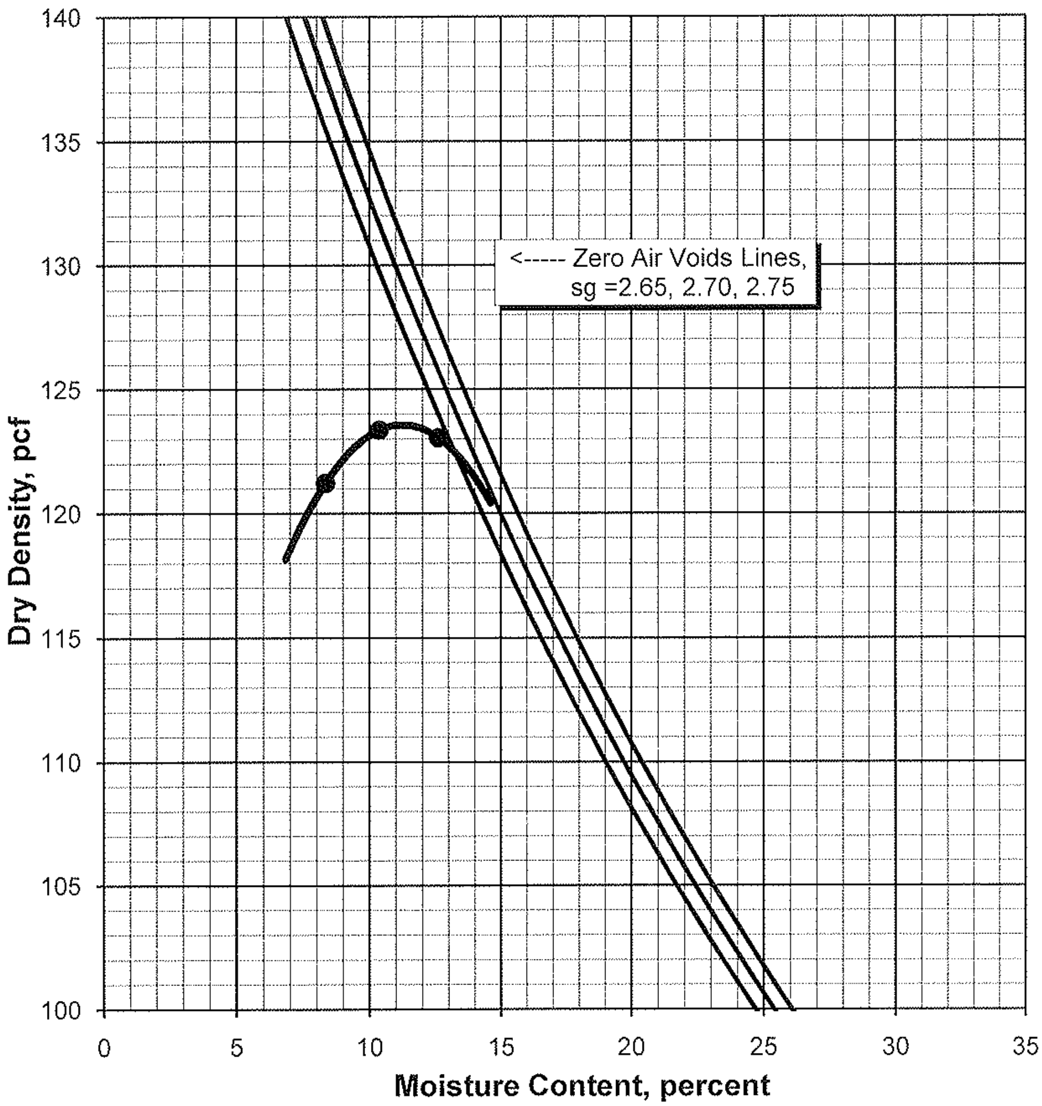
**MAXIMUM DENSITY / OPTIMUM MOISTURE** ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA
Sample ID: 5
Location: BP-4 @ 0-5 feet
Description: Brown, Silty F to C Sand (SM)

Procedure Used: B
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 09-0292

**Maximum Density:** **123.5 pcf**
**Optimum Moisture:** **11.5%**

| Sieve Size | % Retained |
|---|---|
| 3/4" | 8.2 |
| 3/8" | 14.3 |
| #4 | 20.3 |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

## MAXIMUM DENSITY / OPTIMUM MOISTURE

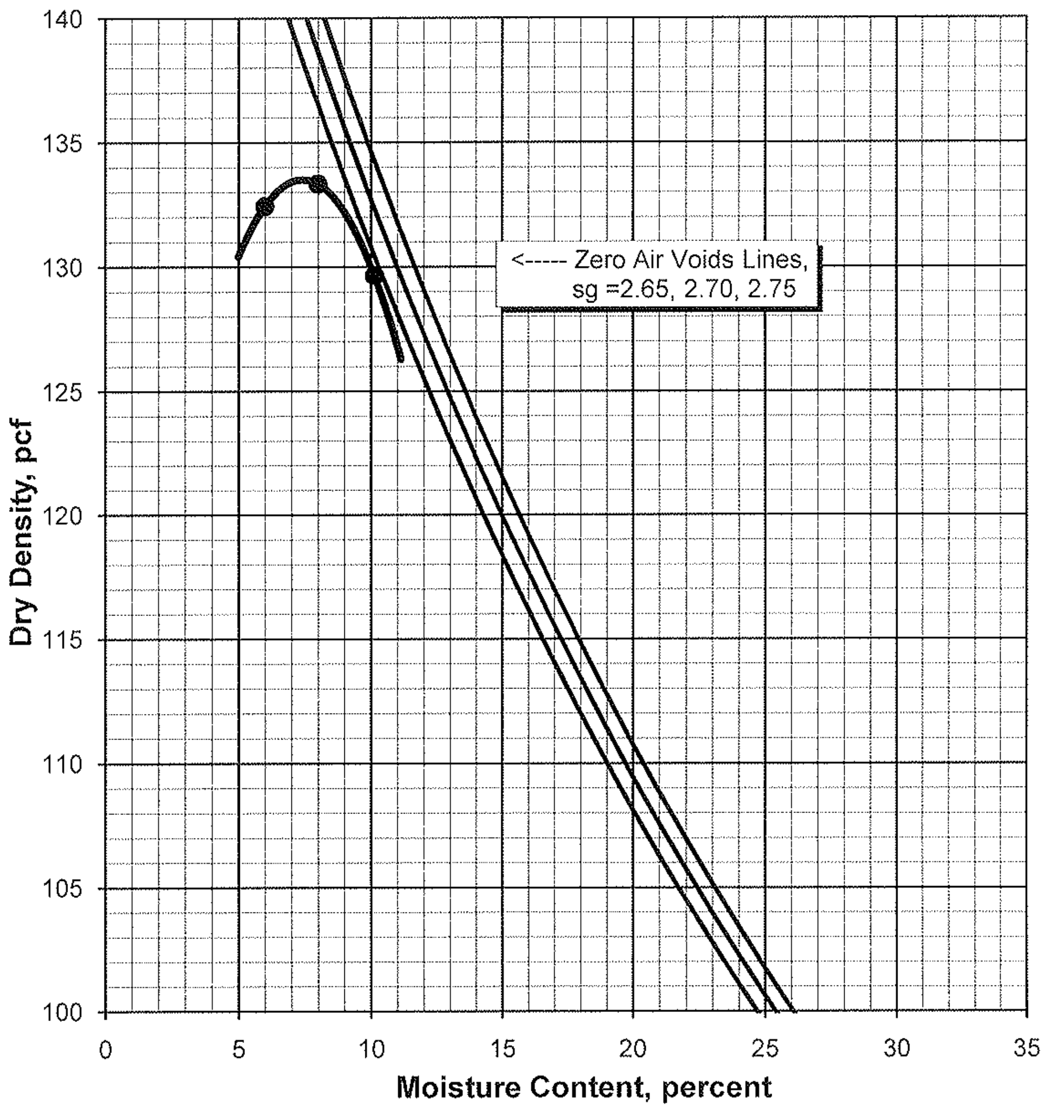
ASTM D 1557-07 (Modified)

Job Name: Desert Sunlite Project, Desert Center, CA
Sample ID: 6
Location: BP-5 @ 0-4 1/2 feet
Description: Brown, Silty F to C Sand (SM)

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 09-0292

**Maximum Density:** **133.5 pcf**
**Optimum Moisture:** **7.5%**

| Sieve Size | % Retained |
|---|---|
| 3/4" | 1.1 |
| 3/8" | 4.3 |
| #4 | 10.5 |



File No.: 11666-01 January 19, 2010

Lab No.: 09-0292

## SOIL CHEMICAL ANALYSES

Job Name: Desert Sunlite Project, Desert Center, CA

Job No.: 11666-01

| Sample ID: | BP-1 | BP-2 | BP-3 | | |
|---|---|---|---|---|---|
| Sample Depth, feet: | 0-4 | -05 | 0-1.5 | DF | RL |
| Sulfate, mg/Kg (ppm): | **86** | **19** | **24** | 1 | 0.50 |
| Chloride, mg/Kg (ppm): | **285** | **70** | **32** | 1 | 0.20 |
| pH, (pH Units): | **7.27** | **7.50** | **7.54** | 1 | 0.41 |
| Resistivity, (ohm-cm): | **2,481** | **14,184** | **8,945** | N/A | N/A |
| Conductivity, (μmhos-cm): | | | | 1 | 2.00 |

Note: Tests performed by Subcontract Laboratory:
Surabian AG Laboratory
105 Tesori Drive
Palm Desert, California 92211 Tel: (760) 200-4498

DF: Dilution Factor
RL: Reporting Limit
N.D.: Not Detectable

**General Guidelines for Soil Corrosivity**

| Chemical Agent | Amount in Soil | Degree of Corrosivity |
|---|---|---|
| Soluble Sulfates | 0 -1000 mg/Kg (ppm) [ 0-.1%] | Low |
| | 1000 - 2000 mg/Kg (ppm) [0.1-0.2%] | Moderate |
| | 2000 - 20,000 mg/Kg (ppm) [0.2-2.0%] | Severe |
| | > 20,000 mg/Kg (ppm) [>2.0%] | Very Severe |
| Resistivity | 1-1000 ohm-cm | Very Severe |
| | 1000-2000 ohm-cm | Severe |
| | 2000-10,000 ohm-cm | Moderate |
| | 10,000+ ohm-cm | Low |

File No.: 11666-01

Lab No.: 09-0292

January 19, 2010

# SOIL CHEMICAL ANALYSES

Job Name: Desert Sunlite Project, Desert Center, CA

Job No.: 11666-01

| Sample ID: | BP-3 | BP-4 | BP-5 | | |
|---|---|---|---|---|---|
| Sample Depth, feet: | 1.5-10 | 0-5 | 0-4.5 | DF | RL |
| Sulfate, mg/Kg (ppm): | **20** | **289** | **58** | 1 | 0.50 |
| Chloride, mg/Kg (ppm): | **101** | **1,011** | **354** | 1 | 0.20 |
| pH, (pH Units): | **7.72** | **7.50** | **7.87** | 1 | 0.41 |
| Resistivity, (ohm-cm): | **7,309** | **1,748** | **882** | N/A | N/A |
| Conductivity, (μmhos-cm): | | | | 1 | 2.00 |

Note: Tests performed by Subcontract Laboratory:
Surabian AG Laboratory
105 Tesori Drive
Palm Desert, California 92211 Tel: (760) 200-4498

DF: Dilution Factor
RL: Reporting Limit
N.D.: Not Detectable

**General Guidelines for Soil Corrosivity**

| Chemical Agent | Amount in Soil | Degree of Corrosivity |
|---|---|---|
| Soluble Sulfates | 0 -1000 mg/Kg (ppm) [ 0-.1%] | Low |
| | 1000 - 2000 mg/Kg (ppm) [0.1-0.2%] | Moderate |
| | 2000 - 20,000 mg/Kg (ppm) [0.2-2.0%] | Severe |
| | > 20,000 mg/Kg (ppm) [>2.0%] | Very Severe |
| Resistivity | 1-1000 ohm-cm | Very Severe |
| | 1000-2000 ohm-cm | Severe |
| | 2000-10,000 ohm-cm | Moderate |
| | 10,000+ ohm-cm | Low |

**APPENDIX C**

Table 1 – Physical Drive Time Characteristics
Table 2 – Pile Load Test Results

**Desert Sunlight Solar Farm**
**Desert Center, Riverside County, California**
**Table 1**
**Physical Drive Time Characteristics**

| Location | Date | Total Drive Time (seconds) | Final Depth (inches) | Comments (Feet - Seconds) |
|---|---|---|---|---|
| TP-1A | 12/10/09 | 23 | 48 | 1' - 3 sec; 2' - 8 sec; 3' - 15 sec; 4' - 23 sec |
| TP-1B | 12/10/09 | 45 | 60 | 1' - 4 sec; 2' - 8 sec; 3' - 17 sec; 4' - 24 sec; 5' - 45 sec |
| TP-2A | 12/10/09 | 41 | 48 | 1' - 1 sec; 2' - 7 sec; 3' - 22 sec; 4' - 41 sec |
| TP-2B | 12/10/09 | 27 | 36 | 1' - 0.5 sec; 2' - 7 sec; 3' - 27 sec |
| TP-3A | 12/10/09 | 23 | 48 | 1' - 0 sec; 2' - 4 sec; 3' - 12 sec; 4' - 23 sec |
| TP-3B | 12/10/09 | 26 | 58 | 1' - 0 sec; 2' - 3 sec; 3' - 11 sec; 4' - 17 sec; 4.8' - 26 sec |
| TP-4A | 12/10/09 | 26 | 47 | 1' - 2 sec; 2' - 4 sec; 3' - 15 sec; 4' - 26 sec |
| TP-4B | 12/10/09 | 21 | 40 | 1' - 0 sec; 2' - 4 sec; 3' - 21 sec |
| TP-5A | 12/10/09 | 26 | 48 | 1' - 5 sec; 2' - 10 sec; 3' - 15 sec; 4' - 26 sec |
| TP-5B | 12/10/09 | 15 | 36 | 1' - 4 sec; 2' - 8 sec; 3' - 15 sec |
| TP-6A | 12/11/09 | 20 | 48 | 1' - 1 sec; 2' - 3 sec; 3' - 5 sec; 4' - 20 sec |
| TP-6B | 12/11/09 | 10 | 37 | 1' - 2 sec; 2' - 5 sec; 3' - 10 sec |
| TP-7A | 12/11/09 | 18 | 48 | 1' - 0.5 sec; 2' - 1 sec; 3' - 10 sec; 4' - 18 sec |
| TP-7B | 12/11/09 | 9 | 36 | 1' - 0.5 sec; 2' - 2 sec; 3' - 9 sec |
| TP-8A | 12/10/09 | 32 | 48 | 1' - 1 sec; 2' - 8 sec; 3' - 14 sec; 4' - 32 sec |
| TP-8B | 12/10/09 | 14 | 35 | 1' - 1 sec; 2' - 5 sec; 3' - 14 sec |
| TP-9A | 12/10/09 | 13 | 48 | 1' - 1 sec; 2' - 4 sec; 3' - 9 sec; 4' - 13 sec |
| TP-9B | 12/10/09 | 32 | 56 | 1' - 0.5 sec; 2' - 3 sec; 3' - 8 sec; 4' - 16 sec; 4.6' - 32 sec |
| TP-10A | 12/10/09 | 25 | 45 | 1' - 1 sec; 2' - 3 sec; 3' - 10 sec; 4' - 25 sec |
| TP-10B | 12/10/09 | 29 | 59 | 1' - 2 sec; 2' - 5 sec; 3' - 6 sec; 4' - 16 sec; 4.9' - 29 sec |
| TP-11A | 12/11/09 | 9 | 48 | 1' - 0 sec; 2' - 1 sec; 3' - 3 sec; 4' - 9 sec |
| TP-11B | 12/11/09 | 19 | 60 | 1' - 0.5 sec; 2' - 3 sec; 3' - 6 sec; 4' - 10 sec; 5' - 19 sec |
| TP-12A | 12/11/09 | 12 | 48 | 1' - 0.5 sec; 2' - 2 sec; 3' - 4 sec; 4' - 12 sec |
| TP-12B | 12/11/09 | 32 | 58 | 1' - 0 sec; 2' - 1 sec; 3' - 3 sec; 4' - 12 sec; 4.8' - 32 sec |
| TP-13A | 12/11/09 | 25 | 48 | 1' - 1 sec; 2' - 4 sec; 3' - 10 sec; 4' - 25 sec |
| TP-13B | 12/11/09 | 10 | 34 | 1' - 0.5 sec; 2' - 1 sec; 3' - 10 sec |
| TP-14A | 12/10/09 | 33 | 48 | 1' - 5 sec; 2' - 13 sec; 3' - 22 sec; 4' - 33 sec |
| TP-14B | 12/10/09 | 17 | 36 | 1' - 5 sec; 2' - 9 sec; 3' - 17 sec |
| TP-15A | 12/10/09 | 8 | 48 | 1' - 1 sec; 2' - 2 sec; 3' - 4 sec; 4' - 8 sec |
| TP-15B | 12/10/09 | 26 | 60 | 1' - 2 sec; 2' - 5 sec; 3' - 11 sec; 4' - 15 sec; 5' - 26 sec |
| TP-16A | 12/11/09 | 12 | 48 | 1' - 1 sec; 2' - 3 sec; 3' - 7 sec; 4' - 12 sec |
| TP-16B | 12/11/09 | 27 | 60 | 1' - 1 sec; 2' - 5 sec; 3' - 8 sec; 4' - 13 sec; 5' - 27 sec |
| TP-17A | 12/11/09 | 9 | 48 | 1' - 0 sec; 2' - 2 sec; 3' - 4 sec; 4' - 9 sec |
| TP-17B | 12/11/09 | 35 | 60 | 1' - 3 sec; 2' - 5 sec; 3' - 10 sec; 4' - 19 sec; 5' - 35 sec |
| TP-18A | 12/11/09 | 22 | 48 | 1' - 1 sec; 2' - 5 sec; 3' - 10 sec; 4' - 22 sec |
| TP-18B | 12/11/09 | 11 | 36 | 1' - 1 sec; 2' - 3 sec; 3' - 11 sec |
| TP-19A | 12/11/09 | 13 | 48 | 1' - 1 sec; 2' - 2 sec; 3' - 4 sec; 4' - 13 sec |
| TP-19B | 12/11/09 | 18 | 60 | 1' - 0 sec; 2' - 1 sec; 3' - 4 sec; 4' - 9 sec; 5' - 18 sec |
| TP-20A | 12/11/09 | 15 | 48 | 1' - 0.5 sec; 2' - 2 sec; 3' - 6 sec; 4' - 15 sec |
| TP-20B | 12/11/09 | 19 | 60 | 1' - 0 sec; 2' - 2 sec; 3' - 5 sec; 4' - 10 sec; 5' - 19 sec |
| TP-21A | 12/10/09 | 9 | 48 | 1' - 1 sec; 2' - 3 sec; 3' - 5 sec; 4' - 9 sec |
| TP-21B | 12/10/09 | 12 | 56 | 1' - 0.5 sec; 2' - 1 sec; 3' - 5 sec; 4' - 7 sec; 4.7' - 12 sec |
| TP-22A | 12/10/09 | 20 | 48 | 1' - 1 sec; 2' - 4 sec; 3' - 9 sec; 4' - 20 sec |
| TP-22B | 12/10/09 | 23 | 58 | 1' - 0 sec; 2' - 4 sec; 3' - 7 sec; 4' - 12 sec; 4.8' - 23 sec |
| TP-23A | 12/11/09 | 21 | 48 | 1' - 0.5 sec; 2' - 3 sec; 3' - 11 sec; 4' - 21 sec |
| TP-23B | 12/11/09 | 13 | 36 | 1' - 0.5 sec; 2' - 2 sec; 3' - 13 sec |
| TP-24A | 12/11/09 | 20 | 48 | 1' - 1 sec; 2' - 4 sec; 3' - 9 sec; 4' - 20 sec |
| TP-24B | 12/11/09 | 6 | 36 | 1' - 1 sec; 2' - 2 sec; 3' - 6 sec |

** Speed of driver with depth*

## Desert Sunlight Solar Farm, Desert Center, California

**Table 2**

**Summary of Pile Load Test Results**

| Pile Test No. | Pile Driven Depth (inches) | Max Test Uplift Load (lbs) | Deflection at Max Load (inches) | Load at 0.25 Movement (inches) | Max Test Latera Load (lbs) | Deflection at Max Load (inches) | Load at 0.50 Deflection (inches) |
|---|---|---|---|---|---|---|---|
| PT-1A | 48 | 5000 | 0.39 | 3800 | 3450 | 0.51 | 3350 |
| PT-1B | 60 | 5000 | 0.54 | 4150 | Not tested due to Eagle Mt. GM | | |
| PT-2A | 48 | 5000 | 0.20 | 5000 | 3450 | 0.77 | 1900 |
| PT-2B | 36 | 5000 | 0.44 | 3400 | 2300 | 0.91 | 200 |
| PT-3A | 48 | 5000 | 0.33 | 4000 | 3450 | 0.40 | 3450 |
| PT-3B | 58 | 5000 | 0.31 | 4350 | 3450 | 0.93 | 1400 |
| PT-4A | 47 | 5000 | 0.14 | 5000 | 3450 | 0.42 | 3450 |
| PT-4B | 40 | 5000 | 0.03 | 5000 | 2850 | 0.71 | 2000 |
| PT-5A | 48 | 5000 | 0.60 | 3650 | 2850 | 0.97 | 600 |
| PT-5B | 36 | 4450 | 0.96 | 2200 | 3450 | 0.61 | 2150 |
| PT-6A | 48 | 5000 | 0.60 | 4250 | 2300 | 0.90 | 450 |
| PT-6B | 37 | 4450 | 0.71 | 2900 | 3450 | 0.74 | 2350 |
| PT-7A | 48 | 2850 | 0.50 | 1700 | 3450 | 0.76 | 2200 |
| PT-7B | 36 | 850 | 0.37 | 750 | 3450 | 0.88 | 1050 |
| PT-8A | 48 | 5000 | 0.19 | 5000 | 3450 | 0.53 | 3200 |
| PT-8B | 35 | 3450 | 0.40 | 2750 | 1800 | 1.01 | 750 |
| PT-9A | 48 | 5000 | 0.37 | 3500 | 2850 | 0.90 | 1850 |
| PT-9B | 56 | 5000 | 0.02 | 5000 | 3450 | 0.32 | 3450 |
| PT-10A | 45 | 3450 | 0.57 | 2650 | 2300 | 1.04 | 100 |
| PT-10B | 60 | 5000 | 0.71 | 1950 | 2300 | 0.95 | 250 |
| PT-11A | 48 | 5000 | 0.14 | 5000 | 3000 | 0.86 | 1700 |
| PT-11B | 60 | 5000 | 0.04 | 5000 | 3000 | 0.42 | 3000 |
| PT-12A | 48 | 5000 | 0.08 | 5000 | 3000 | 0.37 | 3000 |
| PT-12B | 58 | 5000 | 0.01 | 5000 | 3000 | 0.41 | 3000 |
| PT-13A | 48 | 5000 | 0.01 | 5000 | 3450 | 0.24 | 3450 |
| PT-13B | 34 | 5000 | 0.11 | 4300 | 3450 | 0.58 | 3000 |
| PT-14A | 48 | 5000 | 0.04 | 5000 | 3450 | 0.63 | 2550 |
| PT-14B | 36 | 5000 | 0.48 | 3450 | 3450 | 0.75 | 1800 |
| PT-15A | 48 | 3950 | 1.02 | 1200 | 2850 | 0.92 | 1200 |
| PT-15B | 60 | 5000 | 0.29 | 4800 | 3450 | 0.79 | 1900 |
| PT-16A | 48 | 5000 | 0.72 | 3050 | 2300 | 0.86 | 750 |
| PT-16B | 60 | 5000 | 0.19 | 5000 | 2850 | 1.07 | 750 |
| PT-17A | 48 | 2300 | 0.89 | 900 | 2300 | 0.97 | 300 |
| PT-17B | 60 | 5000 | 0.07 | 5000 | 2850 | 0.98 | 850 |
| PT-18A | 48 | 5000 | 0.32 | 4400 | 1800 | 0.63 | 1000 |
| PT-18B | 36 | 5000 | 0.68 | 2700 | 2300 | 0.87 | 200 |
| PT-19A | 48 | 5000 | 0.15 | 5000 | 3450 | 0.70 | 2300 |
| PT-19B | 60 | 5000 | 0.06 | 5000 | 2850 | 0.84 | 1250 |
| PT-20A | 48 | 5000 | 0.17 | 5000 | 3450 | 0.55 | 3150 |
| PT-20B | 60 | 5000 | 0.07 | 5000 | 3450 | 0.56 | 3100 |
| PT-21A | 48 | 5000 | 0.44 | 3700 | 3450 | 0.79 | 2500 |
| PT-21B | 56 | 5000 | 0.45 | 4250 | 3450 | 0.85 | 2200 |
| PT-22A | 48 | 5000 | 0.11 | 5000 | 3450 | 0.49 | 3450 |
| PT-22B | 58 | 5000 | 0.02 | 5000 | 3450 | 0.79 | 2150 |
| PT-23A | 48 | 5000 | 0.13 | 5000 | 3000 | 0.44 | 3000 |
| PT-23B | 36 | 5000 | 0.32 | 4350 | 3000 | 0.64 | 2300 |
| PT-24A | 48 | 5000 | 0.04 | 5000 | 3450 | 0.27 | 3450 |
| PT-24B | 36 | 3450 | 0.45 | 2350 | 2300 | 0.86 | 150 |

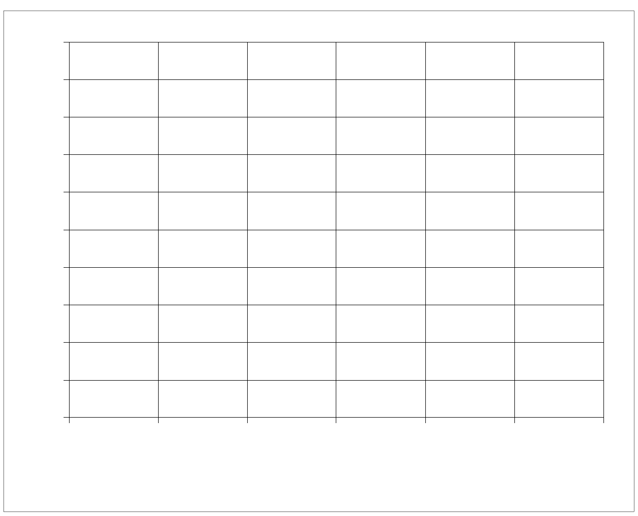
# Desert Sunlight Solar Farm, Desert Center, California

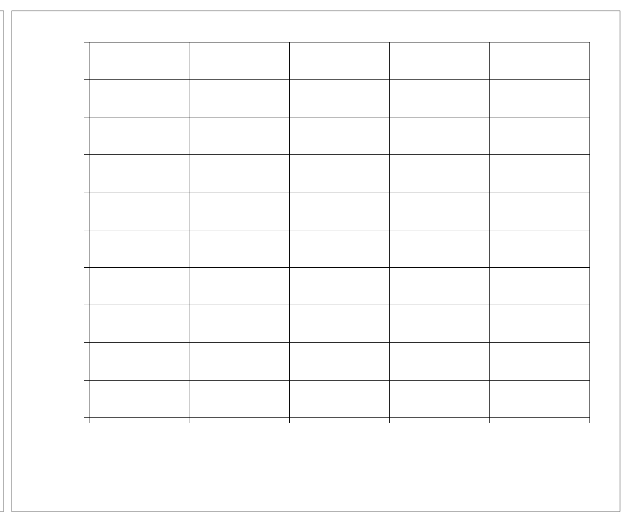
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-1A |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 3:26 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 3:42 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.004 | 0.001 | 0.002 | | | 200 | 400 | 0.069 | 0.069 | |
| | 400 | 850 | 0.011 | 0.005 | 0.008 | | | 400 | 850 | 0.156 | 0.156 | |
| | 600 | 1300 | 0.046 | 0.037 | 0.042 | | | 0 | 0 | 0.040 | 0.040 | |
| | 800 | 1800 | 0.081 | 0.069 | 0.075 | | | 200 | 400 | 0.109 | 0.109 | |
| | 1000 | 2300 | 0.144 | 0.126 | 0.135 | | | 400 | 850 | 0.157 | 0.157 | |
| | 1200 | 2850 | 0.171 | 0.152 | 0.161 | | | 600 | 1300 | 0.213 | 0.213 | |
| | 1400 | 3450 | 0.215 | 0.196 | 0.205 | | | 800 | 1800 | 0.281 | 0.281 | |
| | 1600 | 3950 | 0.287 | 0.261 | 0.274 | | | 0 | 0 | 0.074 | 0.074 | |
| | 1800 | 4450 | 0.337 | 0.303 | 0.320 | | | 400 | 850 | 0.197 | 0.197 | |
| 3:30 | 2000 | 5000 | 0.380 | 0.343 | 0.362 | | | 600 | 1300 | 0.248 | 0.248 | |
| 3:35 | 2000 | 5000 | 0.407 | 0.368 | 0.387 | | | 800 | 1800 | 0.299 | 0.299 | |
| | 0 | 0 | 0.346 | 0.328 | 0.337 | | | 1000 | 2300 | 0.359 | 0.359 | |
| | | | | | | | | 0 | 0 | 0.096 | 0.096 | |
| | | | | | | | | 400 | 850 | 0.226 | 0.226 | |
| | | | | | | | | 800 | 1800 | 0.325 | 0.325 | |
| | | | | | | | | 1000 | 2300 | 0.371 | 0.371 | |
| | | | | | | | | 1200 | 2850 | 0.421 | 0.421 | |
| | | | | | | | | 1400 | 3450 | 0.512 | 0.512 | |
| | | | | | | | 3:41 | 0 | 0 | 0.126 | 0.126 | |

Notes:





EARTH SYSTEMS SOUTHWEST

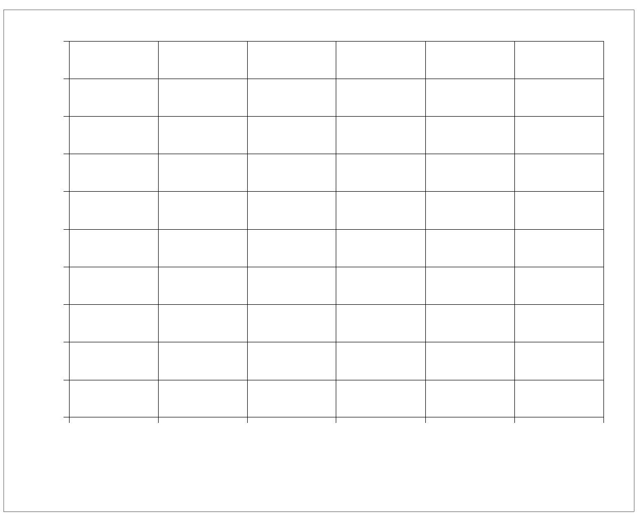
* - Gages reading positive with vertical displacement

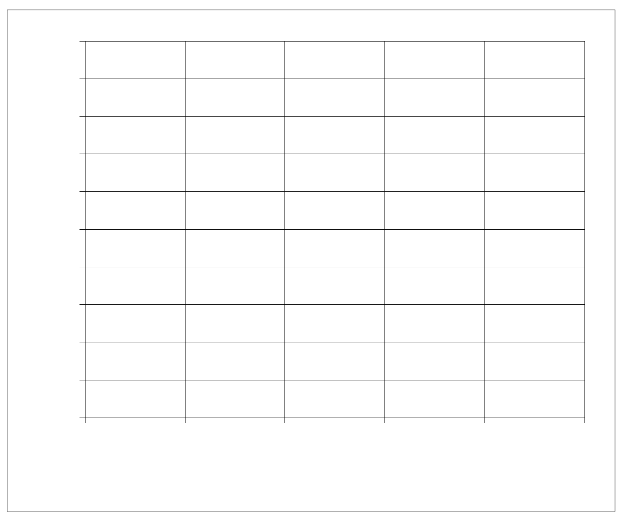
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-1B |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 7:30 | 0 | 0 | 0.000 | 0.000 | 0.000 | | | 0 | 0 | | 0.000 | |
| | 200 | 400 | -0.002 | 0.007 | 0.003 | | | 200 | 400 | | 0.000 | |
| | 400 | 850 | -0.003 | 0.012 | 0.004 | | | 400 | 850 | | 0.000 | |
| | 600 | 1300 | -0.004 | 0.018 | 0.007 | | | 0 | 0 | | 0.000 | |
| | 800 | 1800 | -0.005 | 0.027 | 0.011 | | | 200 | 400 | | 0.000 | |
| | 1000 | 2300 | -0.005 | 0.041 | 0.018 | | | 400 | 850 | | 0.000 | |
| | 1200 | 2850 | 0.018 | 0.076 | 0.047 | | | 600 | 1300 | | 0.000 | |
| | 1400 | 3450 | 0.061 | 0.138 | 0.099 | | | 800 | 1800 | | 0.000 | |
| | 1600 | 3950 | 0.157 | 0.268 | 0.212 | | | 0 | 0 | | 0.000 | |
| | 1800 | 4450 | 0.241 | 0.456 | 0.348 | | | 400 | 850 | | 0.000 | |
| 7:35 | 2000 | 5000 | 0.283 | 0.622 | 0.452 | | | 600 | 1300 | | 0.000 | |
| 7:40 | 2000 | 5000 | 0.445 | 0.632 | 0.538 | | | 800 | 1800 | | 0.000 | |
| | 0 | 0 | 0.397 | 0.461 | 0.429 | | | 1000 | 2300 | | 0.000 | |
| | | | | | | | | 0 | 0 | | 0.000 | |
| | | | | | | | | 400 | 850 | | 0.000 | |
| | | | | | | | | 800 | 1800 | | 0.000 | |
| | | | | | | | | 1000 | 2300 | | 0.000 | |
| | | | | | | | | 1200 | 2850 | | 0.000 | |
| | | | | | | | | 1400 | 3450 | | 0.000 | |
| | | | | | | | | 0 | 0 | | 0.000 | |

Notes: Cobbles& Boulders





EARTH SYSTEMS SOUTHWEST

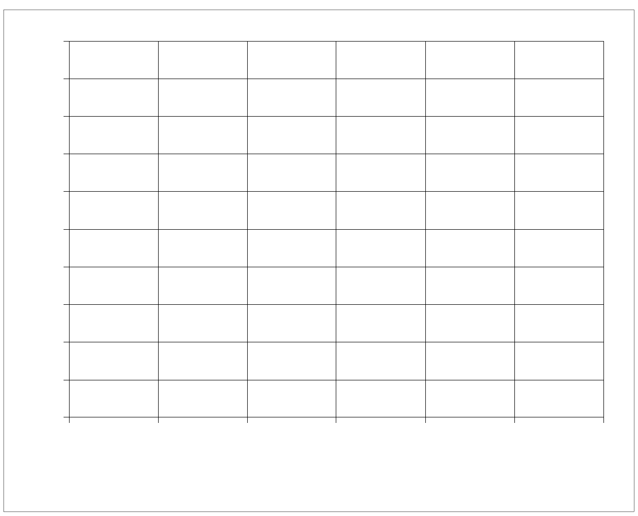
* - Gages reading positive with vertical displacement

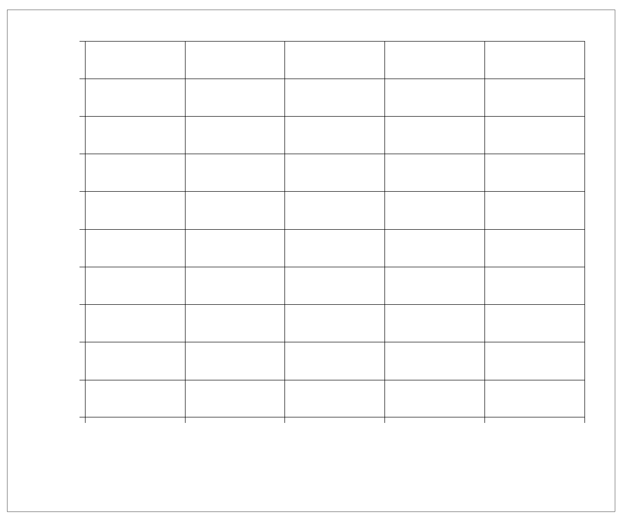
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-2A |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 1:49 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 2:07 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.109 | 0.109 | |
| | 400 | 850 | 0.002 | 0.000 | 0.001 | | | 400 | 850 | 0.210 | 0.210 | |
| | 600 | 1300 | 0.006 | 0.000 | 0.003 | | | 0 | 0 | 0.034 | 0.034 | |
| | 800 | 1800 | 0.014 | 0.016 | 0.015 | | | 200 | 400 | 0.164 | 0.164 | |
| | 1000 | 2300 | 0.028 | 0.028 | 0.028 | | | 400 | 850 | 0.222 | 0.222 | |
| | 1200 | 2850 | 0.055 | 0.049 | 0.052 | | | 600 | 1300 | 0.310 | 0.310 | |
| | 1400 | 3450 | 0.090 | 0.079 | 0.084 | | | 800 | 1800 | 0.414 | 0.414 | |
| | 1600 | 3950 | 0.126 | 0.111 | 0.118 | | | 0 | 0 | 0.075 | 0.075 | |
| | 1800 | 4450 | 0.165 | 0.145 | 0.155 | | | 400 | 850 | 0.306 | 0.306 | |
| 1:54 | 2000 | 5000 | 0.196 | 0.173 | 0.184 | | | 600 | 1300 | 0.362 | 0.362 | |
| 1:59 | 2000 | 5000 | 0.212 | 0.190 | 0.201 | | | 800 | 1800 | 0.433 | 0.433 | |
| | 0 | 0 | 0.183 | 0.187 | 0.185 | | | 1000 | 2300 | 0.514 | 0.514 | |
| | | | | | | | | 0 | 0 | 0.105 | 0.105 | |
| | | | | | | | | 400 | 850 | 0.349 | 0.349 | |
| | | | | | | | | 800 | 1800 | 0.485 | 0.485 | |
| | | | | | | | | 1000 | 2300 | 0.540 | 0.540 | |
| | | | | | | | | 1200 | 2850 | 0.637 | 0.637 | |
| | | | | | | | | 1400 | 3450 | 0.774 | 0.774 | |
| | | | | | | | 2:18 | 0 | 0 | 0.181 | 0.181 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

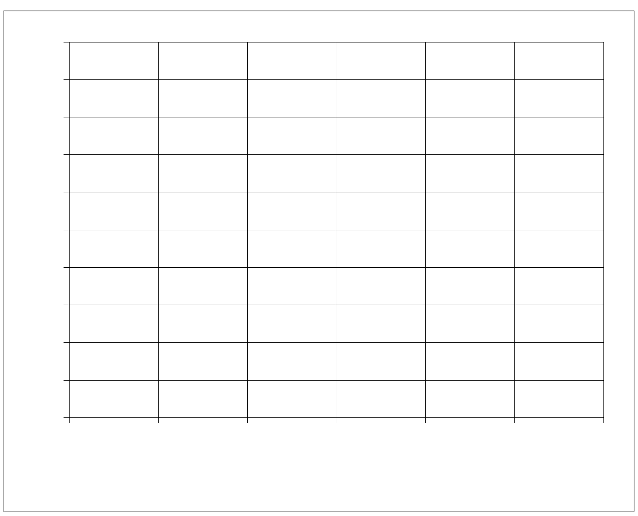
## Desert Sunlight Solar Farm, Desert Center, California

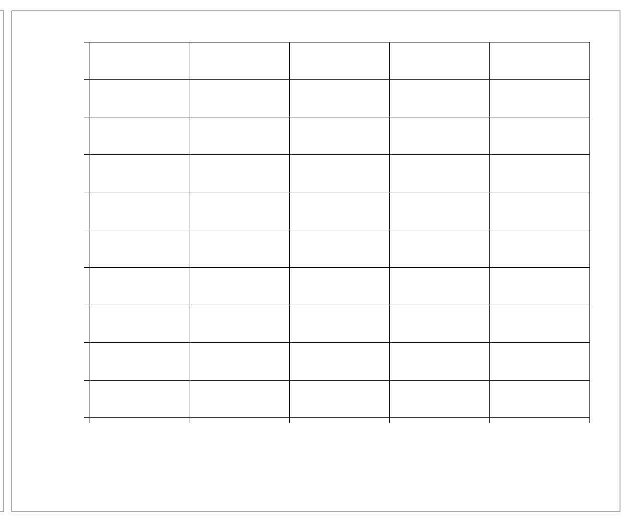
### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-2B |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 2:22 | 0 | 0 | 0.001 | -0.002 | 0.000 | | 2:41 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.009 | -0.002 | 0.004 | | | 200 | 400 | 0.166 | 0.166 | |
| | 400 | 850 | 0.030 | 0.008 | 0.019 | | | 400 | 850 | 0.336 | 0.336 | |
| | 600 | 1300 | 0.067 | 0.031 | 0.049 | | | 0 | 0 | 0.103 | 0.103 | |
| | 800 | 1800 | 0.123 | 0.070 | 0.097 | | | 200 | 400 | 0.247 | 0.247 | |
| | 1000 | 2300 | 0.179 | 0.115 | 0.147 | | | 400 | 850 | 0.355 | 0.355 | |
| | 1200 | 2850 | 0.239 | 0.162 | 0.201 | | | 600 | 1300 | 0.524 | 0.524 | |
| | 1400 | 3450 | 0.296 | 0.208 | 0.253 | | | 800 | 1800 | 0.699 | 0.699 | |
| | 1600 | 3950 | 0.348 | 0.248 | 0.298 | | | 0 | 0 | 0.264 | 0.264 | |
| | 1800 | 4450 | 0.404 | 0.290 | 0.347 | | | 400 | 850 | 0.551 | 0.551 | |
| 2:27 | 2000 | 5000 | 0.490 | 0.360 | 0.425 | | | 600 | 1300 | 0.653 | 0.653 | |
| 2:32 | 2000 | 5000 | 0.509 | 0.378 | 0.444 | | | 800 | 1800 | 0.771 | 0.771 | |
| | 0 | 0 | 0.410 | 0.356 | 0.383 | | | 1000 | 2300 | 0.914 | 0.914 | |
| | | | | | | | | 0 | 0 | 0.391 | 0.391 | |
| | | | | | | | | 400 | 850 | 0.691 | 0.691 | |
| | | | | | | | | 800 | 1800 | 0.883 | 0.883 | |
| | | | | | | | 2:49 | 0 | 0 | 0.439 | 0.439 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Notes:





EARTH SYSTEMS SOUTHWEST

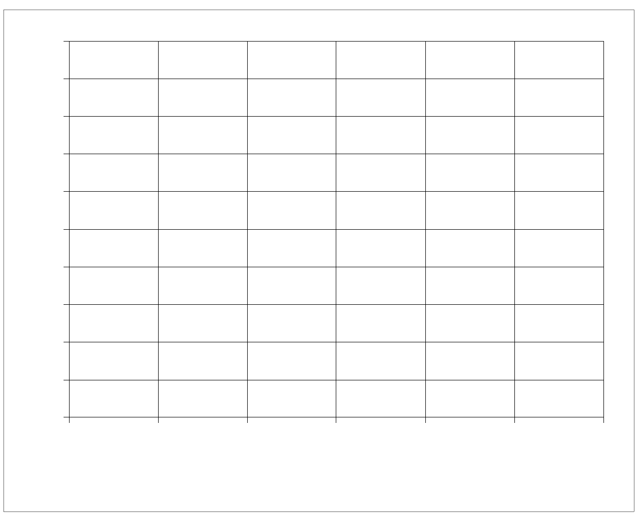
* - Gages reading positive with vertical displacement

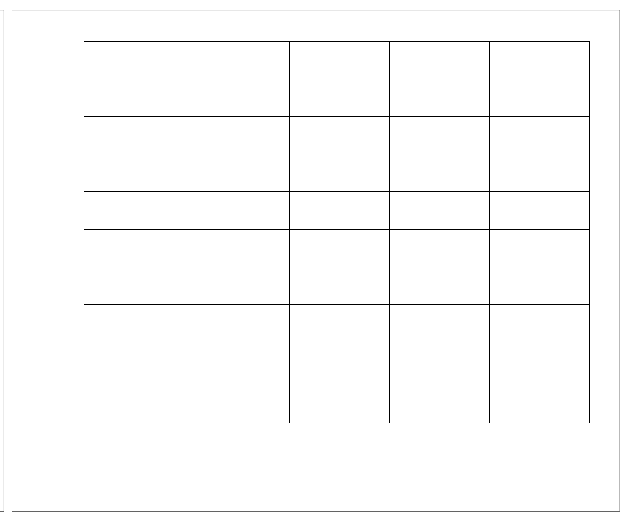
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-3A |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 12:55 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 1:14 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | 0.000 | 0.001 | | | 200 | 400 | 0.049 | 0.049 | |
| | 400 | 850 | 0.007 | 0.000 | 0.004 | | | 400 | 850 | 0.105 | 0.105 | |
| | 600 | 1300 | 0.033 | 0.021 | 0.027 | | | 0 | 0 | 0.038 | 0.038 | |
| | 800 | 1800 | 0.077 | 0.066 | 0.071 | | | 200 | 400 | 0.083 | 0.083 | |
| | 1000 | 2300 | 0.126 | 0.111 | 0.118 | | | 400 | 850 | 0.108 | 0.108 | |
| | 1200 | 2850 | 0.168 | 0.152 | 0.160 | | | 600 | 1300 | 0.163 | 0.163 | |
| | 1400 | 3450 | 0.212 | 0.192 | 0.202 | | | 800 | 1800 | 0.197 | 0.197 | |
| | 1600 | 3950 | 0.259 | 0.236 | 0.248 | | | 0 | 0 | 0.066 | 0.066 | |
| | 1800 | 4450 | 0.292 | 0.271 | 0.281 | | | 400 | 850 | 0.160 | 0.160 | |
| 1:00 | 2000 | 5000 | 0.330 | 0.309 | 0.319 | | | 600 | 1300 | 0.195 | 0.195 | |
| 1:05 | 2000 | 5000 | 0.334 | 0.328 | 0.331 | | | 800 | 1800 | 0.227 | 0.227 | |
| | 0 | 0 | 0.298 | 0.296 | 0.297 | | | 1000 | 2300 | 0.271 | 0.271 | |
| | | | | | | | | 0 | 0 | 0.070 | 0.070 | |
| | | | | | | | | 400 | 850 | 0.194 | 0.194 | |
| | | | | | | | | 800 | 1800 | 0.248 | 0.248 | |
| | | | | | | | | 1000 | 2300 | 0.275 | 0.275 | |
| | | | | | | | | 1200 | 2850 | 0.326 | 0.326 | |
| | | | | | | | | 1400 | 3450 | 0.398 | 0.398 | |
| | | | | | | | 1:15 | 0 | 0 | 0.047 | 0.047 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

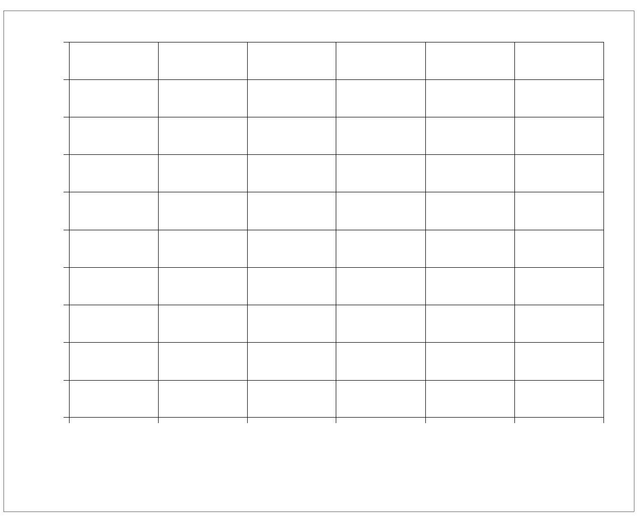
# Desert Sunlight Solar Farm, Desert Center, California

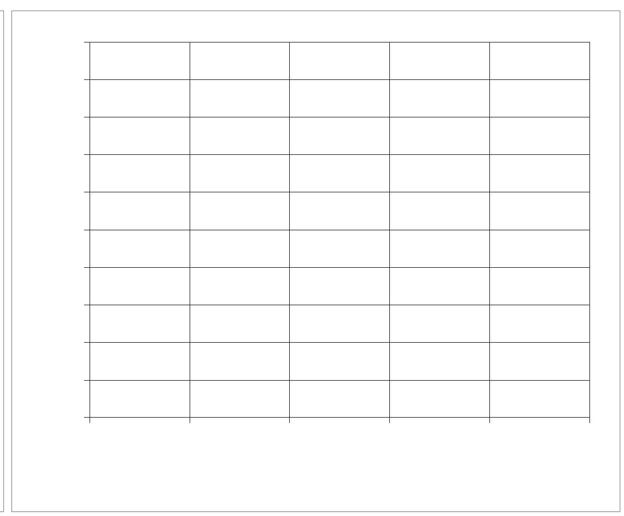
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-3B |
| Date: | 14-Dec |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **58** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 12:22 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 12:41 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.117 | 0.117 | |
| | 400 | 850 | 0.000 | 0.000 | 0.000 | | | 400 | 850 | 0.211 | 0.211 | |
| | 600 | 1300 | 0.007 | 0.007 | 0.007 | | | 0 | 0 | 0.022 | 0.022 | |
| | 800 | 1800 | 0.023 | 0.021 | 0.022 | | | 200 | 400 | 0.148 | 0.148 | |
| | 1000 | 2300 | 0.053 | 0.052 | 0.052 | | | 400 | 850 | 0.212 | 0.212 | |
| | 1200 | 2850 | 0.112 | 0.100 | 0.106 | | | 600 | 1300 | 0.301 | 0.301 | |
| | 1400 | 3450 | 0.171 | 0.152 | 0.161 | | | 800 | 1800 | 0.428 | 0.428 | |
| | 1600 | 3950 | 0.222 | 0.191 | 0.206 | | | 0 | 0 | 0.052 | 0.052 | |
| | 1800 | 4450 | 0.283 | 0.240 | 0.261 | | | 400 | 850 | 0.302 | 0.302 | |
| 12:28 | 2000 | 5000 | 0.326 | 0.274 | 0.300 | | | 600 | 1300 | 0.363 | 0.363 | |
| 12:33 | 2000 | 5000 | 0.339 | 0.289 | 0.314 | | | 800 | 1800 | 0.452 | 0.452 | |
| | 0 | 0 | 0.293 | 0.277 | 0.285 | | | 1000 | 2300 | 0.613 | 0.613 | |
| | | | | | | | | 0 | 0 | 0.096 | 0.096 | |
| | | | | | | | | 400 | 850 | 0.379 | 0.379 | |
| | | | | | | | | 800 | 1800 | 0.570 | 0.570 | |
| | | | | | | | | 1000 | 2300 | 0.640 | 0.640 | |
| | | | | | | | | 1200 | 2850 | 0.751 | 0.751 | |
| | | | | | | | | 1400 | 3450 | 0.931 | 0.931 | |
| | | | | | | | 12:42 | 0 | 0 | 0.206 | 0.206 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California

## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-4A
Date: 12/14/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **47**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 11:30 | 0 | 0 | 0.000 | -0.001 | 0.000 | | 11:50 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | -0.002 | 0.000 | | | 200 | 400 | 0.069 | 0.069 | |
| | 400 | 850 | 0.000 | -0.001 | 0.000 | | | 400 | 850 | 0.136 | 0.136 | |
| | 600 | 1300 | 0.000 | 0.001 | 0.001 | | | 0 | 0 | 0.022 | 0.022 | |
| | 800 | 1800 | 0.002 | 0.003 | 0.003 | | | 200 | 400 | 0.091 | 0.091 | |
| | 1000 | 2300 | 0.004 | 0.005 | 0.005 | | | 400 | 850 | 0.135 | 0.135 | |
| | 1200 | 2850 | 0.012 | 0.013 | 0.013 | | | 600 | 1300 | 0.188 | 0.188 | |
| | 1400 | 3450 | 0.028 | 0.030 | 0.029 | | | 800 | 1800 | 0.249 | 0.249 | |
| | 1600 | 3950 | 0.048 | 0.051 | 0.050 | | | 0 | 0 | 0.016 | 0.016 | |
| | 1800 | 4450 | 0.086 | 0.087 | 0.087 | | | 400 | 850 | 0.178 | 0.178 | |
| 11:36 | 2000 | 5000 | 0.124 | 0.126 | 0.125 | | | 600 | 1300 | 0.214 | 0.214 | |
| 11:41 | 2000 | 5000 | 0.137 | 0.138 | 0.138 | | | 800 | 1800 | 0.259 | 0.259 | |
| | 0 | 0 | 0.124 | 0.122 | 0.124 | | | 1000 | 2300 | 0.315 | 0.315 | |
| | | | | | | | | 0 | 0 | 0.003 | 0.003 | |
| | | | | | | | | 400 | 850 | 0.170 | 0.170 | |
| | | | | | | | | 800 | 1800 | 0.276 | 0.276 | |
| | | | | | | | | 1000 | 2300 | 0.324 | 0.324 | |
| | | | | | | | | 1200 | 2850 | 0.366 | 0.366 | |
| | | | | | | | | 1400 | 3450 | 0.418 | 0.418 | |
| | | | | | | | 12:00 | 0 | 0 | 0.039 | 0.039 | |

Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-4B |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **40** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:57 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:12 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | 0.002 | 0.002 | | | 200 | 400 | 0.091 | 0.091 | |
| | 400 | 850 | 0.003 | 0.004 | 0.003 | | | 400 | 850 | 0.169 | 0.169 | |
| | 600 | 1300 | 0.007 | 0.005 | 0.006 | | | 0 | 0 | 0.019 | 0.019 | |
| | 800 | 1800 | 0.010 | 0.006 | 0.008 | | | 200 | 400 | 0.110 | 0.110 | |
| | 1000 | 2300 | 0.017 | 0.007 | 0.012 | | | 400 | 850 | 0.181 | 0.181 | |
| | 1200 | 2850 | 0.024 | 0.007 | 0.015 | | | 600 | 1300 | 0.263 | 0.263 | |
| | 1400 | 3450 | 0.036 | 0.005 | 0.020 | | | 800 | 1800 | 0.355 | 0.355 | |
| | 1600 | 3950 | 0.050 | -0.002 | 0.024 | | | 0 | 0 | 0.054 | 0.054 | |
| | 1800 | 4450 | 0.072 | -0.014 | 0.029 | | | 400 | 850 | 0.246 | 0.246 | |
| 11:01 | 2000 | 5000 | 0.099 | -0.034 | 0.033 | | | 600 | 1300 | 0.310 | 0.310 | |
| 11:06 | 2000 | 5000 | 0.100 | -0.036 | 0.032 | | | 800 | 1800 | 0.383 | 0.383 | |
| | 0 | 0 | 0.060 | -0.050 | 0.005 | | | 1000 | 2300 | 0.495 | 0.495 | |
| | | | | | | | | 0 | 0 | 0.097 | 0.097 | |
| | | | | | | | | 400 | 850 | 0.305 | 0.305 | |
| | | | | | | | | 800 | 1800 | 0.464 | 0.464 | |
| | | | | | | | | 1000 | 2300 | 0.559 | 0.559 | |
| | | | | | | | | 1200 | 2850 | 0.712 | 0.712 | |
| | | | | | | | 11:21 | 0 | 0 | 0.049 | 0.049 | |
| | | | | | | | | | | | | |

Notes:

EARTH SYSTEMS SOUTHWEST

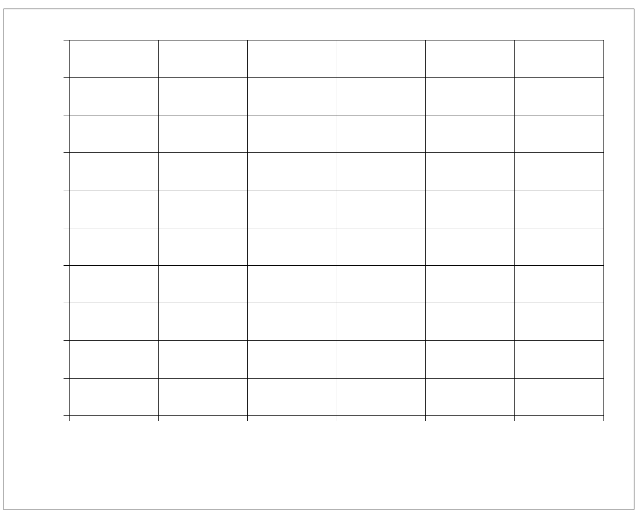
* - Gages reading positive with vertical displacement

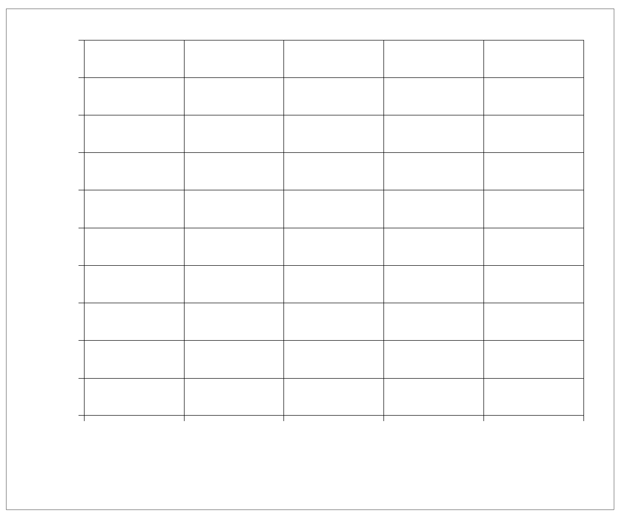
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-5A
Date: 12/15/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **48**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 3:12 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 3:27 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.004 | 0.001 | 0.002 | | | 200 | 400 | 0.165 | 0.165 | |
| | 400 | 850 | 0.013 | 0.008 | 0.011 | | | 400 | 850 | 0.296 | 0.296 | |
| | 600 | 1300 | 0.035 | 0.026 | 0.030 | | | 0 | 0 | 0.062 | 0.062 | |
| | 800 | 1800 | 0.073 | 0.062 | 0.067 | | | 200 | 400 | 0.220 | 0.220 | |
| | 1000 | 2300 | 0.115 | 0.100 | 0.108 | | | 400 | 850 | 0.318 | 0.318 | |
| | 1200 | 2850 | 0.171 | 0.157 | 0.164 | | | 600 | 1300 | 0.450 | 0.450 | |
| | 1400 | 3450 | 0.235 | 0.218 | 0.227 | | | 800 | 1800 | 0.610 | 0.610 | |
| | 1600 | 3950 | 0.317 | 0.303 | 0.310 | | | 0 | 0 | 0.154 | 0.154 | |
| | 1800 | 4450 | 0.430 | 0.426 | 0.428 | | | 400 | 850 | 0.437 | 0.437 | |
| 3:16 | 2000 | 5000 | 0.562 | 0.563 | 0.563 | | | 600 | 1300 | 0.538 | 0.538 | |
| 3:21 | 2000 | 5000 | 0.603 | 0.605 | 0.604 | | | 800 | 1800 | 0.655 | 0.655 | |
| | 0 | 0 | 0.548 | 0.541 | 0.545 | | | 1000 | 2300 | 0.802 | 0.802 | |
| | | | | | | | | 0 | 0 | 0.244 | 0.244 | |
| | | | | | | | | 400 | 850 | 0.537 | 0.537 | |
| | | | | | | | | 800 | 1800 | 0.729 | 0.729 | |
| | | | | | | | | 1000 | 2300 | 0.828 | 0.828 | |
| | | | | | | | | 1200 | 2850 | 0.967 | 0.967 | |
| | | | | | | | 3:36 | 0 | 0 | 0.323 | 0.323 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-5B |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 2:52 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 3:01 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.006 | 0.000 | 0.003 | | | 200 | 400 | 0.082 | 0.082 | |
| | 400 | 850 | 0.031 | 0.017 | 0.024 | | | 400 | 850 | 0.218 | 0.218 | |
| | 600 | 1300 | 0.080 | 0.063 | 0.072 | | | 0 | 0 | 0.099 | 0.099 | |
| | 800 | 1800 | 0.173 | 0.150 | 0.161 | | | 200 | 400 | 0.166 | 0.166 | |
| | 1000 | 2300 | 0.297 | 0.272 | 0.284 | | | 400 | 850 | 0.236 | 0.236 | |
| | 1200 | 2850 | 0.443 | 0.411 | 0.427 | | | 600 | 1300 | 0.349 | 0.349 | |
| | 1400 | 3450 | 0.598 | 0.566 | 0.582 | | | 800 | 1800 | 0.431 | 0.431 | |
| | 1600 | 3950 | 0.755 | 0.715 | 0.735 | | | 0 | 0 | 0.179 | 0.179 | |
| | 1800 | 4450 | 0.987 | 0.941 | 0.964 | | | 400 | 850 | 0.337 | 0.337 | |
| 2:55 | 0 | 0 | 0.987 | 0.941 | 0.964 | | | 600 | 1300 | 0.391 | 0.391 | |
| | | | | | | | | 800 | 1800 | 0.447 | 0.447 | |
| | | | | | | | | 1000 | 2300 | 0.494 | 0.494 | |
| | | | | | | | | 0 | 0 | 0.193 | 0.193 | |
| | | | | | | | | 400 | 850 | 0.362 | 0.362 | |
| | | | | | | | | 800 | 1800 | 0.465 | 0.465 | |
| | | | | | | | | 1000 | 2300 | 0.512 | 0.512 | |
| | | | | | | | | 1200 | 2850 | 0.557 | 0.557 | |
| | | | | | | | | 1400 | 3450 | 0.609 | 0.609 | |
| | | | | | | | 3:11 | 0 | 0 | 0.161 | 0.161 | |

Notes:

EARTH SYSTEMS SOUTHWEST

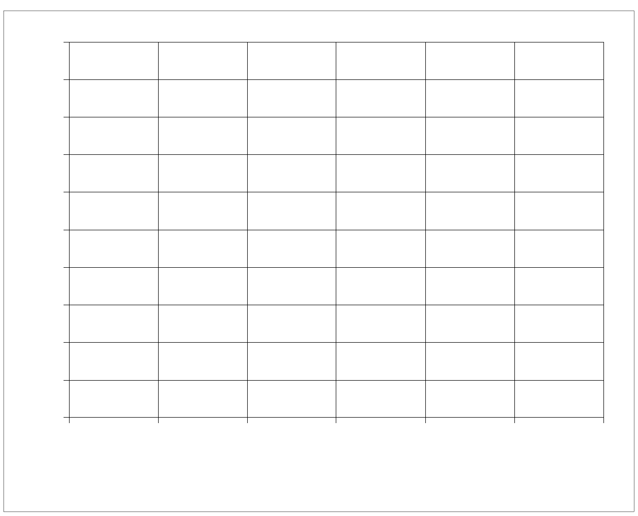
* - Gages reading positive with vertical displacement

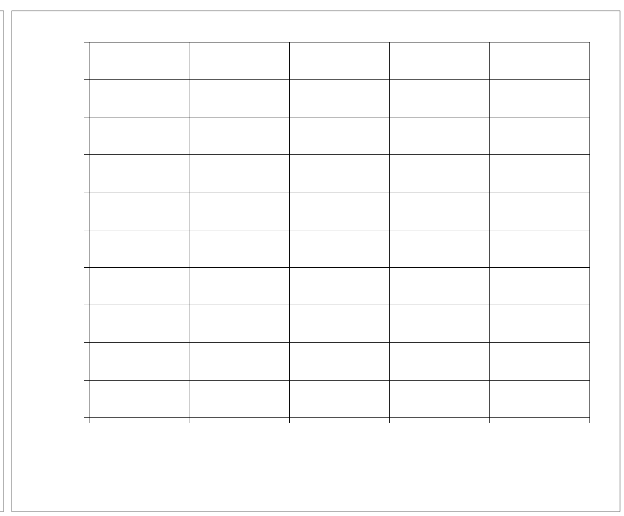
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-6A
Date: 12/16/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **48**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 11:34 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:53 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | 0.003 | 0.003 | | | 200 | 400 | 0.212 | 0.212 | |
| | 400 | 850 | 0.003 | 0.010 | 0.007 | | | 400 | 850 | 0.365 | 0.365 | |
| | 600 | 1300 | 0.008 | 0.017 | 0.012 | | | 0 | 0 | 0.056 | 0.056 | |
| | 800 | 1800 | 0.017 | 0.030 | 0.023 | | | 200 | 400 | 0.248 | 0.248 | |
| | 1000 | 2300 | 0.030 | 0.050 | 0.040 | | | 400 | 850 | 0.382 | 0.382 | |
| | 1200 | 2850 | 0.052 | 0.079 | 0.065 | | | 600 | 1300 | 0.502 | 0.502 | |
| | 1400 | 3450 | 0.084 | 0.119 | 0.101 | | | 800 | 1800 | 0.676 | 0.676 | |
| | 1600 | 3950 | 0.145 | 0.189 | 0.167 | | | 0 | 0 | 0.133 | 0.133 | |
| | 1800 | 4450 | 0.361 | 0.419 | 0.390 | | | 400 | 850 | 0.500 | 0.500 | |
| 11:39 | 2000 | 5000 | 0.546 | 0.588 | 0.567 | | | 600 | 1300 | 0.602 | 0.602 | |
| 11:44 | 2000 | 5000 | 0.583 | 0.624 | 0.603 | | | 800 | 1800 | 0.716 | 0.716 | |
| | 0 | 0 | 0.543 | 0.569 | 0.556 | | | 1000 | 2300 | 0.876 | 0.876 | |
| | | | | | | | | 0 | 0 | 0.210 | 0.210 | |
| | | | | | | | | 400 | 850 | 0.574 | 0.574 | |
| | | | | | | | | 800 | 1800 | 0.792 | 0.792 | |
| | | | | | | | | 1000 | 2300 | 0.902 | 0.902 | |
| | | | | | | | 12:04 | 0 | 0 | 0.245 | 0.245 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Notes:





EARTH SYSTEMS SOUTHWEST

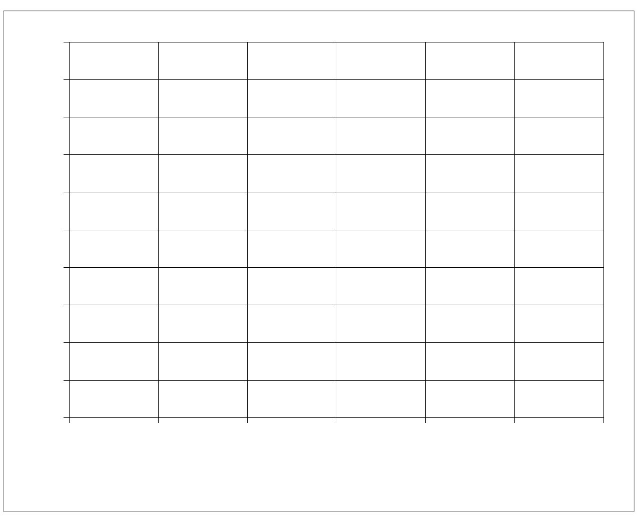
* - Gages reading positive with vertical displacement

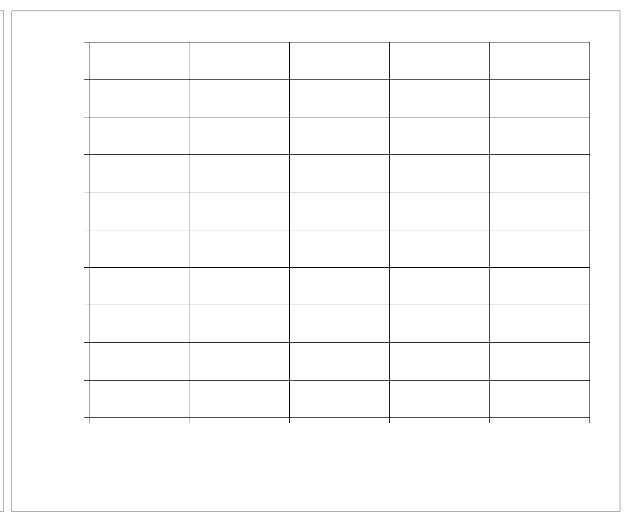
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-6B |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **37** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 11:22 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 12:02 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | 0.006 | 0.004 | | | 200 | 400 | 0.037 | 0.037 | |
| | 400 | 850 | 0.017 | 0.029 | 0.023 | | | 400 | 850 | 0.154 | 0.154 | |
| | 600 | 1300 | 0.055 | 0.068 | 0.061 | | | 0 | 0 | 0.034 | 0.034 | |
| | 800 | 1800 | 0.118 | 0.134 | 0.126 | | | 200 | 400 | 0.103 | 0.103 | |
| | 1000 | 2300 | 0.181 | 0.197 | 0.189 | | | 400 | 850 | 0.164 | 0.164 | |
| | 1200 | 2850 | 0.232 | 0.250 | 0.241 | | | 600 | 1300 | 0.252 | 0.252 | |
| | 1400 | 3450 | 0.314 | 0.330 | 0.322 | | | 800 | 1800 | 0.368 | 0.368 | |
| | 1600 | 3950 | 0.420 | 0.439 | 0.429 | | | 0 | 0 | 0.087 | 0.087 | |
| 11:27 | 1800 | 4450 | 0.701 | 0.718 | 0.710 | | | 400 | 850 | 0.276 | 0.276 | |
| | | | | | | | | 600 | 1300 | 0.340 | 0.340 | |
| | | | | | | | | 800 | 1800 | 0.395 | 0.395 | |
| | | | | | | | | 1000 | 2300 | 0.474 | 0.474 | |
| | | | | | | | | 0 | 0 | 0.132 | 0.132 | |
| | | | | | | | | 400 | 850 | 0.331 | 0.331 | |
| | | | | | | | | 800 | 1800 | 0.442 | 0.442 | |
| | | | | | | | | 1000 | 2300 | 0.486 | 0.486 | |
| | | | | | | | | 1200 | 2850 | 0.597 | 0.597 | |
| | | | | | | | | 1400 | 3450 | 0.737 | 0.737 | |
| | | | | | | | 12:12 | 0 | 0 | 0.228 | 0.228 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

## Desert Sunlight Solar Farm, Desert Center, California

### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-7A |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 7:44 | 0 | 0 | 0.000 | 0.002 | 0.000 | | 8:08 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.037 | 0.040 | 0.038 | | | 200 | 400 | 0.096 | 0.096 | |
| | 400 | 850 | 0.100 | 0.103 | 0.101 | | | 400 | 850 | 0.248 | 0.248 | |
| | 600 | 1300 | 0.177 | 0.182 | 0.179 | | | 0 | 0 | 0.043 | 0.043 | |
| | 800 | 1800 | 0.266 | 0.273 | 0.269 | | | 200 | 400 | 0.172 | 0.172 | |
| | 1000 | 2300 | 0.363 | 0.370 | 0.366 | | | 400 | 850 | 0.261 | 0.261 | |
| 7:47 | 1200 | 2850 | 0.494 | 0.501 | 0.497 | | | 600 | 1300 | 0.360 | 0.360 | |
| | | | | | | | | 800 | 1800 | 0.455 | 0.455 | |
| | | | | | | | | 0 | 0 | 0.100 | 0.100 | |
| | | | | | | | | 400 | 850 | 0.346 | 0.346 | |
| | | | | | | | | 600 | 1300 | 0.415 | 0.415 | |
| | | | | | | | | 800 | 1800 | 0.474 | 0.474 | |
| | | | | | | | | 1000 | 2300 | 0.488 | 0.488 | |
| | | | | | | | | 0 | 0 | 0.135 | 0.135 | |
| | | | | | | | | 400 | 850 | 0.363 | 0.363 | |
| | | | | | | | | 800 | 1800 | 0.461 | 0.461 | |
| | | | | | | | | 1000 | 2300 | 0.508 | 0.508 | |
| | | | | | | | | 1200 | 2850 | 0.608 | 0.608 | |
| | | | | | | | | 1400 | 3450 | 0.765 | 0.765 | |
| | | | | | | | 8:17 | 0 | 0 | 0.167 | 0.167 | |

Notes:

EARTH SYSTEMS SOUTHWEST

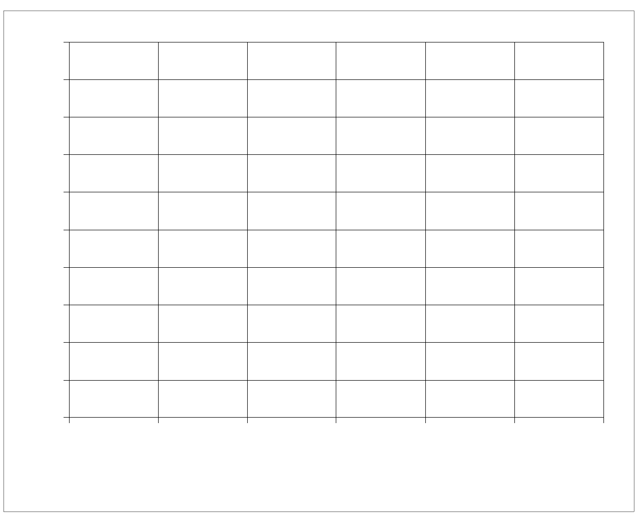
* - Gages reading positive with vertical displacement

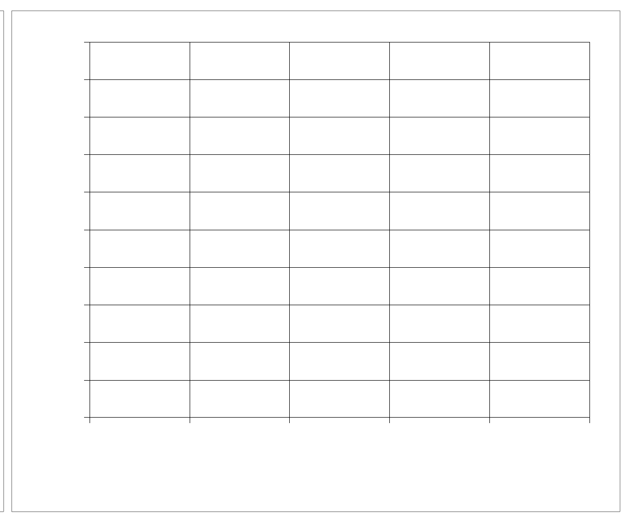
## Desert Sunlight Solar Farm, Desert Center, California
### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-7B |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 7:33 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 7:58 | 0 | 0 | 0.002 | 0.000 | |
| | 200 | 400 | 0.054 | 0.069 | 0.061 | | | 200 | 400 | 0.125 | 0.123 | |
| 7:34 | 400 | 850 | 0.361 | 0.387 | 0.374 | | | 400 | 850 | 0.260 | 0.258 | |
| | | | | | | | | 0 | 0 | 0.150 | 0.148 | |
| | | | | | | | | 200 | 400 | 0.226 | 0.224 | |
| | | | | | | | | 400 | 850 | 0.281 | 0.279 | |
| | | | | | | | | 600 | 1300 | 0.379 | 0.377 | |
| | | | | | | | | 800 | 1800 | 0.503 | 0.501 | |
| | | | | | | | | 0 | 0 | 0.248 | 0.246 | |
| | | | | | | | | 400 | 850 | 0.410 | 0.408 | |
| | | | | | | | | 600 | 1300 | 0.462 | 0.460 | |
| | | | | | | | | 800 | 1800 | 0.520 | 0.518 | |
| | | | | | | | | 1000 | 2300 | 0.612 | 0.610 | |
| | | | | | | | | 0 | 0 | 0.318 | 0.316 | |
| | | | | | | | | 400 | 850 | 0.470 | 0.468 | |
| | | | | | | | | 800 | 1800 | 0.576 | 0.574 | |
| | | | | | | | | 1000 | 2300 | 0.637 | 0.635 | |
| | | | | | | | | 1200 | 2850 | 0.729 | 0.727 | |
| | | | | | | | | 1400 | 3450 | 0.883 | 0.881 | |
| | | | | | | | 8:09 | 0 | 0 | 0.449 | 0.447 | |

Notes:





EARTH SYSTEMS SOUTHWEST

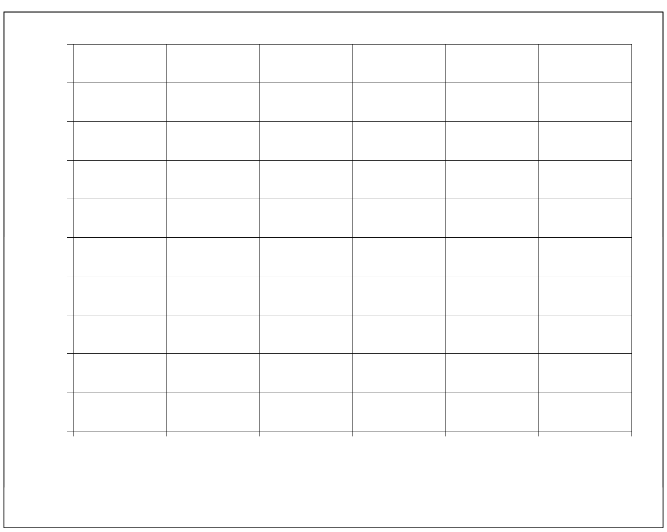
* - Gages reading positive with vertical displacement

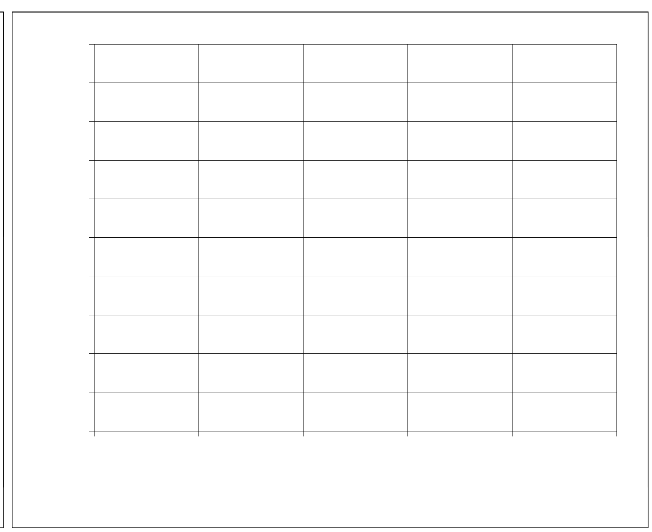
## Desert Sunlight Solar Farm, Desert Center, California
### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-8A |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 7:18 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 8:01 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | -0.003 | 0.002 | -0.001 | | | 200 | 400 | 0.061 | 0.061 | |
| | 400 | 850 | -0.001 | 0.008 | 0.004 | | | 400 | 850 | 0.155 | 0.155 | |
| | 600 | 1300 | 0.006 | 0.017 | 0.011 | | | 0 | 0 | 0.033 | 0.033 | |
| | 800 | 1800 | 0.022 | 0.035 | 0.029 | | | 200 | 400 | 0.120 | 0.120 | |
| | 1000 | 2300 | 0.044 | 0.057 | 0.050 | | | 400 | 850 | 0.163 | 0.163 | |
| | 1200 | 2850 | 0.063 | 0.077 | 0.070 | | | 600 | 1300 | 0.228 | 0.228 | |
| | 1400 | 3450 | 0.086 | 0.102 | 0.094 | | | 800 | 1800 | 0.300 | 0.300 | |
| | 1600 | 3950 | 0.108 | 0.126 | 0.117 | | | 0 | 0 | 0.063 | 0.063 | |
| | 1800 | 4450 | 0.140 | 0.156 | 0.148 | | | 400 | 850 | 0.197 | 0.197 | |
| 7:23 | 2000 | 5000 | 0.166 | 0.187 | 0.176 | | | 600 | 1300 | 0.263 | 0.263 | |
| 7:28 | 2000 | 5000 | 0.180 | 0.201 | 0.190 | | | 800 | 1800 | 0.308 | 0.308 | |
| | 0 | 0 | 0.114 | 0.130 | 0.122 | | | 1000 | 2300 | 0.383 | 0.383 | |
| | | | | | | | | 0 | 0 | 0.080 | 0.080 | |
| | | | | | | | | 400 | 850 | 0.255 | 0.255 | |
| | | | | | | | | 800 | 1800 | 0.359 | 0.359 | |
| | | | | | | | | 1000 | 2300 | 0.403 | 0.403 | |
| | | | | | | | | 1200 | 2850 | 0.459 | 0.459 | |
| | | | | | | | | 1400 | 3450 | 0.529 | 0.529 | |
| | | | | | | | 8:11 | 0 | 0 | 0.089 | 0.089 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California

## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-8B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **35** |
| | |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 8:37 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 7:50 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.015 | 0.007 | 0.011 | | | 200 | 400 | 0.195 | 0.195 | |
| | 400 | 850 | 0.033 | 0.026 | 0.029 | | | 400 | 850 | 0.476 | 0.476 | |
| | 600 | 1300 | 0.059 | 0.053 | 0.056 | | | 0 | 0 | 0.244 | 0.244 | |
| | 800 | 1800 | 0.110 | 0.108 | 0.109 | | | 200 | 400 | 0.390 | 0.390 | |
| | 1000 | 2300 | 0.185 | 0.182 | 0.183 | | | 400 | 850 | 0.521 | 0.521 | |
| | 1200 | 2850 | 0.271 | 0.269 | 0.270 | | | 600 | 1300 | 0.740 | 0.740 | |
| 8:40 | 1400 | 3450 | 0.398 | 0.394 | 0.396 | | | 800 | 1800 | 0.972 | 0.972 | |
| | | | | | | | | 0 | 0 | 0.540 | 0.540 | |
| | | | | | | | | 400 | 850 | 0.834 | 0.834 | |
| | | | | | | | | 600 | 1300 | 0.931 | 0.931 | |
| | | | | | | | 7:53 | 800 | 1800 | 1.013 | 1.013 | |
| | | | | | | | | 0 | 0 | 0.619 | 0.619 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
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Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-9A |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:08 | 0 | 0 | 0.000 | 0.001 | 0.000 | | 9:27 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.003 | 0.002 | | | 200 | 400 | 0.083 | 0.083 | |
| | 400 | 850 | 0.009 | 0.012 | 0.010 | | | 400 | 850 | 0.167 | 0.167 | |
| | 600 | 1300 | 0.034 | 0.038 | 0.035 | | | 0 | 0 | 0.019 | 0.019 | |
| | 800 | 1800 | 0.091 | 0.098 | 0.094 | | | 200 | 400 | 0.116 | 0.116 | |
| | 1000 | 2300 | 0.136 | 0.148 | 0.141 | | | 400 | 850 | 0.168 | 0.168 | |
| | 1200 | 2850 | 0.185 | 0.202 | 0.193 | | | 600 | 1300 | 0.252 | 0.252 | |
| | 1400 | 3450 | 0.234 | 0.255 | 0.244 | | | 800 | 1800 | 0.399 | 0.399 | |
| | 1600 | 3950 | 0.275 | 0.300 | 0.287 | | | 0 | 0 | 0.062 | 0.062 | |
| | 1800 | 4450 | 0.311 | 0.337 | 0.324 | | | 400 | 850 | 0.247 | 0.247 | |
| 9:15 | 2000 | 5000 | 0.348 | 0.378 | 0.362 | | | 600 | 1300 | 0.326 | 0.326 | |
| 9:20 | 2000 | 5000 | 0.355 | 0.385 | 0.369 | | | 800 | 1800 | 0.411 | 0.411 | |
| | 0 | 0 | 0.337 | 0.348 | 0.342 | | | 1000 | 2300 | 0.582 | 0.582 | |
| | | | | | | | | 0 | 0 | 0.126 | 0.126 | |
| | | | | | | | | 400 | 850 | 0.325 | 0.325 | |
| | | | | | | | | 800 | 1800 | 0.482 | 0.482 | |
| | | | | | | | | 1000 | 2300 | 0.623 | 0.623 | |
| | | | | | | | | 1200 | 2850 | 0.903 | 0.903 | |
| | | | | | | | 9:36 | 0 | 0 | 0.303 | 0.303 | |

Notes:

EARTH SYSTEMS SOUTHWEST

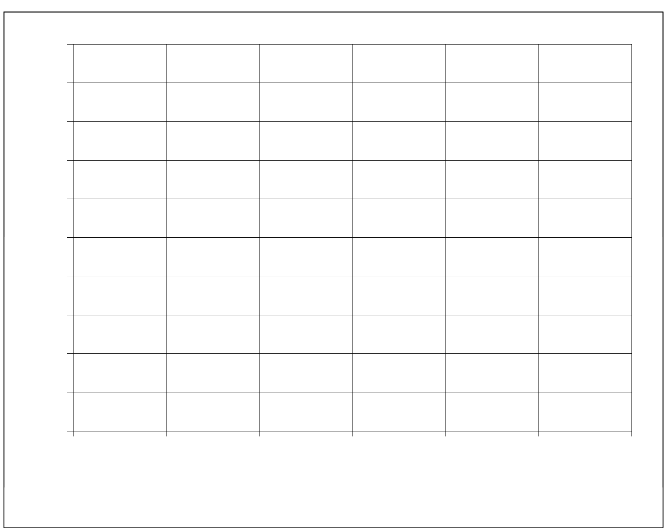
* - Gages reading positive with vertical displacement

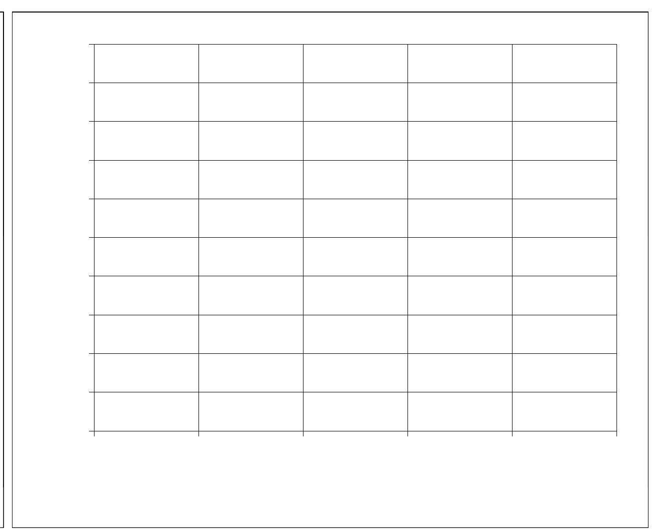
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-9B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **56** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 8:47 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 9:38 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.001 | 0.001 | | | 200 | 400 | 0.066 | 0.066 | |
| | 400 | 850 | -0.001 | 0.002 | 0.001 | | | 400 | 850 | 0.087 | 0.087 | |
| | 600 | 1300 | 0.001 | 0.003 | 0.002 | | | 0 | 0 | 0.016 | 0.016 | |
| | 800 | 1800 | 0.001 | 0.004 | 0.003 | | | 200 | 400 | 0.082 | 0.082 | |
| | 1000 | 2300 | 0.003 | 0.005 | 0.004 | | | 400 | 850 | 0.106 | 0.106 | |
| | 1200 | 2850 | 0.007 | 0.008 | 0.008 | | | 600 | 1300 | 0.142 | 0.142 | |
| | 1400 | 3450 | 0.008 | 0.011 | 0.010 | | | 800 | 1800 | 0.188 | 0.188 | |
| | 1600 | 3950 | 0.013 | 0.014 | 0.014 | | | 0 | 0 | 0.036 | 0.036 | |
| | 1800 | 4450 | 0.019 | 0.018 | 0.018 | | | 400 | 850 | 0.142 | 0.142 | |
| 8:54 | 2000 | 5000 | 0.025 | 0.023 | 0.024 | | | 600 | 1300 | 0.171 | 0.171 | |
| | 2000 | 5000 | 0.026 | 0.024 | 0.025 | | | 800 | 1800 | 0.200 | 0.200 | |
| | 0 | 0 | 0.015 | 0.015 | 0.015 | | | 1000 | 2300 | 0.235 | 0.235 | |
| | | | | | | | | 0 | 0 | 0.040 | 0.040 | |
| | | | | | | | | 400 | 850 | 0.159 | 0.159 | |
| | | | | | | | | 800 | 1800 | 0.224 | 0.224 | |
| | | | | | | | | 1000 | 2300 | 0.251 | 0.251 | |
| | | | | | | | | 1200 | 2850 | 0.275 | 0.275 | |
| | | | | | | | | 1400 | 3450 | 0.318 | 0.318 | |
| | | | | | | | 9:48 | 0 | 0 | 0.014 | 0.014 | |

Notes:





EARTH SYSTEMS SOUTHWEST

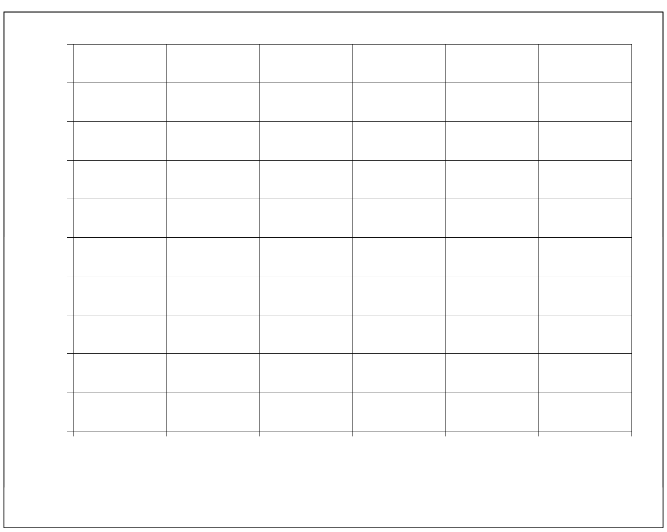
* - Gages reading positive with vertical displacement

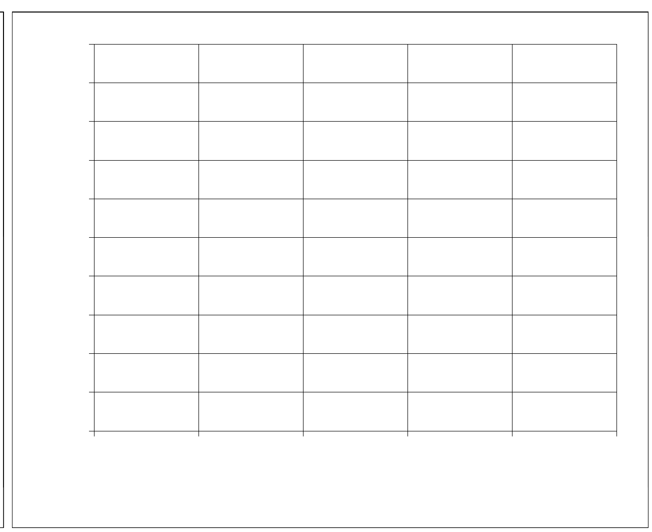
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-10A |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **45** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 12:50 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 1:01 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | -0.001 | 0.000 | | | 200 | 400 | 0.199 | 0.199 | |
| | 400 | 850 | 0.006 | -0.001 | 0.003 | | | 400 | 850 | 0.425 | 0.425 | |
| | 600 | 1300 | 0.021 | 0.013 | 0.017 | | | 0 | 0 | 0.144 | 0.144 | |
| | 800 | 1800 | 0.045 | 0.035 | 0.040 | | | 200 | 400 | 0.321 | 0.321 | |
| | 1000 | 2300 | 0.153 | 0.143 | 0.148 | | | 400 | 850 | 0.456 | 0.456 | |
| | 1200 | 2850 | 0.358 | 0.348 | 0.353 | | | 600 | 1300 | 0.626 | 0.626 | |
| 12:53 | 1400 | 3450 | 0.573 | 0.566 | 0.570 | | | 800 | 1800 | 0.815 | 0.815 | |
| | | | | | | | | 0 | 0 | 0.288 | 0.288 | |
| | | | | | | | | 400 | 850 | 0.623 | 0.623 | |
| | | | | | | | | 600 | 1300 | 0.753 | 0.753 | |
| | | | | | | | | 800 | 1800 | 0.867 | 0.867 | |
| | | | | | | | | 1000 | 2300 | 1.044 | 1.044 | |
| | | | | | | | | 0 | 0 | 0.413 | 0.413 | |
| | | | | | | | | 400 | 850 | 0.764 | 0.764 | |
| | | | | | | | | 800 | 1800 | 0.964 | 0.964 | |
| | | | | | | | 1:08 | 0 | 0 | 0.442 | 0.442 | |

Notes: Vert. 1"+@ 1500 lbs.





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-10B |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 1:21 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 1:36 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.020 | 0.016 | 0.018 | | | 200 | 400 | 0.215 | 0.215 | |
| | 400 | 850 | 0.097 | 0.092 | 0.095 | | | 400 | 850 | 0.367 | 0.367 | |
| | 600 | 1300 | 0.168 | 0.162 | 0.165 | | | 0 | 0 | 0.074 | 0.074 | |
| | 800 | 1800 | 0.235 | 0.226 | 0.230 | | | 200 | 400 | 0.252 | 0.252 | |
| | 1000 | 2300 | 0.290 | 0.284 | 0.287 | | | 400 | 850 | 0.375 | 0.375 | |
| | 1200 | 2850 | 0.358 | 0.349 | 0.354 | | | 600 | 1300 | 0.548 | 0.548 | |
| | 1400 | 3450 | 0.447 | 0.439 | 0.443 | | | 800 | 1800 | 0.735 | 0.735 | |
| | 1600 | 3950 | 0.517 | 0.507 | 0.512 | | | 0 | 0 | 0.205 | 0.205 | |
| | 1800 | 4450 | 0.557 | 0.550 | 0.553 | | | 400 | 850 | 0.513 | 0.513 | |
| 1:25 | 2000 | 5000 | 0.688 | 0.678 | 0.683 | | | 600 | 1300 | 0.657 | 0.657 | |
| 1:30 | 2000 | 5000 | 0.715 | 0.707 | 0.711 | | | 800 | 1800 | 0.793 | 0.793 | |
| | 0 | 0 | 0.634 | 0.632 | 0.633 | | | 1000 | 2300 | 0.953 | 0.953 | |
| | | | | | | | | 0 | 0 | 0.310 | 0.310 | |
| | | | | | | | | 400 | 850 | 0.622 | 0.622 | |
| | | | | | | | | 800 | 1800 | 0.877 | 0.877 | |
| | | | | | | | | 1000 | 2300 | 0.955 | 0.955 | |
| | | | | | | | | 0 | 0 | 0.293 | 0.293 | |

Notes:

EARTH SYSTEMS SOUTHWEST

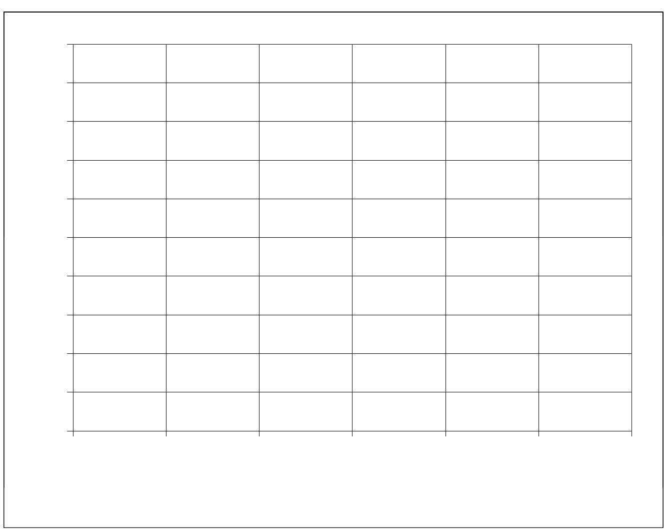
* - Gages reading positive with vertical displacement

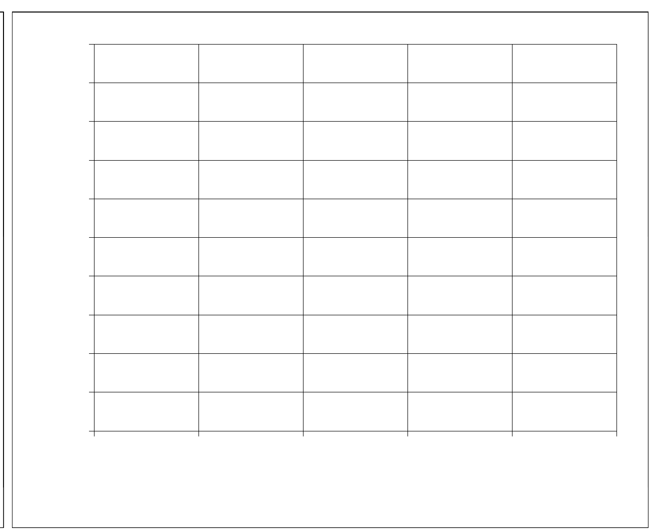
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-11A |
| Date: | 12/18/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 20 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:52 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:10 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.001 | 0.000 | 0.001 | | | 500 | 500 | 0.120 | 0.120 | |
| | 1000 | 1000 | 0.005 | 0.002 | 0.004 | | | 750 | 750 | 0.195 | 0.195 | |
| | 1500 | 1500 | 0.013 | 0.007 | 0.010 | | | 0 | 0 | 0.025 | 0.025 | |
| | 2000 | 2000 | 0.020 | 0.016 | 0.018 | | | 500 | 500 | 0.108 | 0.108 | |
| | 2500 | 2500 | 0.057 | 0.031 | 0.044 | | | 750 | 750 | 0.159 | 0.159 | |
| | 3000 | 3000 | 0.048 | 0.046 | 0.047 | | | 1000 | 1000 | 0.230 | 0.230 | |
| | 3500 | 3500 | 0.067 | 0.067 | 0.067 | | | 1500 | 1500 | 0.387 | 0.387 | |
| | 4000 | 4000 | 0.086 | 0.084 | 0.085 | | | 0 | 0 | 0.053 | 0.053 | |
| | 4500 | 4500 | 0.111 | 0.108 | 0.110 | | | 750 | 750 | 0.197 | 0.197 | |
| 10:57 | 5000 | 5000 | 0.134 | 0.131 | 0.133 | | | 1500 | 1500 | 0.402 | 0.402 | |
| 11:02 | 5000 | 5000 | 0.145 | 0.142 | 0.144 | | | 1750 | 1750 | 0.465 | 0.465 | |
| | 0 | 0 | 0.122 | 0.118 | 0.120 | | | 2000 | 2000 | 0.539 | 0.539 | |
| | | | | | | | | 0 | 0 | 0.088 | 0.088 | |
| | | | | | | | | 750 | 750 | 0.272 | 0.272 | |
| | | | | | | | | 1500 | 1500 | 0.461 | 0.461 | |
| | | | | | | | | 2000 | 2000 | 0.565 | 0.565 | |
| | | | | | | | | 2500 | 2500 | 0.700 | 0.700 | |
| | | | | | | | | 3000 | 3000 | 0.856 | 0.856 | |
| | | | | | | | 11:19 | 0 | 0 | 0.190 | 0.190 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

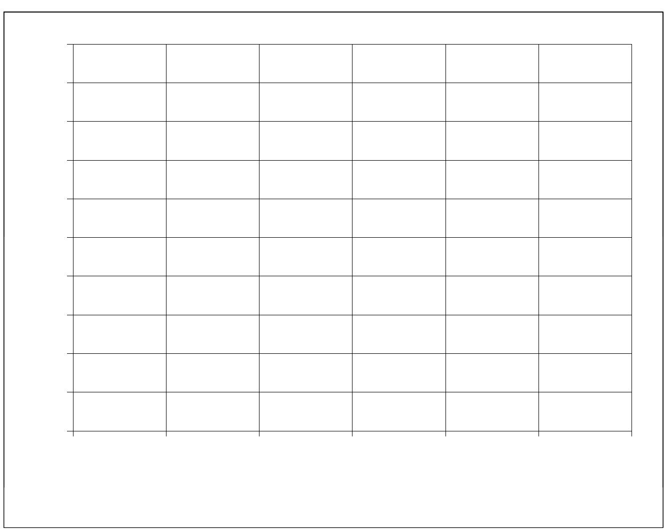
# Desert Sunlight Solar Farm, Desert Center, California

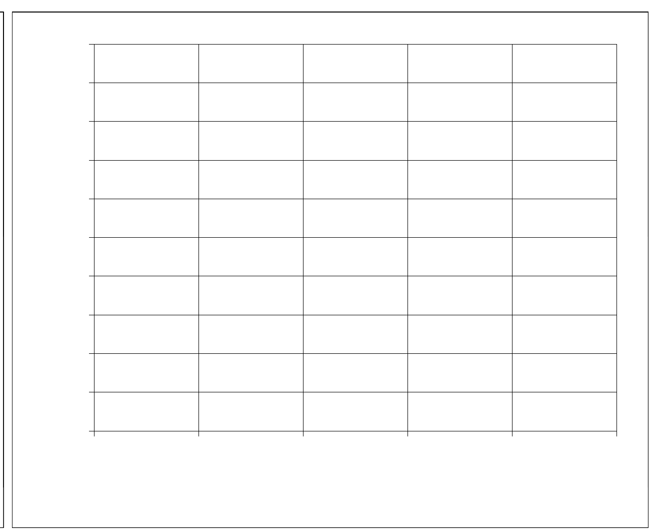
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-11B |
| Date: | 12/18/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 20 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:35 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:20 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.000 | 0.000 | 0.000 | | | 500 | 500 | 0.038 | 0.038 | |
| | 1000 | 1000 | 0.001 | 0.001 | 0.001 | | | 750 | 750 | 0.098 | 0.098 | |
| | 1500 | 1500 | 0.005 | 0.002 | 0.004 | | | 0 | 0 | 0.013 | 0.013 | |
| | 2000 | 2000 | 0.008 | 0.003 | 0.006 | | | 500 | 500 | 0.066 | 0.066 | |
| | 2500 | 2500 | 0.012 | 0.005 | 0.009 | | | 750 | 750 | 0.103 | 0.103 | |
| | 3000 | 3000 | 0.017 | 0.009 | 0.013 | | | 1000 | 1000 | 0.145 | 0.145 | |
| | 3500 | 3500 | 0.024 | 0.015 | 0.020 | | | 1500 | 1500 | 0.221 | 0.221 | |
| | 4000 | 4000 | 0.031 | 0.022 | 0.027 | | | 0 | 0 | 0.024 | 0.024 | |
| | 4500 | 4500 | 0.038 | 0.029 | 0.034 | | | 750 | 750 | 0.137 | 0.137 | |
| 10:40 | 5000 | 5000 | 0.049 | 0.037 | 0.043 | | | 1500 | 1500 | 0.220 | 0.220 | |
| 10:45 | 5000 | 5000 | 0.048 | 0.038 | 0.043 | | | 1750 | 1750 | 0.244 | 0.244 | |
| | 0 | 0 | 0.029 | 0.031 | 0.030 | | | 2000 | 2000 | 0.282 | 0.282 | |
| | | | | | | | | 0 | 0 | 0.035 | 0.035 | |
| | | | | | | | | 750 | 750 | 0.140 | 0.140 | |
| | | | | | | | | 1500 | 1500 | 0.248 | 0.248 | |
| | | | | | | | | 2000 | 2000 | 0.290 | 0.290 | |
| | | | | | | | | 2500 | 2500 | 0.343 | 0.343 | |
| | | | | | | | | 3000 | 3000 | 0.421 | 0.421 | |
| | | | | | | | 11:30 | 0 | 0 | 0.064 | 0.064 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-12A |
| Date: | 12/18/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 20 Tonn |
| Lateral Gage Position: | 1 inch above grade |

**Axial Tension Load Test**

| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|---|
| 7:59 | 0 | 0 | 0.000 | 0.000 | 0.000 | |
| | 500 | 500 | 0.000 | 0.002 | 0.001 | |
| | 1000 | 1000 | 0.000 | 0.005 | 0.003 | |
| | 1500 | 1500 | 0.000 | 0.008 | 0.004 | |
| | 2000 | 2000 | 0.008 | 0.010 | 0.009 | |
| | 2500 | 2500 | 0.013 | 0.016 | 0.015 | |
| | 3000 | 3000 | 0.021 | 0.029 | 0.025 | |
| | 3500 | 3500 | 0.030 | 0.039 | 0.035 | |
| | 4000 | 4000 | 0.042 | 0.050 | 0.046 | |
| | 4500 | 4500 | 0.055 | 0.063 | 0.059 | |
| 8:03 | 5000 | 5000 | 0.070 | 0.078 | 0.074 | |
| 8:08 | 5000 | 5000 | 0.074 | 0.081 | 0.078 | |
| | 0 | 0 | 0.050 | 0.058 | 0.054 | |

**Lateral Load Test**

| Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|
| 8:15 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.041 | 0.041 | |
| | 750 | 750 | 0.069 | 0.069 | |
| | 0 | 0 | 0.014 | 0.014 | |
| | 500 | 500 | 0.057 | 0.057 | |
| | 750 | 750 | 0.074 | 0.074 | |
| | 1000 | 1000 | 0.094 | 0.094 | |
| | 1500 | 1500 | 0.165 | 0.165 | |
| | 0 | 0 | 0.033 | 0.033 | |
| | 750 | 750 | 0.103 | 0.103 | |
| | 1500 | 1500 | 0.181 | 0.181 | |
| | 1750 | 1750 | 0.199 | 0.199 | |
| | 2000 | 2000 | 0.235 | 0.235 | |
| | 0 | 0 | 0.041 | 0.041 | |
| | 750 | 750 | 0.133 | 0.133 | |
| | 1500 | 1500 | 0.197 | 0.197 | |
| | 2000 | 2000 | 0.249 | 0.249 | |
| | 2500 | 2500 | 0.305 | 0.305 | |
| | 3000 | 3000 | 0.374 | 0.374 | |
| 8:24 | 0 | 0 | 0.048 | 0.048 | |

Notes:

EARTH SYSTEMS SOUTHWEST

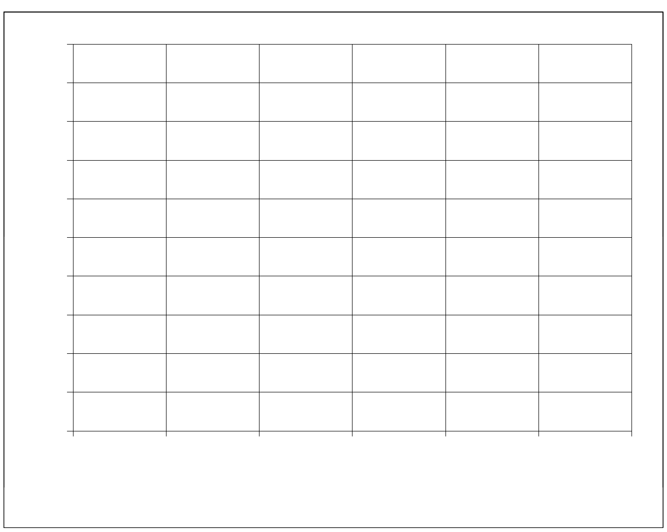
* - Gages reading positive with vertical displacement

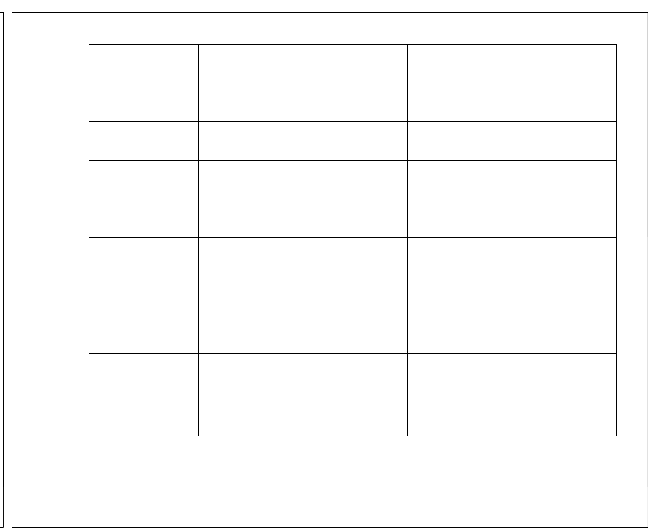
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-12B |
| Date: | 12/18/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **58** |
| Jack: | 20 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 7:38 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 8:25 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.000 | 0.000 | 0.000 | | | 500 | 500 | 0.036 | 0.036 | |
| | 1000 | 1000 | 0.000 | 0.001 | 0.001 | | | 750 | 750 | 0.090 | 0.090 | |
| | 1500 | 1500 | 0.001 | 0.002 | 0.002 | | | 0 | 0 | 0.016 | 0.016 | |
| | 2000 | 2000 | 0.001 | 0.003 | 0.002 | | | 500 | 500 | 0.056 | 0.056 | |
| | 2500 | 2500 | 0.002 | 0.004 | 0.003 | | | 750 | 750 | 0.080 | 0.080 | |
| | 3000 | 3000 | 0.001 | 0.006 | 0.004 | | | 1000 | 1000 | 0.104 | 0.104 | |
| | 3500 | 3500 | 0.001 | 0.007 | 0.004 | | | 1500 | 1500 | 0.177 | 0.177 | |
| | 4000 | 4000 | 0.001 | 0.008 | 0.005 | | | 0 | 0 | 0.029 | 0.029 | |
| | 4500 | 4500 | 0.001 | 0.009 | 0.005 | | | 750 | 750 | 0.099 | 0.099 | |
| 7:45 | 5000 | 5000 | 0.003 | 0.010 | 0.007 | | | 1500 | 1500 | 0.188 | 0.188 | |
| 7:50 | 5000 | 5000 | 0.003 | 0.010 | 0.007 | | | 1750 | 1750 | 0.214 | 0.214 | |
| | 0 | 0 | 0.001 | 0.002 | 0.002 | | | 2000 | 2000 | 0.255 | 0.255 | |
| | | | | | | | | 0 | 0 | 0.039 | 0.039 | |
| | | | | | | | | 750 | 750 | 0.124 | 0.124 | |
| | | | | | | | | 1500 | 1500 | 0.218 | 0.218 | |
| | | | | | | | | 2000 | 2000 | 0.259 | 0.259 | |
| | | | | | | | | 2500 | 2500 | 0.325 | 0.325 | |
| | | | | | | | | 3000 | 3000 | 0.414 | 0.414 | |
| | | | | | | | 8:35 | 0 | 0 | 0.062 | 0.062 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California

## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-13A |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 3:12 | 0 | 0 | 0.000 | 0.001 | 0.000 | | 3:26 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.002 | 0.001 | | | 200 | 400 | 0.018 | 0.018 | |
| | 400 | 850 | 0.001 | 0.002 | 0.001 | | | 400 | 850 | 0.059 | 0.059 | |
| | 600 | 1300 | 0.002 | 0.002 | 0.001 | | | 0 | 0 | 0.013 | 0.013 | |
| | 800 | 1800 | 0.002 | 0.003 | 0.002 | | | 200 | 400 | 0.042 | 0.042 | |
| | 1000 | 2300 | 0.003 | 0.003 | 0.003 | | | 400 | 850 | 0.062 | 0.062 | |
| | 1200 | 2850 | 0.004 | 0.004 | 0.004 | | | 600 | 1300 | 0.084 | 0.084 | |
| | 1400 | 3450 | 0.006 | 0.006 | 0.005 | | | 800 | 1800 | 0.112 | 0.112 | |
| | 1600 | 3950 | 0.008 | 0.007 | 0.007 | | | 0 | 0 | 0.009 | 0.009 | |
| | 1800 | 4450 | 0.011 | 0.009 | 0.009 | | | 400 | 850 | 0.079 | 0.079 | |
| 3:15 | 2000 | 5000 | 0.013 | 0.011 | 0.011 | | | 600 | 1300 | 0.099 | 0.099 | |
| 3:20 | 2000 | 5000 | 0.015 | 0.013 | 0.013 | | | 800 | 1800 | 0.120 | 0.120 | |
| | 0 | 0 | 0.009 | 0.008 | 0.008 | | | 1000 | 2300 | 0.149 | 0.149 | |
| | | | | | | | | 0 | 0 | 0.001 | 0.001 | |
| | | | | | | | | 400 | 850 | 0.086 | 0.086 | |
| | | | | | | | | 800 | 1800 | 0.140 | 0.140 | |
| | | | | | | | | 1000 | 2300 | 0.164 | 0.164 | |
| | | | | | | | | 1200 | 2850 | 0.194 | 0.194 | |
| | | | | | | | | 1400 | 3450 | 0.235 | 0.235 | |
| | | | | | | | 3:35 | 0 | 0 | 0.035 | 0.035 | |

Notes:

EARTH SYSTEMS SOUTHWEST

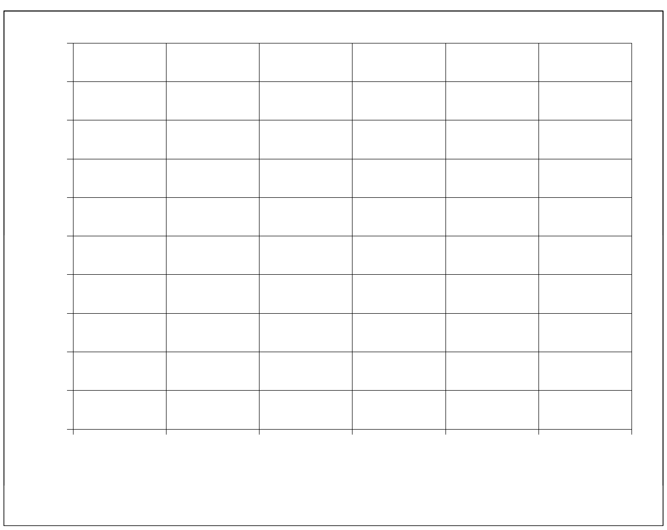
* - Gages reading positive with vertical displacement

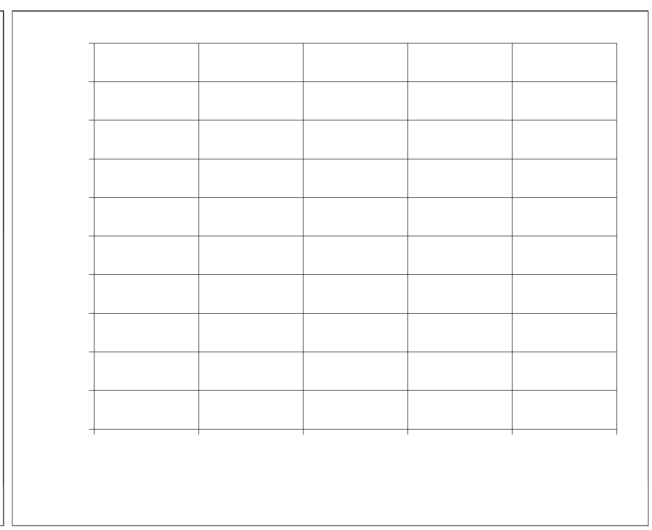
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-13B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **34** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 2:50 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 3:40 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.093 | 0.093 | |
| | 400 | 850 | 0.003 | 0.000 | 0.002 | | | 400 | 850 | 0.153 | 0.153 | |
| | 600 | 1300 | 0.007 | 0.002 | 0.004 | | | 0 | 0 | 0.037 | 0.037 | |
| | 800 | 1800 | 0.012 | 0.006 | 0.009 | | | 200 | 400 | 0.119 | 0.119 | |
| | 1000 | 2300 | 0.020 | 0.013 | 0.017 | | | 400 | 850 | 0.158 | 0.158 | |
| | 1200 | 2850 | 0.032 | 0.023 | 0.027 | | | 600 | 1300 | 0.215 | 0.215 | |
| | 1400 | 3450 | 0.043 | 0.035 | 0.039 | | | 800 | 1800 | 0.300 | 0.300 | |
| | 1600 | 3950 | 0.062 | 0.049 | 0.056 | | | 0 | 0 | 0.073 | 0.073 | |
| | 1800 | 4450 | 0.082 | 0.065 | 0.073 | | | 400 | 850 | 0.235 | 0.235 | |
| 2:58 | 2000 | 5000 | 0.105 | 0.088 | 0.096 | | | 600 | 1300 | 0.276 | 0.276 | |
| 3:03 | 2000 | 5000 | 0.115 | 0.097 | 0.106 | | | 800 | 1800 | 0.319 | 0.319 | |
| | 0 | 0 | 0.075 | 0.070 | 0.073 | | | 1000 | 2300 | 0.383 | 0.383 | |
| | | | | | | | | 0 | 0 | 0.098 | 0.098 | |
| | | | | | | | | 400 | 850 | 0.274 | 0.274 | |
| | | | | | | | | 800 | 1800 | 0.361 | 0.361 | |
| | | | | | | | | 1000 | 2300 | 0.406 | 0.406 | |
| | | | | | | | | 1200 | 2850 | 0.479 | 0.479 | |
| | | | | | | | | 1400 | 3450 | 0.576 | 0.576 | |
| | | | | | | | 3:50 | 0 | 0 | 0.175 | 0.175 | |

Notes:





EARTH SYSTEMS SOUTHWEST

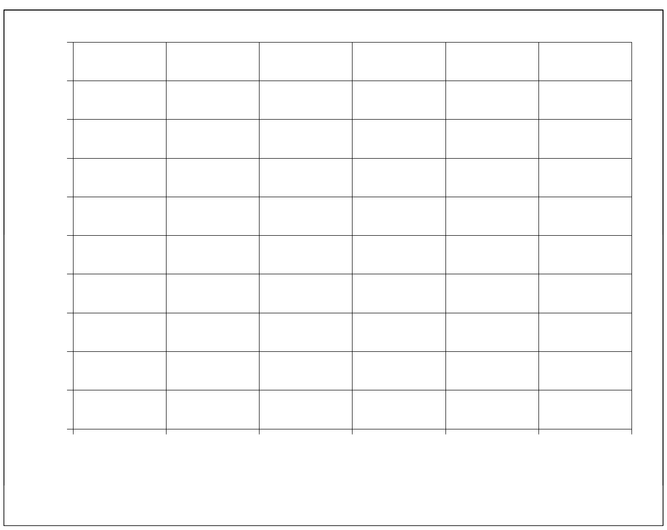
* - Gages reading positive with vertical displacement

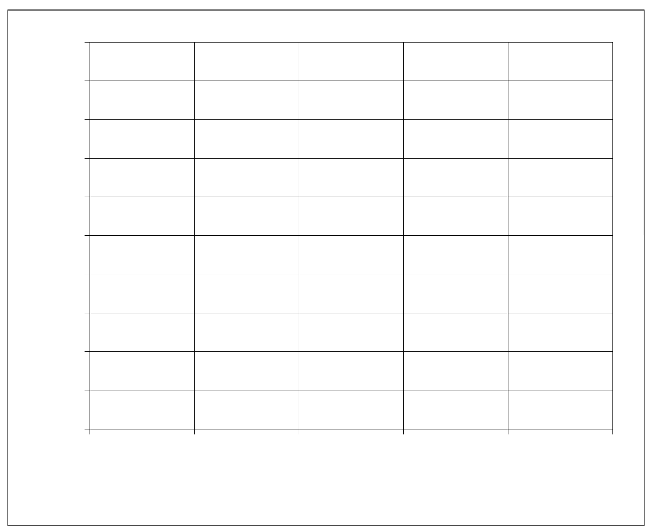
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-14A |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:25 | 0 | 0 | -0.001 | -0.001 | 0.000 | | 9:45 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | | | 0.001 | | | 200 | 400 | 0.033 | 0.033 | |
| | 400 | 850 | -0.001 | -0.001 | 0.000 | | | 400 | 850 | 0.141 | 0.141 | |
| | 600 | 1300 | | | 0.001 | | | 0 | 0 | 0.016 | 0.016 | |
| | 800 | 1800 | 0.000 | 0.001 | 0.001 | | | 200 | 400 | 0.080 | 0.080 | |
| | 1000 | 2300 | 0.002 | 0.001 | 0.002 | | | 400 | 850 | 0.143 | 0.143 | |
| | 1200 | 2850 | 0.004 | 0.004 | 0.005 | | | 600 | 1300 | 0.238 | 0.238 | |
| | 1400 | 3450 | 0.009 | 0.010 | 0.010 | | | 800 | 1800 | 0.333 | 0.333 | |
| | 1600 | 3950 | 0.014 | 0.015 | 0.015 | | | 0 | 0 | 0.048 | 0.048 | |
| | 1800 | 4450 | 0.023 | 0.024 | 0.024 | | | 400 | 850 | 0.198 | 0.198 | |
| 9:29 | 2000 | 5000 | 0.034 | 0.036 | 0.036 | | | 600 | 1300 | 0.263 | 0.263 | |
| 9:34 | 2000 | 5000 | 0.037 | 0.039 | 0.039 | | | 800 | 1800 | 0.351 | 0.351 | |
| | 0 | 0 | 0.035 | 0.036 | 0.036 | | | 1000 | 2300 | 0.438 | 0.438 | |
| | | | | | | | | 0 | 0 | 0.077 | 0.077 | |
| | | | | | | | | 400 | 850 | 0.241 | 0.241 | |
| | | | | | | | | 800 | 1800 | 0.398 | 0.398 | |
| | | | | | | | | 1000 | 2300 | 0.466 | 0.466 | |
| | | | | | | | | 1200 | 2850 | 0.541 | 0.541 | |
| | | | | | | | | 1400 | 3450 | 0.630 | 0.630 | |
| | | | | | | | 9:55 | 0 | 0 | 0.129 | 0.129 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

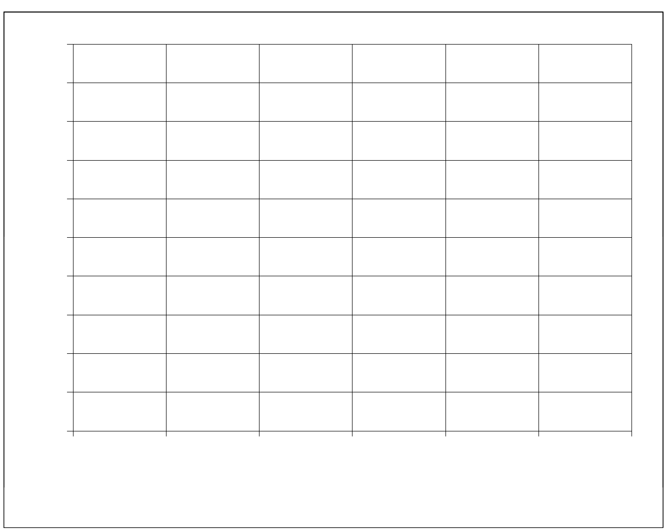
# Desert Sunlight Solar Farm, Desert Center, California

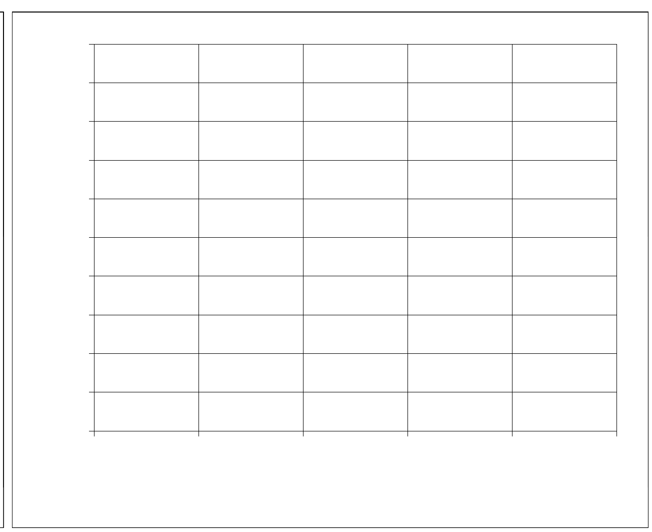
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-14B |
| Date: | 12/14/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:03 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 10:18 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.003 | 0.002 | | | 200 | 400 | 0.101 | 0.101 | |
| | 400 | 850 | 0.007 | 0.012 | 0.009 | | | 400 | 850 | 0.210 | 0.210 | |
| | 600 | 1300 | 0.021 | 0.023 | 0.022 | | | 0 | 0 | 0.030 | 0.030 | |
| | 800 | 1800 | 0.056 | 0.053 | 0.054 | | | 200 | 400 | 0.128 | 0.128 | |
| | 1000 | 2300 | 0.135 | 0.129 | 0.132 | | | 400 | 850 | 0.213 | 0.213 | |
| | 1200 | 2850 | 0.191 | 0.184 | 0.187 | | | 600 | 1300 | 0.310 | 0.310 | |
| | 1400 | 3450 | 0.257 | 0.248 | 0.252 | | | 800 | 1800 | 0.438 | 0.438 | |
| | 1600 | 3950 | 0.325 | 0.315 | 0.320 | | | 0 | 0 | 0.094 | 0.094 | |
| | 1800 | 4450 | 0.389 | 0.379 | 0.384 | | | 400 | 850 | 0.286 | 0.286 | |
| 10:07 | 2000 | 5000 | 0.457 | 0.443 | 0.450 | | | 600 | 1300 | 0.375 | 0.375 | |
| 10:12 | 2000 | 5000 | 0.486 | 0.471 | 0.478 | | | 800 | 1800 | 0.456 | 0.456 | |
| | 0 | 0 | 0.463 | 0.452 | 0.458 | | | 1000 | 2300 | 0.545 | 0.545 | |
| | | | | | | | | 0 | 0 | 0.128 | 0.128 | |
| | | | | | | | | 400 | 850 | 0.326 | 0.326 | |
| | | | | | | | | 800 | 1800 | 0.497 | 0.497 | |
| | | | | | | | | 1000 | 2300 | 0.564 | 0.564 | |
| | | | | | | | | 1200 | 2850 | 0.643 | 0.643 | |
| | | | | | | | | 1400 | 3450 | 0.745 | 0.745 | |
| | | | | | | | 10:28 | 0 | 0 | 0.201 | 0.201 | |

Notes:





EARTH SYSTEMS SOUTHWEST

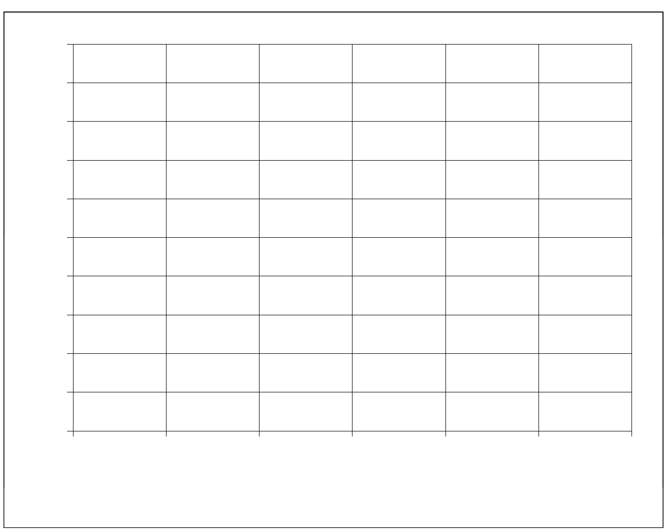
* - Gages reading positive with vertical displacement

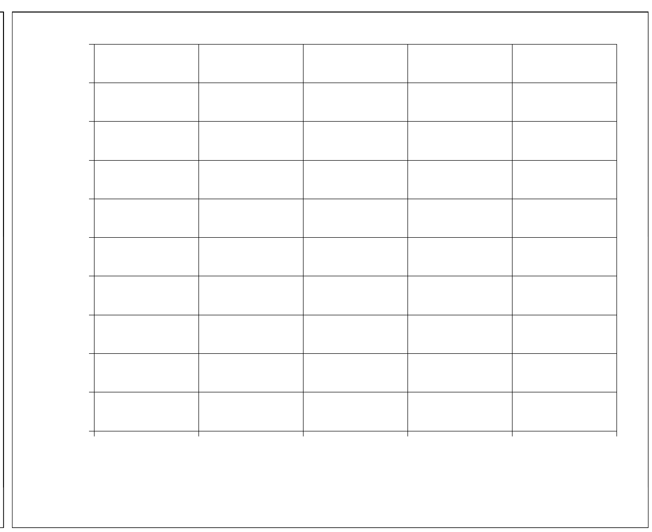
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-15A |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 2:15 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 2:25 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.041 | 0.042 | 0.041 | | | 200 | 400 | 0.173 | 0.173 | |
| | 400 | 850 | 0.153 | 0.155 | 0.154 | | | 400 | 850 | 0.276 | 0.276 | |
| | 600 | 1300 | 0.274 | 0.278 | 0.276 | | | 0 | 0 | 0.072 | 0.072 | |
| | 800 | 1800 | 0.397 | 0.402 | 0.400 | | | 200 | 400 | 0.216 | 0.216 | |
| | 1000 | 2300 | 0.525 | 0.531 | 0.528 | | | 400 | 850 | 0.294 | 0.294 | |
| | 1200 | 2850 | 0.706 | 0.714 | 0.710 | | | 600 | 1300 | 0.414 | 0.414 | |
| | 1400 | 3450 | 0.842 | 0.847 | 0.844 | | | 800 | 1800 | 0.550 | 0.550 | |
| 2:18 | 1600 | 3950 | 1.032 | 1.012 | 1.022 | | | 0 | 0 | 0.166 | 0.166 | |
| | 0 | 0 | 0.881 | 0.878 | 0.880 | | | 400 | 850 | 0.436 | 0.436 | |
| | | | | | | | | 600 | 1300 | 0.515 | 0.515 | |
| | | | | | | | | 800 | 1800 | 0.586 | 0.586 | |
| | | | | | | | | 1000 | 2300 | 0.731 | 0.731 | |
| | | | | | | | | 0 | 0 | 0.276 | 0.276 | |
| | | | | | | | | 400 | 850 | 0.549 | 0.549 | |
| | | | | | | | | 800 | 1800 | 0.699 | 0.699 | |
| | | | | | | | | 1000 | 2300 | 0.780 | 0.780 | |
| | | | | | | | | 1200 | 2850 | 0.922 | 0.922 | |
| | | | | | | | 2:32 | 0 | 0 | 0.393 | 0.393 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

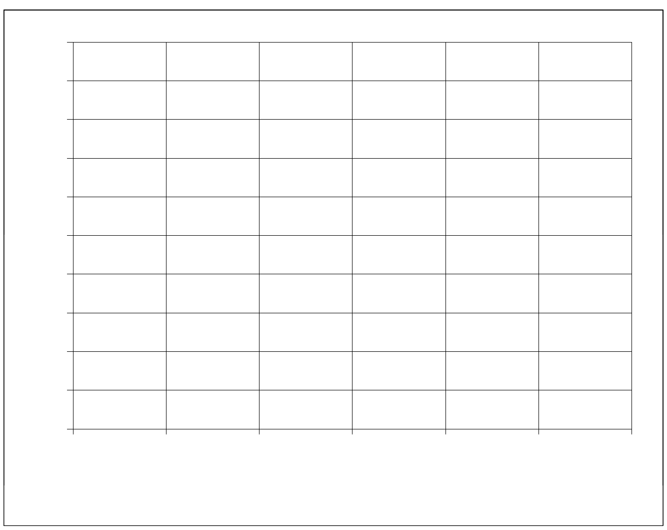
# Desert Sunlight Solar Farm, Desert Center, California

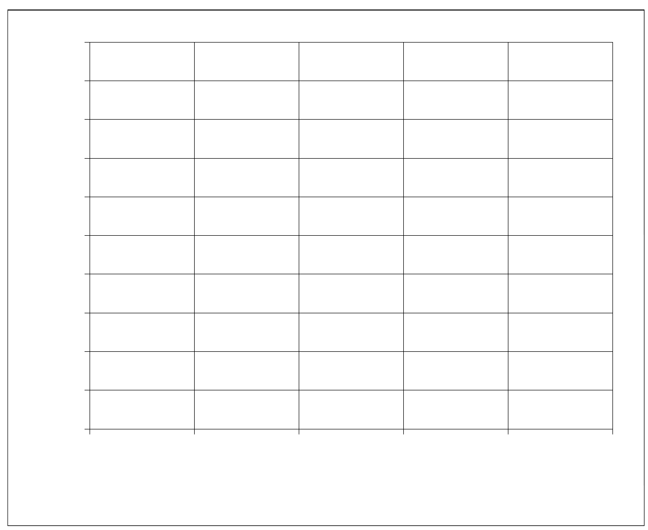
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-15B |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 1:34 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 1:57 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.003 | 0.000 | 0.002 | | | 200 | 400 | 0.047 | 0.047 | |
| | 400 | 850 | 0.007 | 0.003 | 0.005 | | | 400 | 850 | 0.152 | 0.152 | |
| | 600 | 1300 | 0.014 | 0.010 | 0.012 | | | 0 | 0 | 0.014 | 0.014 | |
| | 800 | 1800 | 0.033 | 0.029 | 0.031 | | | 200 | 400 | 0.094 | 0.094 | |
| | 1000 | 2300 | 0.057 | 0.053 | 0.055 | | | 400 | 850 | 0.166 | 0.166 | |
| | 1200 | 2850 | 0.095 | 0.090 | 0.092 | | | 600 | 1300 | 0.279 | 0.279 | |
| | 1400 | 3450 | 0.137 | 0.134 | 0.135 | | | 800 | 1800 | 0.392 | 0.392 | |
| | 1600 | 3950 | 0.170 | 0.168 | 0.169 | | | 0 | 0 | 0.004 | 0.004 | |
| | 1800 | 4450 | 0.223 | 0.211 | 0.217 | | | 400 | 850 | 0.263 | 0.263 | |
| 1:40 | 2000 | 5000 | 0.282 | 0.264 | 0.273 | | | 600 | 1300 | 0.331 | 0.331 | |
| 1:45 | 2000 | 5000 | 0.293 | 0.277 | 0.285 | | | 800 | 1800 | 0.428 | 0.428 | |
| | 0 | 0 | 0.222 | 0.226 | 0.224 | | | 1000 | 2300 | 0.536 | 0.536 | |
| | | | | | | | | 0 | 0 | 0.026 | 0.026 | |
| | | | | | | | | 400 | 850 | 0.326 | 0.326 | |
| | | | | | | | | 800 | 1800 | 0.481 | 0.481 | |
| | | | | | | | | 1000 | 2300 | 0.575 | 0.575 | |
| | | | | | | | | 1200 | 2850 | 0.688 | 0.688 | |
| | | | | | | | | 1400 | 3450 | 0.790 | 0.790 | |
| | | | | | | | 2:07 | 0 | 0 | 0.100 | 0.100 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-16A |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

**Axial Tension Load Test**

| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|---|
| 12:40 | 0 | 0 | 0.000 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.001 | 0.001 | |
| | 400 | 850 | 0.010 | 0.010 | 0.010 | |
| | 600 | 1300 | 0.037 | 0.036 | 0.037 | |
| | 800 | 1800 | 0.064 | 0.063 | 0.063 | |
| | 1000 | 2300 | 0.151 | 0.148 | 0.149 | |
| | 1200 | 2850 | 0.218 | 0.215 | 0.216 | |
| | 1400 | 3450 | 0.324 | 0.320 | 0.322 | |
| | 1600 | 3950 | 0.422 | 0.418 | 0.420 | |
| | 1800 | 4450 | 0.534 | 0.528 | 0.531 | |
| 12:46 | 2000 | 5000 | 0.680 | 0.674 | 0.677 | |
| 12:51 | 2000 | 5000 | 0.725 | 0.720 | 0.723 | |
| | 0 | 0 | 0.663 | 0.662 | 0.662 | |

**Lateral Load Test**

| Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|
| 1:00 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.058 | 0.058 | |
| | 400 | 850 | 0.176 | 0.176 | |
| | 0 | 0 | 0.012 | 0.012 | |
| | 200 | 400 | 0.077 | 0.077 | |
| | 400 | 850 | 0.194 | 0.194 | |
| | 600 | 1300 | 0.389 | 0.389 | |
| | 800 | 1800 | 0.601 | 0.601 | |
| | 0 | 0 | 0.065 | 0.065 | |
| | 400 | 850 | 0.359 | 0.359 | |
| | 600 | 1300 | 0.507 | 0.507 | |
| | 800 | 1800 | 0.652 | 0.652 | |
| | 1000 | 2300 | 0.861 | 0.861 | |
| | 0 | 0 | 0.190 | 0.190 | |
| | 400 | 850 | 0.508 | 0.508 | |
| | 800 | 1800 | 0.774 | 0.774 | |
| | 1000 | 2300 | 0.861 | 0.861 | |
| 1:10 | 0 | 0 | 0.240 | 0.240 | |

Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

## Desert Sunlight Solar Farm, Desert Center, California

### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-16B |
| Date: | |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 12:03 | 0 | 0 | 0.001 | 0.000 | 0.000 | | 12:23 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.000 | 0.000 | | | 200 | 400 | 0.166 | 0.166 | |
| | 400 | 850 | 0.002 | 0.000 | 0.001 | | | 400 | 850 | 0.349 | 0.349 | |
| | 600 | 1300 | 0.008 | 0.001 | 0.004 | | | 0 | 0 | 0.066 | 0.066 | |
| | 800 | 1800 | 0.022 | 0.001 | 0.011 | | | 200 | 400 | 0.240 | 0.240 | |
| | 1000 | 2300 | 0.030 | 0.006 | 0.017 | | | 400 | 850 | 0.365 | 0.365 | |
| | 1200 | 2850 | 0.045 | 0.011 | 0.028 | | | 600 | 1300 | 0.473 | 0.473 | |
| | 1400 | 3450 | 0.071 | 0.032 | 0.051 | | | 800 | 1800 | 0.576 | 0.576 | |
| | 1600 | 3950 | 0.104 | 0.057 | 0.080 | | | 0 | 0 | 0.075 | 0.075 | |
| | 1800 | 4450 | 0.144 | 0.090 | 0.116 | | | 400 | 850 | 0.385 | 0.385 | |
| 12:09 | 2000 | 5000 | 0.206 | 0.143 | 0.174 | | | 600 | 1300 | 0.531 | 0.531 | |
| 12:14 | 2000 | 5000 | 0.221 | 0.154 | 0.187 | | | 800 | 1800 | 0.688 | 0.688 | |
| | 0 | 0 | 0.169 | 0.149 | 0.158 | | | 1000 | 2300 | 0.913 | 0.913 | |
| | | | | | | | | 0 | 0 | 0.152 | 0.152 | |
| | | | | | | | | 400 | 850 | 0.512 | 0.512 | |
| | | | | | | | | 800 | 1800 | 0.801 | 0.801 | |
| | | | | | | | | 1000 | 2300 | 0.939 | 0.939 | |
| | | | | | | | | 1200 | 2850 | 1.070 | 1.070 | |
| | | | | | | | | 0 | 0 | 0.279 | 0.279 | |

Notes:

EARTH SYSTEMS SOUTHWEST

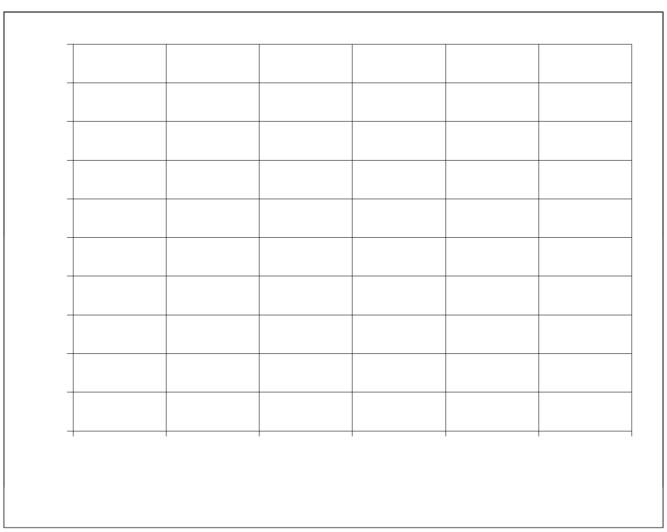
* - Gages reading positive with vertical displacement

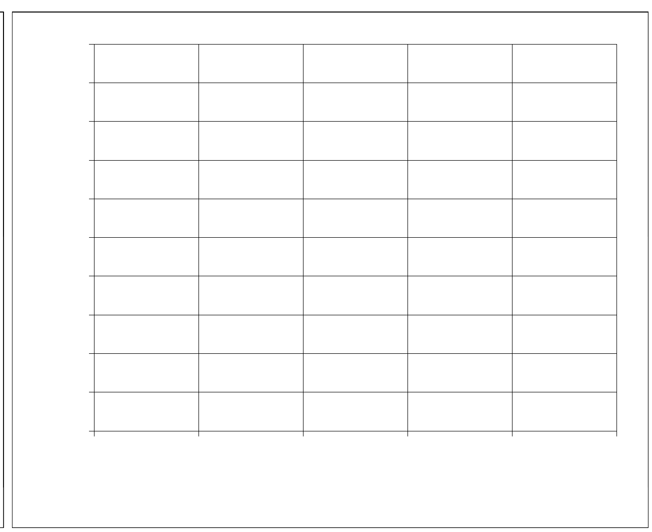
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-17A |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 11:12 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:22 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.018 | 0.007 | 0.013 | | | 200 | 400 | 0.084 | 0.084 | |
| | 400 | 850 | 0.230 | 0.201 | 0.215 | | | 400 | 850 | 0.270 | 0.270 | |
| | 600 | 1300 | 0.563 | 0.520 | 0.542 | | | 0 | 0 | 0.014 | 0.014 | |
| | 800 | 1800 | 0.787 | 0.736 | 0.762 | | | 200 | 400 | 0.158 | 0.158 | |
| | 1000 | 2300 | 0.883 | 0.899 | 0.891 | | | 400 | 850 | 0.279 | 0.279 | |
| | | | | | | | | 600 | 1300 | 0.473 | 0.473 | |
| | | | | | | | | 800 | 1800 | 0.709 | 0.709 | |
| | | | | | | | | 0 | 0 | 0.128 | 0.128 | |
| | | | | | | | | 400 | 850 | 0.498 | 0.498 | |
| | | | | | | | | 600 | 1300 | 0.607 | 0.607 | |
| | | | | | | | | 800 | 1800 | 0.750 | 0.750 | |
| | | | | | | | | 1000 | 2300 | 0.970 | 0.970 | |
| | | | | | | | | 0 | 0 | 0.254 | 0.254 | |
| | | | | | | | | 400 | 850 | 0.632 | 0.632 | |
| | | | | | | | | 800 | 1800 | 0.888 | 0.888 | |
| | | | | | | | | 0 | 0 | 0.295 | 0.295 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Notes: 1" + @ 970 lbs Lat , 1" + @ 1100 lbs Vert.





EARTH SYSTEMS SOUTHWEST

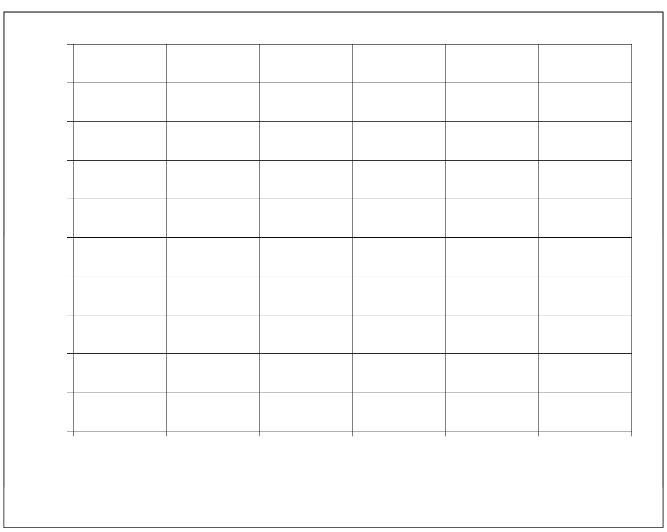
* - Gages reading positive with vertical displacement

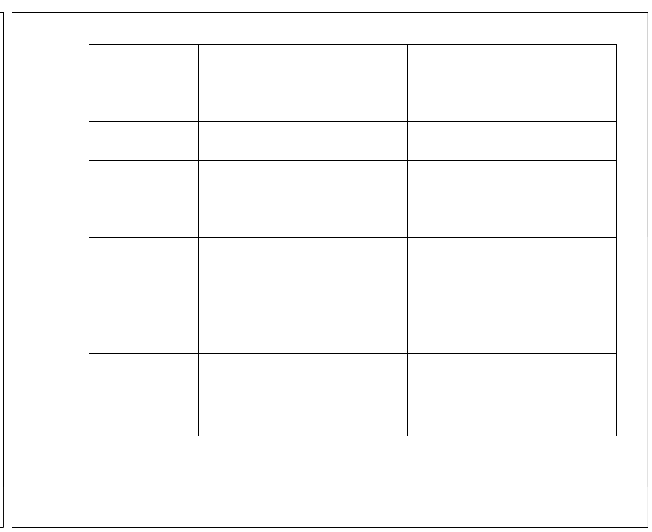
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-17B |
| Date: | 12/15/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:40 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 11:00 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.124 | 0.124 | |
| | 400 | 850 | 0.003 | 0.000 | 0.002 | | | 400 | 850 | 0.266 | 0.266 | |
| | 600 | 1300 | 0.005 | 0.000 | 0.002 | | | 0 | 0 | 0.041 | 0.041 | |
| | 800 | 1800 | 0.008 | 0.002 | 0.005 | | | 200 | 400 | 0.178 | 0.178 | |
| | 1000 | 2300 | 0.012 | 0.004 | 0.008 | | | 400 | 850 | 0.283 | 0.283 | |
| | 1200 | 2850 | 0.019 | 0.007 | 0.013 | | | 600 | 1300 | 0.434 | 0.434 | |
| | 1400 | 3450 | 0.029 | 0.012 | 0.020 | | | 800 | 1800 | 0.608 | 0.608 | |
| | 1600 | 3950 | 0.041 | 0.018 | 0.030 | | | 0 | 0 | 0.127 | 0.127 | |
| | 1800 | 4450 | 0.057 | 0.029 | 0.043 | | | 400 | 850 | 0.424 | 0.424 | |
| 10:43 | 2000 | 5000 | 0.078 | 0.044 | 0.061 | | | 600 | 1300 | 0.526 | 0.526 | |
| 10:47 | 2000 | 5000 | 0.085 | 0.050 | 0.067 | | | 800 | 1800 | 0.635 | 0.635 | |
| | 0 | 0 | 0.051 | 0.040 | 0.045 | | | 1000 | 2300 | 0.781 | 0.781 | |
| | | | | | | | | 0 | 0 | 0.197 | 0.197 | |
| | | | | | | | | 400 | 850 | 0.500 | 0.500 | |
| | | | | | | | | 800 | 1800 | 0.712 | 0.712 | |
| | | | | | | | | 1000 | 2300 | 0.812 | 0.812 | |
| | | | | | | | | 1200 | 2850 | 0.982 | 0.982 | |
| | | | | | | | | 0 | 0 | 0.316 | 0.316 | |
| | | | | | | | | | | | | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

## Desert Sunlight Solar Farm, Desert Center, California
### Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-18A
Date: 12/15/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **48**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:43 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 10:07 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.004 | 0.000 | 0.002 | | | 200 | 400 | 0.160 | 0.160 | |
| | 400 | 850 | 0.007 | 0.000 | 0.003 | | | 400 | 850 | 0.354 | 0.354 | |
| | 600 | 1300 | 0.021 | 0.000 | 0.011 | | | 0 | 0 | 0.064 | 0.064 | |
| | 800 | 1800 | 0.041 | 0.007 | 0.024 | | | 200 | 400 | 0.228 | 0.228 | |
| | 1000 | 2300 | 0.067 | 0.026 | 0.047 | | | 400 | 850 | 0.360 | 0.360 | |
| | 1200 | 2850 | 0.106 | 0.055 | 0.080 | | | 600 | 1300 | 0.526 | 0.526 | |
| | 1400 | 3450 | 0.168 | 0.104 | 0.136 | | | 800 | 1800 | 0.628 | 0.628 | |
| | 1600 | 3950 | 0.235 | 0.155 | 0.195 | | | 0 | 0 | 0.156 | 0.156 | |
| | 1800 | 4450 | 0.309 | 0.213 | 0.261 | | | 400 | 850 | 0.459 | 0.459 | |
| 9:50 | 2000 | 5000 | 0.357 | 0.249 | 0.303 | | | 600 | 1300 | 0.590 | 0.590 | |
| 9:55 | 2000 | 5000 | 0.377 | 0.265 | 0.321 | | | 800 | 1800 | 0.628 | 0.628 | |
| | 0 | 0 | 0.296 | 0.288 | 0.292 | | 10:14 | 0 | 0 | 0.097 | 0.097 | |
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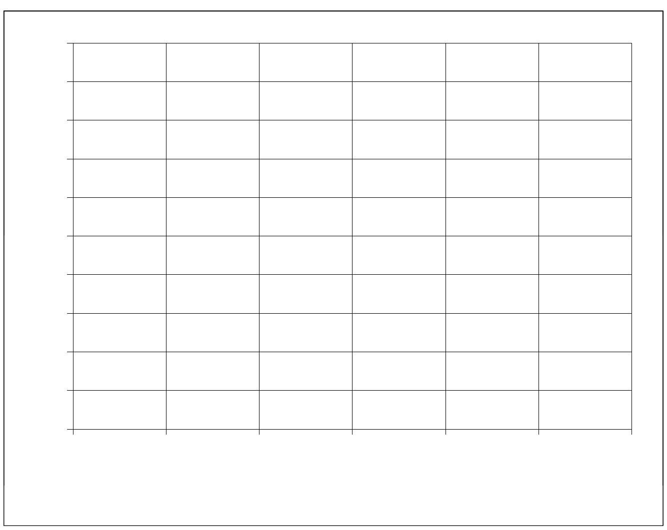
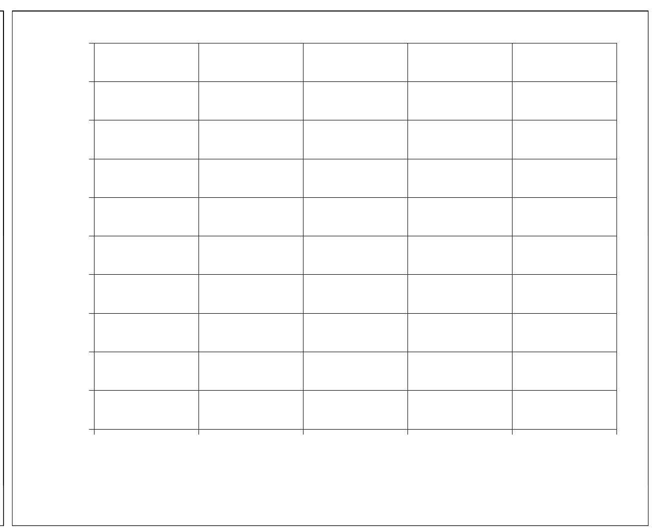
Notes:





EARTH SYSTEMS SOUTHWEST

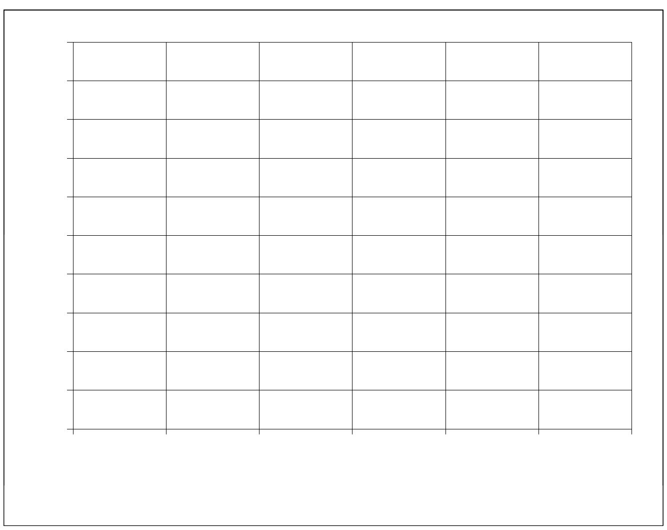
* - Gages reading positive with vertical displacement

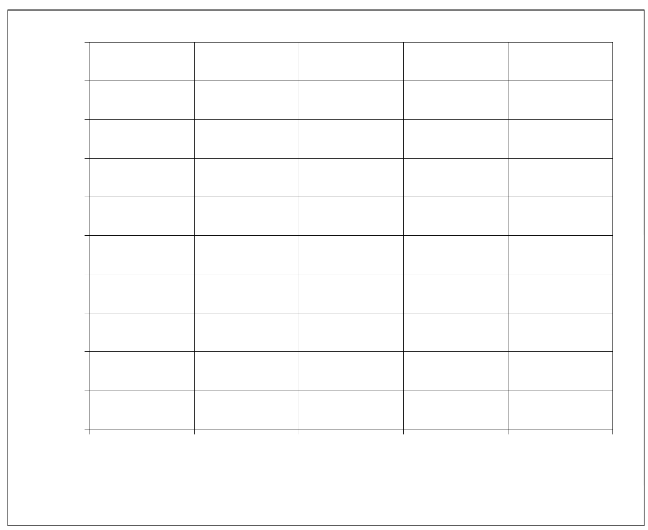
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-18B
Date: 12/15/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **36**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:12 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 9:28 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.008 | 0.003 | 0.005 | | | 200 | 400 | 0.140 | 0.140 | |
| | 400 | 850 | 0.021 | 0.014 | 0.017 | | | 400 | 850 | 0.290 | 0.290 | |
| | 600 | 1300 | 0.070 | 0.059 | 0.064 | | | 0 | 0 | 0.077 | 0.077 | |
| | 800 | 1800 | 0.157 | 0.144 | 0.150 | | | 200 | 400 | 0.189 | 0.189 | |
| | 1000 | 2300 | 0.217 | 0.205 | 0.211 | | | 400 | 850 | 0.310 | 0.310 | |
| | 1200 | 2850 | 0.269 | 0.260 | 0.265 | | | 600 | 1300 | 0.455 | 0.455 | |
| | 1400 | 3450 | 0.347 | 0.341 | 0.344 | | | 800 | 1800 | 0.620 | 0.620 | |
| | 1600 | 3950 | 0.390 | 0.388 | 0.389 | | | 0 | 0 | 0.206 | 0.206 | |
| | 1800 | 4450 | 0.440 | 0.440 | 0.440 | | | 400 | 850 | 0.503 | 0.503 | |
| 9:17 | 2000 | 5000 | 0.610 | 0.626 | 0.618 | | | 600 | 1300 | 0.592 | 0.592 | |
| 9:22 | 2000 | 5000 | 0.666 | 0.687 | 0.677 | | | 800 | 1800 | 0.703 | 0.703 | |
| | 0 | 0 | 0.617 | 0.612 | 0.614 | | | 1000 | 2300 | 0.861 | 0.861 | |
| | | | | | | | | 0 | 0 | 0.363 | 0.363 | |
| | | | | | | | | 400 | 850 | 0.620 | 0.620 | |
| | | | | | | | | 800 | 1800 | 0.810 | 0.810 | |
| | | | | | | | | 1000 | 2300 | 0.867 | 0.867 | |
| | | | | | | | 9:37 | 0 | 0 | 0.408 | 0.408 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

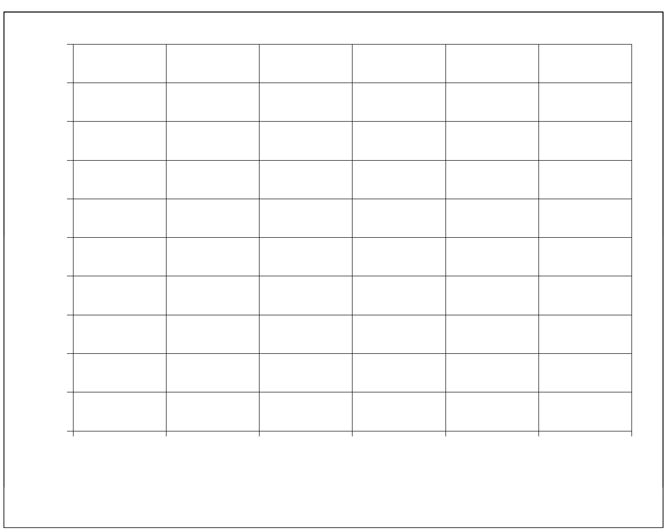
# Desert Sunlight Solar Farm, Desert Center, California

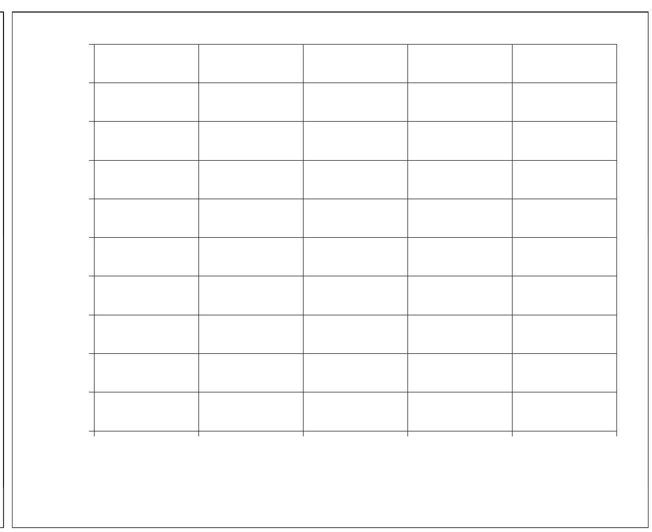
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-19A |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:18 | 0 | 0 | -0.001 | 0.002 | 0.000 | | 10:55 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | -0.001 | 0.002 | 0.000 | | | 200 | 400 | 0.088 | 0.088 | |
| | 400 | 850 | 0.000 | 0.003 | 0.001 | | | 400 | 850 | 0.169 | 0.169 | |
| | 600 | 1300 | 0.002 | 0.005 | 0.003 | | | 0 | 0 | 0.032 | 0.032 | |
| | 800 | 1800 | 0.006 | 0.009 | 0.007 | | | 200 | 400 | 0.125 | 0.125 | |
| | 1000 | 2300 | 0.017 | 0.018 | 0.017 | | | 400 | 850 | 0.174 | 0.174 | |
| | 1200 | 2850 | 0.031 | 0.027 | 0.029 | | | 600 | 1300 | 0.255 | 0.255 | |
| | 1400 | 3450 | 0.048 | 0.048 | 0.048 | | | 800 | 1800 | 0.362 | 0.362 | |
| | 1600 | 3950 | 0.066 | 0.070 | 0.067 | | | 0 | 0 | 0.041 | 0.041 | |
| | 1800 | 4450 | 0.095 | 0.098 | 0.096 | | | 400 | 850 | 0.248 | 0.248 | |
| 10:25 | 2000 | 5000 | 0.145 | 0.146 | 0.145 | | | 600 | 1300 | 0.310 | 0.310 | |
| 10:30 | 2000 | 5000 | 0.154 | 0.155 | 0.154 | | | 800 | 1800 | 0.381 | 0.381 | |
| | 0 | 0 | 0.123 | 0.126 | 0.124 | | | 1000 | 2300 | 0.484 | 0.484 | |
| | | | | | | | | 0 | 0 | 0.063 | 0.063 | |
| | | | | | | | | 400 | 850 | 0.291 | 0.291 | |
| | | | | | | | | 800 | 1800 | 0.427 | 0.427 | |
| | | | | | | | | 1000 | 2300 | 0.503 | 0.503 | |
| | | | | | | | | 1200 | 2850 | 0.600 | 0.600 | |
| | | | | | | | | 1400 | 3450 | 0.705 | 0.705 | |
| | | | | | | | 11:05 | 0 | 0 | 0.132 | 0.132 | |

Notes:





EARTH SYSTEMS SOUTHWEST

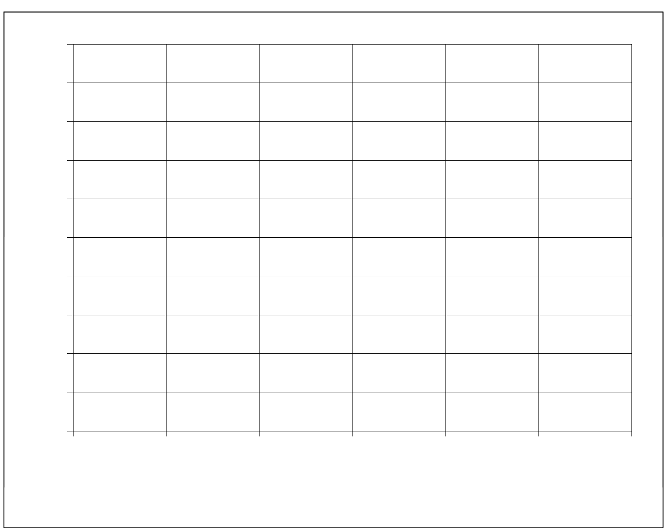
* - Gages reading positive with vertical displacement

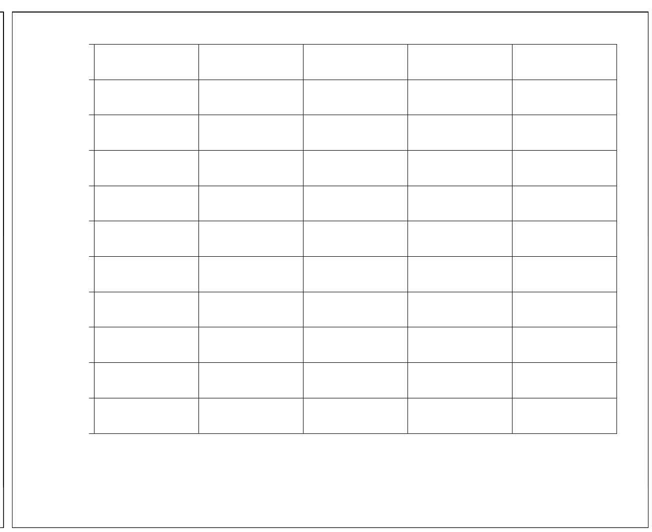
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-19B
Date: 12/16/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **60**
Jack: 12 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:57 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 10:43 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.119 | 0.119 | |
| | 400 | 850 | 0.000 | 0.002 | 0.001 | | | 400 | 850 | 0.234 | 0.234 | |
| | 600 | 1300 | 0.000 | 0.004 | 0.002 | | | 0 | 0 | 0.027 | 0.027 | |
| | 800 | 1800 | 0.007 | 0.007 | 0.007 | | | 200 | 400 | 0.177 | 0.177 | |
| | 1000 | 2300 | 0.008 | 0.010 | 0.009 | | | 400 | 850 | 0.252 | 0.252 | |
| | 1200 | 2850 | 0.014 | 0.002 | 0.008 | | | 600 | 1300 | 0.359 | 0.359 | |
| | 1400 | 3450 | 0.016 | 0.030 | 0.023 | | | 800 | 1800 | 0.500 | 0.500 | |
| | 1600 | 3950 | 0.026 | 0.040 | 0.033 | | | 0 | 0 | 0.047 | 0.047 | |
| | 1800 | 4450 | 0.035 | 0.049 | 0.042 | | | 400 | 850 | 0.357 | 0.357 | |
| 10:02 | 2000 | 5000 | 0.048 | 0.060 | 0.054 | | | 600 | 1300 | 0.443 | 0.443 | |
| 10:07 | 2000 | 5000 | 0.051 | 0.064 | 0.058 | | | 800 | 1800 | 0.526 | 0.526 | |
| | 0 | 0 | 0.043 | 0.038 | 0.040 | | | 1000 | 2300 | 0.654 | 0.654 | |
| | | | | | | | | 0 | 0 | 0.100 | 0.100 | |
| | | | | | | | | 400 | 850 | 0.403 | 0.403 | |
| | | | | | | | | 800 | 1800 | 0.598 | 0.598 | |
| | | | | | | | | 1000 | 2300 | 0.713 | 0.713 | |
| | | | | | | | | 1200 | 2850 | 0.840 | 0.840 | |
| | | | | | | | | | | | | |
| | | | | | | | 10:53 | 0 | 0 | 0.168 | 0.168 | |

Notes:





EARTH SYSTEMS SOUTHWEST

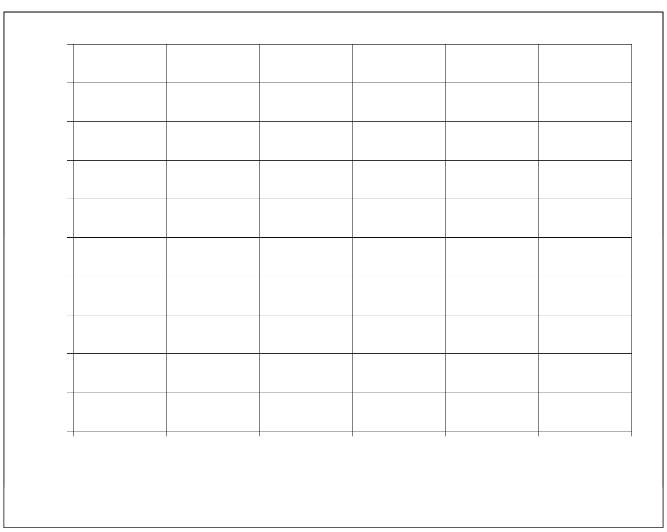
* - Gages reading positive with vertical displacement

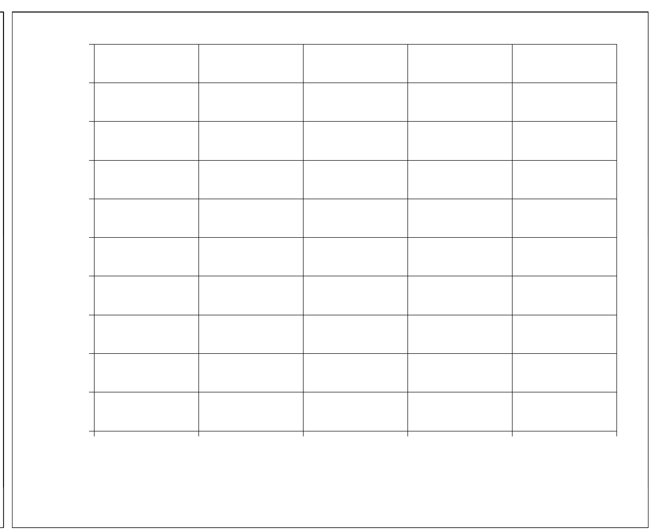
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-20A |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 8:58 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 9:18 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.000 | 0.000 | | | 200 | 400 | 0.062 | 0.062 | |
| | 400 | 850 | 0.000 | 0.002 | 0.001 | | | 400 | 850 | 0.120 | 0.120 | |
| | 600 | 1300 | 0.000 | 0.002 | 0.001 | | | 0 | 0 | 0.038 | 0.038 | |
| | 800 | 1800 | 0.008 | 0.011 | 0.009 | | | 200 | 400 | 0.091 | 0.091 | |
| | 1000 | 2300 | 0.024 | 0.025 | 0.025 | | | 400 | 850 | 0.127 | 0.127 | |
| | 1200 | 2850 | 0.051 | 0.048 | 0.049 | | | 600 | 1300 | 0.186 | 0.186 | |
| | 1400 | 3450 | 0.083 | 0.076 | 0.080 | | | 800 | 1800 | 0.263 | 0.263 | |
| | 1600 | 3950 | 0.113 | 0.102 | 0.107 | | | 0 | 0 | 0.053 | 0.053 | |
| | 1800 | 4450 | 0.144 | 0.127 | 0.135 | | | 400 | 850 | 0.196 | 0.196 | |
| 9:04 | 2000 | 5000 | 0.176 | 0.155 | 0.165 | | | 600 | 1300 | 0.229 | 0.229 | |
| 9:09 | 2000 | 5000 | 0.182 | 0.160 | 0.171 | | | 800 | 1800 | 0.281 | 0.281 | |
| | 0 | 0 | 0.143 | 0.138 | 0.140 | | | 1000 | 2300 | 0.347 | 0.347 | |
| | | | | | | | | 0 | 0 | 0.067 | 0.067 | |
| | | | | | | | | 400 | 850 | 0.222 | 0.222 | |
| | | | | | | | | 800 | 1800 | 0.315 | 0.315 | |
| | | | | | | | | 1000 | 2300 | 0.369 | 0.369 | |
| | | | | | | | | 1200 | 2850 | 0.446 | 0.446 | |
| | | | | | | | | 1400 | 3450 | 0.550 | 0.550 | |
| | | | | | | | 9:28 | 0 | 0 | 0.087 | 0.087 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-20B |
| Date: | 12/16/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **60** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

**Axial Tension Load Test**

| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|---|
| 8:40 | 0 | 0 | 0.001 | 0.002 | 0.000 | |
| | 200 | 400 | 0.001 | 0.002 | 0.000 | |
| | 400 | 850 | 0.004 | 0.003 | 0.002 | |
| | 600 | 1300 | 0.006 | 0.005 | 0.004 | |
| | 800 | 1800 | 0.009 | 0.010 | 0.008 | |
| | 1000 | 2300 | 0.014 | 0.017 | 0.014 | |
| | 1200 | 2850 | 0.024 | 0.023 | 0.022 | |
| | 1400 | 3450 | 0.033 | 0.029 | 0.030 | |
| | 1600 | 3950 | 0.043 | 0.042 | 0.041 | |
| | 1800 | 4450 | 0.055 | 0.051 | 0.051 | |
| 8:45 | 2000 | 5000 | 0.064 | 0.061 | 0.061 | |
| 8:50 | 2000 | 5000 | 0.068 | 0.066 | 0.066 | |
| | 0 | 0 | 0.042 | 0.041 | 0.040 | |
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**Lateral Load Test**

| Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|
| 9:27 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.085 | 0.085 | |
| | 400 | 850 | 0.151 | 0.151 | |
| | 0 | 0 | 0.022 | 0.022 | |
| | 200 | 400 | 0.114 | 0.114 | |
| | 400 | 850 | 0.158 | 0.158 | |
| | 600 | 1300 | 0.219 | 0.219 | |
| | 800 | 1800 | 0.289 | 0.289 | |
| | 0 | 0 | 0.031 | 0.031 | |
| | 400 | 850 | 0.216 | 0.216 | |
| | 600 | 1300 | 0.260 | 0.260 | |
| | 800 | 1800 | 0.309 | 0.309 | |
| | 1000 | 2300 | 0.371 | 0.371 | |
| | 0 | 0 | 0.033 | 0.033 | |
| | 400 | 850 | 0.239 | 0.239 | |
| | 800 | 1800 | 0.346 | 0.346 | |
| | 1000 | 2300 | 0.394 | 0.394 | |
| | 1200 | 2850 | 0.456 | 0.456 | |
| | 1400 | 3450 | 0.555 | 0.555 | |
| 9:37 | 0 | 0 | 0.040 | 0.040 | |

Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-21A |
| Date: | 17-Dec |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

**Axial Tension Load Test**

| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|---|
| 11:53 | 0 | 0 | -0.002 | 0.002 | 0.000 | |
| | 200 | 400 | 0.004 | 0.003 | 0.003 | |
| | 400 | 850 | 0.015 | 0.012 | 0.014 | |
| | 600 | 1300 | 0.041 | 0.036 | 0.039 | |
| | 800 | 1800 | 0.082 | 0.074 | 0.078 | |
| | 1000 | 2300 | 0.127 | 0.117 | 0.122 | |
| | 1200 | 2850 | 0.175 | 0.163 | 0.169 | |
| | 1400 | 3450 | 0.232 | 0.223 | 0.228 | |
| | 1600 | 3950 | 0.280 | 0.274 | 0.277 | |
| | 1800 | 4450 | 0.341 | 0.333 | 0.337 | |
| 12:03 | 2000 | 5000 | 0.423 | 0.415 | 0.419 | |
| 12:08 | 2000 | 5000 | 0.443 | 0.439 | 0.441 | |
| | 0 | 0 | 0.390 | 0.387 | 0.389 | |

**Lateral Load Test**

| Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
|---|---|---|---|---|---|
| 12:17 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.102 | 0.102 | |
| | 400 | 850 | 0.190 | 0.190 | |
| | 0 | 0 | 0.044 | 0.044 | |
| | 200 | 400 | 0.135 | 0.135 | |
| | 400 | 850 | 0.196 | 0.196 | |
| | 600 | 1300 | 0.273 | 0.273 | |
| | 800 | 1800 | 0.349 | 0.349 | |
| | 0 | 0 | 0.073 | 0.073 | |
| | 400 | 850 | 0.252 | 0.252 | |
| | 600 | 1300 | 0.312 | 0.312 | |
| | 800 | 1800 | 0.375 | 0.375 | |
| | 1000 | 2300 | 0.448 | 0.448 | |
| | 0 | 0 | 0.104 | 0.104 | |
| | 400 | 850 | 0.295 | 0.295 | |
| | 800 | 1800 | 0.407 | 0.407 | |
| | 1000 | 2300 | 0.469 | 0.469 | |
| | 1200 | 2850 | 0.554 | 0.554 | |
| | 1400 | 3450 | 0.791 | 0.791 | |
| 12:27 | 0 | 0 | 0.165 | 0.165 | |

Notes:

EARTH SYSTEMS SOUTHWEST

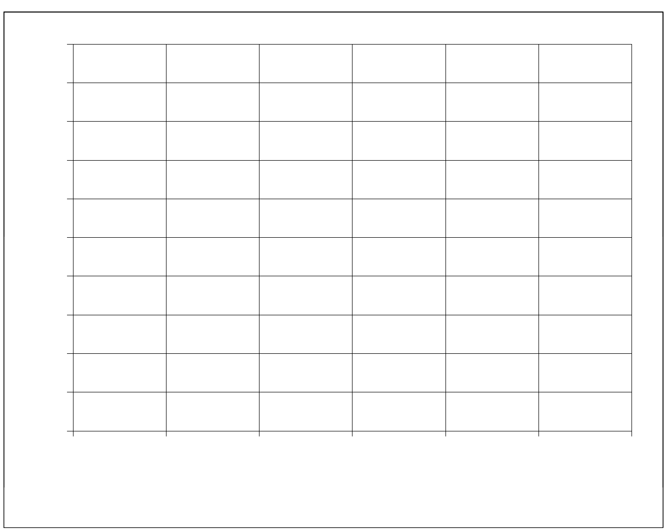
* - Gages reading positive with vertical displacement

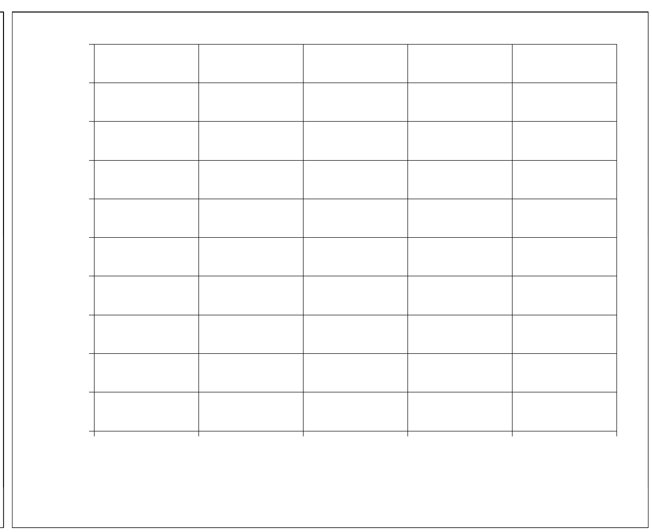
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-21B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **56** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 11:34 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 12:31 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.002 | 0.001 | | | 200 | 400 | 0.083 | 0.083 | |
| | 400 | 850 | 0.011 | 0.014 | 0.013 | | | 400 | 850 | 0.159 | 0.159 | |
| | 600 | 1300 | 0.028 | 0.030 | 0.029 | | | 0 | 0 | 0.017 | 0.017 | |
| | 800 | 1800 | 0.055 | 0.055 | 0.055 | | | 200 | 400 | 0.117 | 0.117 | |
| | 1000 | 2300 | 0.069 | 0.825 | 0.447 | | | 400 | 850 | 0.172 | 0.172 | |
| | 1200 | 2850 | 0.118 | 0.113 | 0.116 | | | 600 | 1300 | 0.250 | 0.250 | |
| | 1400 | 3450 | 0.169 | 0.162 | 0.165 | | | 800 | 1800 | 0.371 | 0.371 | |
| | 1600 | 3950 | 0.224 | 0.211 | 0.217 | | | 0 | 0 | 0.044 | 0.044 | |
| | 1800 | 4450 | 0.280 | 0.265 | 0.272 | | | 400 | 850 | 0.256 | 0.256 | |
| 11:40 | 2000 | 5000 | 0.335 | 0.316 | 0.326 | | | 600 | 1300 | 0.328 | 0.328 | |
| 11:45 | 2000 | 5000 | 0.350 | 0.331 | 0.340 | | | 800 | 1800 | 0.381 | 0.381 | |
| | 0 | 0 | 0.294 | 0.289 | 0.291 | | | 1000 | 2300 | 0.493 | 0.493 | |
| | | | | | | | | 0 | 0 | 0.077 | 0.077 | |
| | | | | | | | | 400 | 850 | 0.313 | 0.313 | |
| | | | | | | | | 800 | 1800 | 0.451 | 0.451 | |
| | | | | | | | | 1000 | 2300 | 0.514 | 0.514 | |
| | | | | | | | | 1200 | 2850 | 0.644 | 0.644 | |
| | | | | | | | | 1400 | 3450 | 0.854 | 0.854 | |
| | | | | | | | 12:41 | 0 | 0 | 0.155 | 0.155 | |

Notes:





EARTH SYSTEMS SOUTHWEST

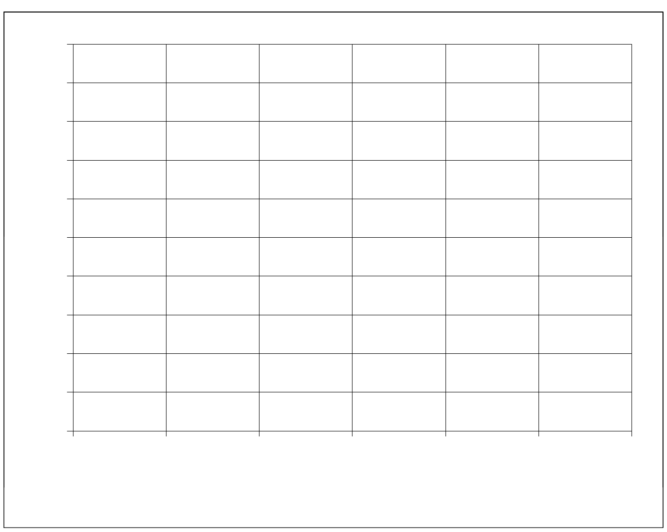
* - Gages reading positive with vertical displacement

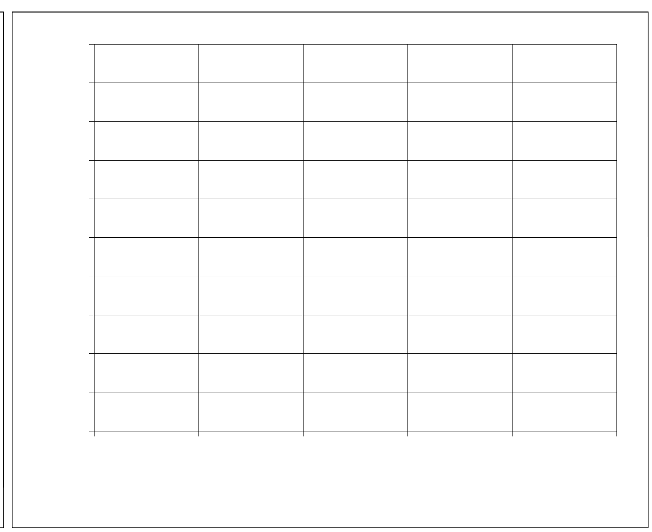
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-22A |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:15 | 0 | 0 | 0.000 | 0.002 | 0.000 | | 11:07 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.002 | 0.004 | 0.002 | | | 200 | 400 | 0.073 | 0.073 | |
| | 400 | 850 | 0.007 | 0.008 | 0.007 | | | 400 | 850 | 0.138 | 0.138 | |
| | 600 | 1300 | 0.012 | 0.014 | 0.012 | | | 0 | 0 | 0.017 | 0.017 | |
| | 800 | 1800 | 0.020 | 0.022 | 0.020 | | | 200 | 400 | 0.096 | 0.096 | |
| | 1000 | 2300 | 0.032 | 0.032 | 0.031 | | | 400 | 850 | 0.143 | 0.143 | |
| | 1200 | 2850 | 0.047 | 0.041 | 0.043 | | | 600 | 1300 | 0.207 | 0.207 | |
| | 1400 | 3450 | 0.062 | 0.052 | 0.056 | | | 800 | 1800 | 0.277 | 0.277 | |
| | 1600 | 3950 | 0.081 | 0.066 | 0.073 | | | 0 | 0 | 0.052 | 0.052 | |
| | 1800 | 4450 | 0.097 | 0.080 | 0.088 | | | 400 | 850 | 0.204 | 0.204 | |
| 10:21 | 2000 | 5000 | 0.115 | 0.095 | 0.104 | | | 600 | 1300 | 0.248 | 0.248 | |
| 10:26 | 2000 | 5000 | 0.119 | 0.101 | 0.109 | | | 800 | 1800 | 0.293 | 0.293 | |
| | 0 | 0 | 0.081 | 0.081 | 0.080 | | | 1000 | 2300 | 0.353 | 0.353 | |
| | | | | | | | | 0 | 0 | 0.079 | 0.079 | |
| | | | | | | | | 400 | 850 | 0.233 | 0.233 | |
| | | | | | | | | 800 | 1800 | 0.329 | 0.329 | |
| | | | | | | | | 1000 | 2300 | 0.371 | 0.371 | |
| | | | | | | | | 1200 | 2850 | 0.430 | 0.430 | |
| | | | | | | | | 1400 | 3450 | 0.495 | 0.495 | |
| | | | | | | | 11:17 | 0 | 0 | 0.124 | 0.124 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

## Desert Sunlight Solar Farm, Desert Center, California
### Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-22B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **58** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 10:34 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 10:53 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.001 | 0.001 | 0.001 | | | 200 | 400 | 0.095 | 0.095 | |
| | 400 | 850 | 0.004 | 0.001 | 0.003 | | | 400 | 850 | 0.199 | 0.199 | |
| | 600 | 1300 | 0.006 | 0.000 | 0.003 | | | 0 | 0 | 0.024 | 0.024 | |
| | 800 | 1800 | 0.009 | 0.001 | 0.005 | | | 200 | 400 | 0.130 | 0.130 | |
| | 1000 | 2300 | 0.015 | -0.001 | 0.007 | | | 400 | 850 | 0.204 | 0.204 | |
| | 1200 | 2850 | 0.013 | 0.002 | 0.008 | | | 600 | 1300 | 0.291 | 0.291 | |
| | 1400 | 3450 | 0.013 | 0.005 | 0.009 | | | 800 | 1800 | 0.385 | 0.385 | |
| | 1600 | 3950 | 0.017 | 0.007 | 0.012 | | | 0 | 0 | 0.050 | 0.050 | |
| | 1800 | 4450 | 0.023 | 0.009 | 0.016 | | | 400 | 850 | 0.263 | 0.263 | |
| 10:40 | 2000 | 5000 | 0.031 | 0.013 | 0.022 | | | 600 | 1300 | 0.319 | 0.319 | |
| 10:45 | 2000 | 5000 | 0.033 | 0.015 | 0.024 | | | 800 | 1800 | 0.392 | 0.392 | |
| | 0 | 0 | 0.014 | 0.012 | 0.013 | | | 1000 | 2300 | 0.508 | 0.508 | |
| | | | | | | | | 0 | 0 | 0.075 | 0.075 | |
| | | | | | | | | 400 | 850 | 0.283 | 0.283 | |
| | | | | | | | | 800 | 1800 | 0.444 | 0.444 | |
| | | | | | | | | 1000 | 2300 | 0.519 | 0.519 | |
| | | | | | | | | 1200 | 2850 | 0.639 | 0.639 | |
| | | | | | | | | 1400 | 3450 | 0.792 | 0.792 | |
| | | | | | | | 11:03 | 0 | 0 | 0.160 | 0.160 | |

Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California

## Pile Load Testing

Location: Desert Sunlight Solar Farm, Desert Center, CA
Test No.: PT-23A
Date: 12/18/2009
Pile Size: W6 x 7.2
Driven Depth (in.): **48**
Jack: 20 Tonn
Lateral Gage Position: 1 inch above grade

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:28 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 9:45 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.002 | 0.001 | 0.002 | | | 500 | 500 | 0.025 | 0.025 | |
| | 1000 | 1000 | 0.004 | 0.003 | 0.004 | | | 750 | 750 | 0.053 | 0.053 | |
| | 1500 | 1500 | 0.008 | 0.006 | 0.007 | | | 0 | 0 | 0.017 | 0.017 | |
| | 2000 | 2000 | 0.015 | 0.012 | 0.014 | | | 500 | 500 | 0.038 | 0.038 | |
| | 2500 | 2500 | 0.028 | 0.024 | 0.026 | | | 750 | 750 | 0.064 | 0.064 | |
| | 3000 | 3000 | 0.043 | 0.039 | 0.041 | | | 1000 | 1000 | 0.099 | 0.099 | |
| | 3500 | 3500 | 0.065 | 0.059 | 0.062 | | | 1500 | 1500 | 0.173 | 0.173 | |
| | 4000 | 4000 | 0.081 | 0.075 | 0.078 | | | 0 | 0 | 0.050 | 0.050 | |
| | 4500 | 4500 | 0.101 | 0.098 | 0.100 | | | 750 | 750 | 0.116 | 0.116 | |
| 9:35 | 5000 | 5000 | 0.124 | 0.121 | 0.123 | | | 1500 | 1500 | 0.195 | 0.195 | |
| 9:40 | 5000 | 5000 | 0.128 | 0.126 | 0.127 | | | 1750 | 1750 | 0.217 | 0.217 | |
| | 0 | 0 | 0.097 | 0.092 | 0.095 | | | 2000 | 2000 | 0.260 | 0.260 | |
| | | | | | | | | 0 | 0 | 0.072 | 0.072 | |
| | | | | | | | | 750 | 750 | 0.149 | 0.149 | |
| | | | | | | | | 1500 | 1500 | 0.227 | 0.227 | |
| | | | | | | | | 2000 | 2000 | 0.281 | 0.281 | |
| | | | | | | | | 2500 | 2500 | 0.347 | 0.347 | |
| | | | | | | | | 3000 | 3000 | 0.437 | 0.437 | |
| | | | | | | | 9:55 | 0 | 0 | 0.123 | 0.123 | |

Notes:

EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-23B |
| Date: | 12/18/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 20 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 9:07 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 9:53 | 0 | 0 | 0.000 | 0.000 | |
| | 500 | 500 | 0.000 | 0.000 | 0.000 | | | 500 | 500 | 0.066 | 0.066 | |
| | 1000 | 1000 | 0.003 | 0.003 | 0.003 | | | 750 | 750 | 0.149 | 0.149 | |
| | 1500 | 1500 | 0.020 | 0.017 | 0.019 | | | 0 | 0 | 0.035 | 0.035 | |
| | 2000 | 2000 | 0.046 | 0.042 | 0.044 | | | 500 | 500 | 0.100 | 0.100 | |
| | 2500 | 2500 | 0.073 | 0.069 | 0.071 | | | 750 | 750 | 0.158 | 0.158 | |
| | 3000 | 3000 | 0.117 | 0.112 | 0.115 | | | 1000 | 1000 | 0.216 | 0.216 | |
| | 3500 | 3500 | 0.166 | 0.166 | 0.166 | | | 1500 | 1500 | 0.325 | 0.325 | |
| | 4000 | 4000 | 0.223 | 0.222 | 0.223 | | | 0 | 0 | 0.086 | 0.086 | |
| | 4500 | 4500 | 0.259 | 0.264 | 0.262 | | | 750 | 750 | 0.222 | 0.222 | |
| 9:13 | 5000 | 5000 | 0.308 | 0.314 | 0.311 | | | 1500 | 1500 | 0.343 | 0.343 | |
| 9:18 | 5000 | 5000 | 0.322 | 0.327 | 0.325 | | | 1750 | 1750 | 0.379 | 0.379 | |
| | 0 | 0 | 0.283 | 0.265 | 0.274 | | | 2000 | 2000 | 0.427 | 0.427 | |
| | | | | | | | | 0 | 0 | 0.129 | 0.129 | |
| | | | | | | | | 750 | 750 | 0.247 | 0.247 | |
| | | | | | | | | 1500 | 1500 | 0.377 | 0.377 | |
| | | | | | | | | 2000 | 2000 | 0.447 | 0.447 | |
| | | | | | | | | 2500 | 2500 | 0.530 | 0.530 | |
| | | | | | | | | 3000 | 3000 | 0.638 | 0.638 | |
| | | | | | | | 10:04 | 0 | 0 | 0.204 | 0.204 | |

Notes:

EARTH SYSTEMS SOUTHWEST

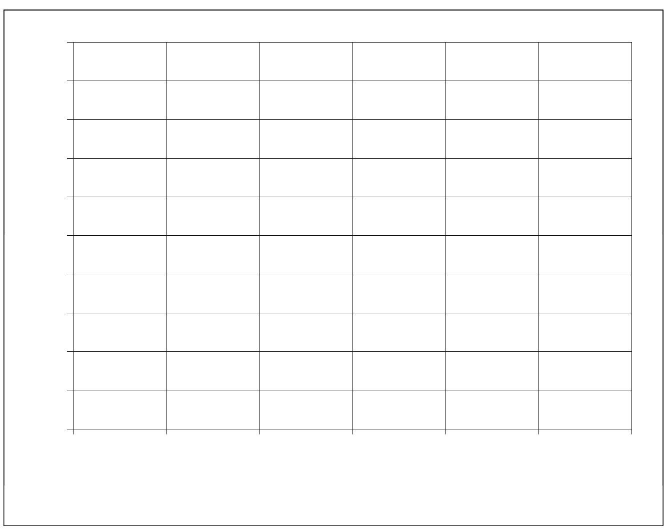
* - Gages reading positive with vertical displacement

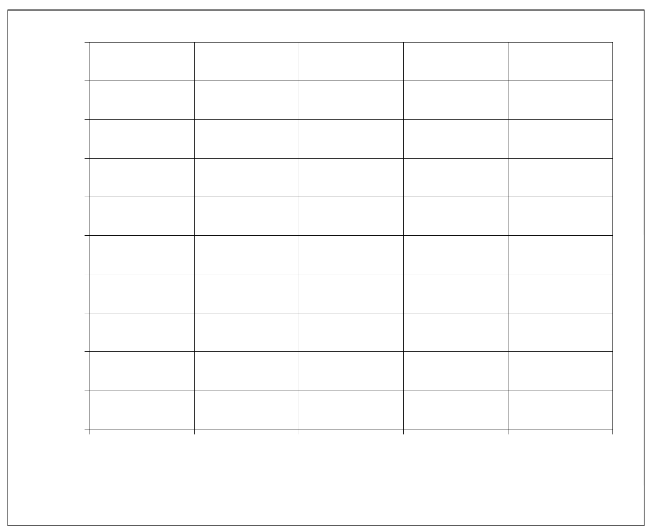
# Desert Sunlight Solar Farm, Desert Center, California
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-24A |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **48** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| Axial Tension Load Test | | | | | | | Lateral Load Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 1:33 | 0 | 0 | 0.000 | 0.000 | 0.000 | | 2:19 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.000 | 0.002 | 0.001 | | | 200 | 400 | 0.046 | 0.046 | |
| | 400 | 850 | -0.001 | 0.003 | 0.001 | | | 400 | 850 | 0.094 | 0.094 | |
| | 600 | 1300 | -0.001 | 0.006 | 0.003 | | | 0 | 0 | 0.012 | 0.012 | |
| | 800 | 1800 | 0.002 | 0.009 | 0.005 | | | 200 | 400 | 0.066 | 0.066 | |
| | 1000 | 2300 | 0.001 | 0.016 | 0.009 | | | 400 | 850 | 0.092 | 0.092 | |
| | 1200 | 2850 | 0.002 | 0.022 | 0.012 | | | 600 | 1300 | 0.126 | 0.126 | |
| | 1400 | 3450 | 0.005 | 0.028 | 0.016 | | | 800 | 1800 | 0.162 | 0.162 | |
| | 1600 | 3950 | 0.009 | 0.035 | 0.022 | | | 0 | 0 | 0.012 | 0.012 | |
| | 1800 | 4450 | 0.014 | 0.042 | 0.028 | | | 400 | 850 | 0.110 | 0.110 | |
| 1:40 | 2000 | 5000 | 0.022 | 0.049 | 0.036 | | | 600 | 1300 | 0.134 | 0.134 | |
| 1:45 | 2000 | 5000 | 0.023 | 0.051 | 0.037 | | | 800 | 1800 | 0.162 | 0.162 | |
| | 0 | 0 | 0.020 | 0.024 | 0.022 | | | 1000 | 2300 | 0.193 | 0.193 | |
| | | | | | | | | 0 | 0 | 0.008 | 0.008 | |
| | | | | | | | | 400 | 850 | 0.095 | 0.095 | |
| | | | | | | | | 800 | 1800 | 0.140 | 0.140 | |
| | | | | | | | | 1000 | 2300 | 0.165 | 0.165 | |
| | | | | | | | | 1200 | 2850 | 0.230 | 0.230 | |
| | | | | | | | | 1400 | 3450 | 0.267 | 0.267 | |
| | | | | | | | 2:30 | 0 | 0 | 0.004 | 0.004 | |

Notes:





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

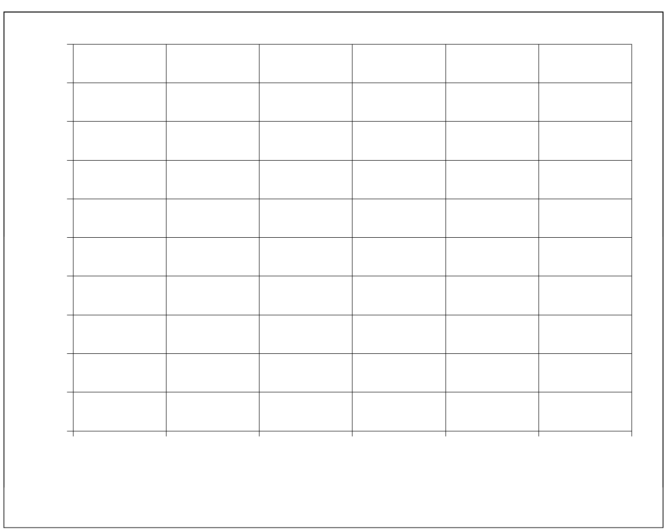
# Desert Sunlight Solar Farm, Desert Center, California

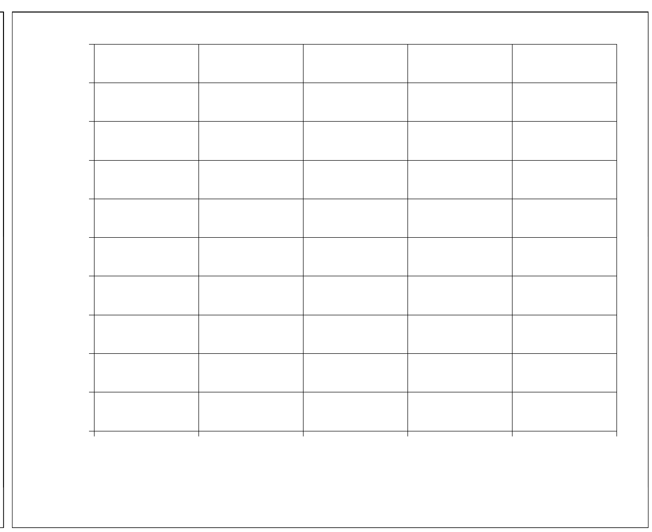
## Pile Load Testing

| | |
|---|---|
| Location: | Desert Sunlight Solar Farm, Desert Center, CA |
| Test No.: | PT-24B |
| Date: | 12/17/2009 |
| Pile Size: | W6 x 7.2 |
| Driven Depth (in.): | **36** |
| Jack: | 12 Tonn |
| Lateral Gage Position: | 1 inch above grade |

| **Axial Tension Load Test** | | | | | | | **Lateral Load Test** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Enerpac Load (psi) | Axial Load (lbs) | Δ * Gage #1 (inches) | Δ * Gage #2 (inches) | Corrected Deflection Δ Average | Notes | Time | Enerpac Load (psi) | Lateral Load (lbs) | Δ Gage (inches) | Corrected Deflection Δ Average | Notes |
| 1:50 | 0 | 0 | 0.001 | 0.001 | 0.000 | | 2:06 | 0 | 0 | 0.000 | 0.000 | |
| | 200 | 400 | 0.008 | 0.008 | 0.007 | | | 200 | 400 | 0.155 | 0.155 | |
| | 400 | 850 | 0.024 | 0.024 | 0.023 | | | 400 | 850 | 0.306 | 0.306 | |
| | 600 | 1300 | 0.054 | 0.056 | 0.054 | | | 0 | 0 | 0.157 | 0.157 | |
| | 800 | 1800 | 0.141 | 0.147 | 0.143 | | | 200 | 400 | 0.246 | 0.246 | |
| | 1000 | 2300 | 0.235 | 0.250 | 0.241 | | | 400 | 850 | 0.317 | 0.317 | |
| | 1200 | 2850 | 0.324 | 0.348 | 0.335 | | | 600 | 1300 | 0.431 | 0.431 | |
| | 1400 | 3450 | 0.436 | 0.472 | 0.453 | | | 800 | 1800 | 0.571 | 0.571 | |
| | | | | | | | | 0 | 0 | 0.296 | 0.296 | |
| | | | | | | | | 400 | 850 | 0.472 | 0.472 | |
| | | | | | | | | 600 | 1300 | 0.541 | 0.541 | |
| | | | | | | | | 800 | 1800 | 0.629 | 0.629 | |
| | | | | | | | | 1000 | 2300 | 0.782 | 0.782 | |
| | | | | | | | | 0 | 0 | 0.430 | 0.430 | |
| | | | | | | | | 400 | 850 | 0.619 | 0.619 | |
| | | | | | | | | 800 | 1800 | 0.765 | 0.765 | |
| | | | | | | | | 1000 | 2300 | 0.858 | 0.858 | |
| | | | | | | | 2:15 | 0 | 0 | 0.564 | 0.564 | |

Notes: .9905 & .7815 @ 1500 lbs Vert/ 1100 lbs =.924 Lat.





EARTH SYSTEMS SOUTHWEST

* - Gages reading positive with vertical displacement

# Estimate for Desert Pavement Coverage

**Earth Systems**
Southwest

79-811B Country Club Drive
Bermuda Dunes, CA 92203
(760) 345-1588
(800) 924-7015
FAX (760) 345-7315

February 19, 2010 **DRAFT** File No.: 11666-01
Doc. No.: 10-02-744

First Solar Electric, LLC
1111 Broadway, 4th Floor
Oakland, California 94607

Attention: Mr. Robert Holbrook

Project: **Desert Sunlight Project**
Proposed 550 MW Solar Project
Desert Center, Riverside County, California

Subject: **Estimate of Desert Pavement Coverage**

As requested by Mr. Robert Holbrook on February 17, 2010, Earth Systems Southwest [ESSW] is providing an estimate of the percent coverage of the project site by desert pavement. We have utilized preliminary soil mapping by ECORP (unpublished), regional geologic maps and a cursory site visit by our senior engineering geologist (on February 19, 2009) to correlate surficial data and observations.

For the purposes of this preliminary estimate, desert pavement is categorized as moderate to strong and weak. Moderate to strong pavement is indicative of complete to nearly complete rock clasts coverage on the surface with minimal soil exposed. Weak desert pavement is where there is predominantly more soil exposed than rock clasts.

For this project, the moderate to strong desert pavement is exposed in areas where older alluvial soils have been mapped, including the southwest and northwest portions of the property. We estimate that in these areas, discounting localized stream channel deposits and sheet flow deposits, that the moderate to strong pavement areas encompass approximately 20 to 30 percent of the project.

Elsewhere within the mapped younger alluvial deposits, which include sheet flow deposits, stream channel deposits, aeolian sands, and undifferentiated younger alluvium, localized areas of weak desert pavement exist within or between the more defined drainage courses. We estimate that within the younger alluvial areas that about 5 to 15 percent of the site has a weakly developed desert pavement.

If you have any questions or require additional information, please contact this office at your convenience.

Respectfully submitted,
**EARTH SYSTEMS SOUTHWEST**

Craig S. Hill,
CE 38234

Letter/mss/csh/ajm

Distribution: 2/First Solar Electric, LLC
2/BD File

# Appendix G

# Water Resources Studies

# Storm Water Hydrology Report for Solar Farm Layout A

# Desert Sunlight Solar Farm – Alternative A

## Storm Water Hydrology Report: Hydrologic, Hydraulic, Sediment Transport and Scour Analyses

**Project Site:**
Desert Sunlight Solar Farm
Riverside County, California

**Prepared for:**
First Solar Inc.
1111 Broadway, 4th Floor
Oakland, California 94607

**Prepared by:**
AECOM
South Portland, Maine/Camarillo, California
April 9, 2010

AECOM Project No. 60131167 (114785)

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## TABLES



## FIGURES

## APPENDICES

# 1 EXECUTIVE SUMMARY

AECOM has conducted hydrologic, hydraulic, sediment transport and scour analyses of storm water for Solar Farm Site – Alternative A of the First Solar, Inc. Desert Sunlight Solar Farm (DSSF or Project). The objectives of this Storm Water Hydrology Report (Report) are:

1. Establish design basis for the DSSF solar farm (Alternative A) improvements and infrastructure from a conservative (100-year) storm water event.
2. Verify that a low impact development measure (decompaction) with an additional measure will mitigate the hydrological impact to the upstream and downstream properties from the DSSF solar farm (Alternative A) improvements and infrastructure for a 10-year storm water event;

The significant results of the modeling determined that:

1. Results of the hydrologic analysis for the DSSF development indicated that implementing decompaction of the areas between the panels will reduce the post development hydraulic conditions to within +/-5% of the pre-development hydraulic conditions. An additional on-site mitigation measure such as basins with rip-rap protection, check dams or strip detention basins can be implemented to retain the remaining excess total off-site storm water volume increase. Please note that the accuracy of the model is approximately +/- 5% and so the differences (i.e. within 5%) calculated by the model are within this range.
2. Results of the hydrologic analysis for the DSSF post-development grading design without the addition of mitigation measures indicated that, in general, storm water off-site peak flow rates and volumes increased 6.7% and 5.5%, respectively for the 10-year storm event. On-site velocities increased 19.4% and flow depths decreased 7.1%, as compared to the pre-development existing conditions for the 10-year storm event.
3. Results of the hydrologic analysis for post-development design that only includes a decompaction mitigation measure indicated that the storm water off-site peak flow and volume increased 2.6% and 2.5%, respectively for the 10-year storm event. On-site velocity increased 19.4%and peak flow depth decreased 7.1%, as compared to the existing conditions for the 10-year storm events. The additional storm water peak volume is reduced by decompaction of soils, which is the most significant measure to mitigate post-development conditions to within +/- 5% of the pre-development conditions.
4. Results of the hydrologic analysis for post-development design that only includes a rip-rap mitigation measure found that for the 10-year storm event, storm water total outflow volume and peak flow depth increased, resulting in decreases in the peak flow and peak velocity, compared to the pre-development existing conditions. The storm water total volume and depth increased 5.5% and 7.1%, for the 10-year storm event. The peak flow and peak velocity decreased 3.0% and 6.5%for the 10-year storm event.
5. The addition of mitigation measures such as basins with rip-rap protection, check dams, or strip detention basins to the DSSF development in addition to decompaction, will address excess post-development hydraulic impacts that are not addressed by decompaction. These additional measures are based on implementing storm water best management practices and have not been rigorously modeled, however they would be designed to retain excess total off-site storm water volume. The intent of an additional mitigation measure is to reduce overall flow depths, velocities and outflow volume by detaining run-on storm water volume. The additional measures would also be successful at reducing potential increases in sediment transport and would be designed to retain the excess total volume capacity which is on the order of 50 ac-ft for the 10-year storm event.
6. Results of the sediment transport analysis for post-development determined that the average degradation for the 100-year and the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions. The average degradation depth for the 10-year storm would be 0.01 feet (i.e., general scour).

7. Results of the total scour analysis for post-development found that the average on-site scour depth would be 0.8 to 1.3 feet at the base of the PV supports for the 100-year storm, depending on the angle of flow to the supports. Placement of riprap will provide a less significant benefit to mitigate for additional runoff. However, riprap placed at the base of each support structure will help reduce the effects of local scour and lower storm water runoff velocities.
8. Results of the qualitative fluvial geomorphologic analysis indicates existing areas of relatively inactive sediments characterized by desert pavement and more active areas consisting of finer sand and gravel. The changes to the site resulting from Project development will create an area that has consistent compaction, soil type and grading compared to existing conditions. It is anticipated that these changes will create a geologic environment conducive to the formation of shallow channels up to two feet or less in depth (i.e. long-term scour). This long term scour can be mitigated by periodic monitoring to identify changes to the site grading and maintenance activities as/if needed to restore design conditions.
9. Along with the mitigation measures, a Monitoring and Response Plan will be prepared and submitted to the BLM. The Monitoring and Response Plan will indicate the procedures that will be followed to mitigate potential impacts to the site structures, storm water infrastructure or site grading that can occur from local scour, sediment transport and long term degradation (i.e. fluvial geomorphology) during the operation of the DSSF.

## 2 INTRODUCTION

AECOM has conducted a hydrologic, hydraulic, sediment transport and scour analyses of storm water conditions within and around Solar Farm Site – Alternative A of the Desert Sunlight Solar Farm (DSSF or Project) for First Solar, Inc. The DSSF is a future 550 MW solar photovoltaic (PV) electric generating facility. The Project is located in Riverside County on public lands under the jurisdiction of the Bureau of Land Management (BLM). This report provides a site description which includes an overview of the Project and its environment (climate, geology, land-use/soil-type, drainage areas), and a specific section on fluvial geomorphology. A quantitative hydrologic, hydraulic and sediment transport analysis was conducted using several computer models. In addition, scour evaluation was performed to assess scour potential around the PV support structures.

The objectives of the Report are:

1. Establish design basis for the DSSF solar farm (Alternative A) improvements and infrastructure from a conservative (100-year) storm water event.
2. Verify that a low impact development measure (decompaction) with an additional measure will mitigate the hydrological impact to the upstream and downstream properties from the DSSF solar farm (Alternative A) improvements and infrastructure for a 10-year storm water event;

The 100-year storm was used to focus on the storm water impacts on the development, and 10-year storm was used to evaluate impacts of the development on the storm water and sediment transport characteristics of the site. During a100-year storm event, the magnitude of the run-off is significant resulting in highest potential of structural impact; however, the difference in run-off between pre and post-development is higher during the 10-year storm, which is more probable to occur during the design life of the project. During the 10-year storm event, the percent difference is not overwhelmed by the shear amount of run-off volume associated with 100-year event, which quickly saturates the ground and effect of infiltration capacity diminishes. Therefore, using the 100-year event to evaluate storm water impacts on the development and the 10-year storm event to evaluate post-development stormwater and sediment transport characteristics represents a conservative approach to understanding the potential for stormwater impacts both on the Project and to the upstream and downstream properties.

The storm water analysis was based on the Riverside County Flood Control and Water Conservation District Hydrology Manual, which uses a 100-year storm event under antecedent moisture conditions (AMC) II criteria for the design basis criteria. A 10-year storm event was analyzed in addition to the 100-year storm event in order to evaluate the more probable event that will be experienced in the Project's lifespan.

The Report presents the results of a detailed hydrologic analysis and hydraulic/sediment-transport model of the DSSF for the existing (i.e., pre-development) conditions. It also includes the results of a watershed analysis that encompasses areas immediately upstream and downstream of the DSSF to determine and evaluate the Project's potential on-site and off-site peak flows during design storm events. The detailed analysis calculated off-site peak flow rate, off-site peak flow volume, maximum and average on-site peak flow depth, and on-site peak and average flow velocity. The off-site peak flow rate and volume are determined at the downstream boundary of the model, which is approximately1/4 mile south of the southern boundary

This report includes the results of the initial hydraulic analysis that modeled the pre-development conditions and compared them to the post-development conditions based on the Project's grading design submitted as part of the Project Description on March 19, 2010. The primary concepts relating to storm water characteristics that were incorporated into this DSSF grading design were contour grading. The intent of the contour grading concept is to smooth the existing surface into consistent graded slopes. Existing slopes on-site will be maintained such that the average cut/fill over the entire site is approximately 5-inches. The results of this comparison are discussed in Section 4.

The hydraulic analysis models the post-development conditions based on the Project's grading design that incorporates a decompaction mitigation measure. The intent of the de-compaction concept is to restore the soil infiltration capacity to the pre-development state. De-compaction will be applied to the areas between the rows of PV panels that were compacted during PV support structure and panel installation. The results of this comparison are discussed in Section 5.

Section 5.4 also includes discussions of other mitigation measures that are proposed to be in addition to the decompaction mitigation measure. These additional mitigation measures are recognized to have beneficial effects to the Project storm water characteristics, but are not as effective as the decompaction mitigation measure. Therefore these additional mitigation measures are discussed in qualitative terms.

Section 5.5 discusses the effect of the Project development on the storm water flows in Pinto Wash.

Sediment Transport characteristics comparing the pre-development conditions and post-development conditions based on the Project's grading design is presented in Section 6.

Fluvial geomorphology for the post-development conditions based on the Project's grading design is discussed in Section 7.

Local scour at the base of the PV solar panel supports for the post-development conditions based on the Project's grading design is discussed in Section 8.

# 3 PROJECT SITE DESCRIPTION

The DSSF is located on a vacant, largely undeveloped and relatively flat tract of land in the Chuckwalla Valley area of the Sonoran Desert in eastern Riverside County, approximately four miles north of the rural community of Tamarisk Park and six miles north of the I-10 freeway and the rural community of Desert Center. The inactive Eagle Mountain Mine and the boundary of Joshua Tree National Park are located approximately 1.5 miles west and 1.4 miles east of the DSSF, respectively. The future DSSF location is shown on Figure 1.

Eagle Mountain Road, Kaiser Road, a paved road, and Eagle Mountain Railroad run from the Eagle Mountain Mine along the southwest portion of the DSSF before continuing south. Because the mine is no longer in operation, the various local roadways are lightly traveled.

Three existing transmission lines pass through the DSSF site. An existing 230-kV transmission line and a 33-kV distribution line, both owned by the Metropolitan Water District of Southern California (MWD), run along Power Line Road and traverse the DSSF.

## 3.1 Proposed Development

The DSSF, as proposed by First Solar, will be a solar photovoltaic (PV) energy generating facility producing 550 Megawatt AC (MWAC). The solar farm will occupy approximately 4,090 acres and includes the solar arrays, an on-site substation, access roads, a monitoring and maintenance facility, and other support facilities.

The First Solar PV modules, of which there will be a total of approximately 8.4 million on-site, are mounted on module framing assemblies made of steel, each holding 16 modules and measuring approximately eight (8) feet wide by 16 feet long. PV module assemblies are attached at an angle to vertical steel piles that are spaced eight (8) feet center-to-center and are driven into the ground to a depth of four (4) to seven (7) feet below grade. Each steel pile is a single W6x9 "I" beam. Once mounted, the front of each PV module assembly will be approximately 1.5 feet above grade, while the rear will be approximately five (5) to six (6) feet above grade.

The PV modules are electrically connected by wiring harnesses running along the bottom of each assembly to combiner boxes that collect power from several rows of modules. The combiner boxes feed DC power from the modules to the Power Conversion Station (PCS) via underground cables. The inverters in the PCS convert the DC electric input into AC electric output and the isolation transformer steps the current up for on-site transmission of the AC power to the PV combining switchgear (PVCS). The PVCS collects the power for transmission to the Substation.

## 3.2 Climate

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14, which was used to estimate precipitation frequency for the hydrologic model, defines southwestern California as a semi-arid region. The Riverside County Hydrology Manual describes the inland valley and desert areas as extremely hot and dry during the summer months and moderate during the winter. The mean seasonal precipitation is three inches in the eastern desert regions and 35 to 40 inches in the San Bernardino and San Jacinto Mountains. There are three types of storms within the region: (1) general winter storms, (2) general summer storms and (3) high intensity thunderstorms. General winter storms originate as tropical cyclones (warm Pacific air masses) that occur in the late fall or winter months. High rates of precipitation occur over the interior mountain ranges but precipitation decreases rapidly over the desert areas. General summer storms can result in heavy precipitation and have durations of several days. These typically occur between the months of July and September as a result of tropical air masses from either the Gulf of Mexico or the South Pacific Ocean. Thunderstorms that generate extremely high precipitation rates for short durations can occur at any time of year.

## 3.3 Geology

Regional and site surficial geology are discussed in the 2007 "Phase 1 Geologic Reconnaissance Report" prepared for the Project by Eberhart/United Consultants (EUC). The site is located within the southwestern portion of the Mojave Desert Geomorphic Province of southern California. The San Andreas Fault defines the southwestern boundary of the Geomorphic Province while the Garlock Fault forms the boundary to the north. The Mojave is a broad interior region of isolated mountain ranges separated by expanses of desert plains. It has an interior enclosed drainage and many playas. The proposed DSSF site is located in the Chuckwalla Valley, which is formed from multiple alluvial fans disseminating from the Eagle Mountains in the west and the Coxcomb Mountains in the east. The Pinto Wash bisects the valley and forms the eastern boundary of the solar farm site.

### 3.4 Land Use and Soil Type

Available data indicates that land use activities at the DSSF site have remained relatively consistent over the past 30 to 40 years. Several small agricultural plots have been established in the vicinity of the site with the use of irrigation. The site itself has remained as largely undeveloped desert with sparse vegetation.

Field reconnaissance by EUC in 2007 investigated the surficial sediments at the site. Two distinct sediment types were present, one associated with areas of desert pavement and the other with more active wash sediments. EUC collected samples with a hand auger at three locations within the proposed DSSF site. Table 1 below summarizes the sediment characteristics.

**Table 1. Surficial Sediment Summary**

| Sample ID | Location | Depth (ft) | $D_{50}$ (mm) | Description |
|---|---|---|---|---|
| A | Southwest | - | - | Well graded gravel (desert pavement) grading into well sorted sand with gravel |
| C | Northwest | 0 to 0.5 | 9.5 | Well graded gravel (desert pavement) grading into well sorted sand with gravel |
| C | Northwest | 0.5 to 1.5 | 0.8 | Well sorted sand with gravel |
| J | South | 2.0 to 4.5 | 1.5 | Well graded sand with gravel |

### 3.5 Drainage Areas and Extent of the Modeling

The major drainage in the vicinity of the DSSF is the Pinto Wash. The Pinto Wash is located along the eastern boundary of the DSSF, continues southeast across undeveloped land, and drains into Palen Dry Lake to the east of the DSSF. Figure 2 shows a map of the model extents for both the hydrologic and hydraulic models. The basin delineation and model extents were developed utilizing automatic basin delineation tools available in the U.S. Environmental Protection Agency's (EPA) BASINS software. Elevations from the United States Geological Survey's (USGS) National Elevation Dataset were used for development of the model hydrology, which is discussed further in the following section.

# 4 HYDROLOGIC ANALYSIS

A two-dimensional (2D) model was constructed to simulate flow patterns and sediment transport within the DSSF. The hydrologic component of the 2D model was developed in HEC-HMS, a product of the Hydrologic Engineering Center (HEC) within the U.S. Army Corps of Engineers. The hydrologic analysis was performed using AMC II conditions utilizing guidelines outlined in the Riverside County Flood Control and Water Conservation District Hydrology Manual. The hydrologic analysis was repeated for the 10-year storm event incorporating various mitigation measures.

## 4.1 Hydrologic Analysis

The Riverside County Manual refers to the NOAA Atlas 2 for rainfall data. However, NOAA has superseded this source with Atlas 14 in the Project area. The website associated with NOAA Atlas 14 can provide rainfall intensity-duration-frequency (IDF) curves for any location based on latitude and longitude. The approximate coordinates of the DSSF site were entered into the website to develop rainfall totals for the 100- and 10-year storm events. A rainfall distribution was not specified by Riverside County; therefore, the balanced distribution recommended by the San Bernardino County Hydrology Manual (August 1986) was used for the analysis.

The Soil Conservation Service (SCS) curve number methodology was used to estimate flows to the hydraulic model. Curve numbers ranging from 79 in upstream areas to 63 in downstream areas were used for delineated basins. These curve numbers reflect AMC II, or normal moisture, conditions as specified by the Riverside County Manual. An initial abstraction of 0.15 was used. Lag times were calculated using the curve number method.

Hydrologic information was entered into HEC-HMS, which was then used to generate flows to the hydraulic model. Figure 3 presents the rainfall hyetograph at the Project site and Figure 4 shows the estimated total storm water peak flow running onto the entire project site over time during the 100-year and 10-year storm events. A summary of the hydrologic analysis is contained below in Table 2.

**Table 2. Hydrologic Analysis Summary**

| Parameter | Value | Value |
|---|---|---|
| Design Storm Frequency | 100-year | 10-year |
| Peak Rainfall Depth | 0.72 inches in 5 minutes | 0.31 inches in 5 minutes |
| Total Rainfall Depth | 3.58 inches | 1.96 inches |

# 5 HYDRAULIC ANALYSIS

Flow and sediment transport within the study area were simulated using FLO-2D. FLO-2D is a two-dimensional model designed to simulate unconfined overland flows. The extents of the FLO-2D model are shown in Figure 2 and include Solar Farm Site – Alternative B as well as the Pinto Wash area immediately to the east. The northern and southern boundaries of the model were determined based on the path of water flow as per the USGS National Elevation Dataset. The upstream boundary extends approximately two miles upstream of the DSSF to establish flow patterns and sediment loads flow entering the site. The downstream boundary condition was set over half a mile downstream so that the downstream boundary condition would not affect flows on the Project site. FLO-2D model grid cells were set to dimensions of 200-feet by 200-feet.

Four configurations were analyzed: (1) existing conditions, (2) proposed or future (post-development) conditions, (3) proposed or future conditions with soil decompaction and (4) proposed or future conditions with rip-rap. Future conditions were modeled without stormwater mitigation measures and with the inclusion of a storm water mitigation measure in the form of either soil decompaction or rip-rap.

## 5.1 Inputs and Assumptions

Light Detection and Ranging (LIDAR) topographic survey data was collected within the DSSF. The LIDAR data was combined with USGS elevation data to populate the 2D model grid with elevations. These elevations represent the existing conditions of the site. For this analysis the same topographic data was used for both existing and proposed or future (post-development) conditions. Using the LIDAR data for both existing and future conditions will show the hydraulic changes at the project site as a result of grading and compaction by changing only the Manning's roughness and infiltration parameters. The grading plan would not greatly affect the model elevations that are averaged within the 200 foot by 200 foot grid elements created in FLO-2D.

The FLO-2D model uses the Green-Ampt method to simulate ground infiltration. The parameters for the Green-Ampt method were calibrated using information from the hydrologic HEC-HMS model. HEC-HMS uses the Curve Number infiltration method. The volume of flow that should runoff the site was estimated in HEC-HMS. The hydraulic conductivity in FLO-2D was adjusted so that the correct volume of flow was generated in the FLO-2D model. A curve number of 63 (i.e. barren land) was used for the majority of the existing conditions. The areas classified as "barren land" represent areas containing existing wash. The areas of desert pavement that occur within the project site were assumed to have similar infiltration capacity as the dirt roads introduced for the future conditions (i.e. curve number 72). Earth Systems Southwest (ESSW) provided an estimate that suggests approximately 20-30 percent of the total project area is covered in moderate to strong desert pavement. Delineation of the desert pavement areas were done by EUC (EUC, 2007). AECOM reviewed EUC's delineation against recent aerial images to confirm accuracy. This delineation is shown in Appendix E the mapped desert pavement area is approximately 30 percent of the project site. The infiltration capacity of desert pavement was assigned in the area shown. It should be noted that approximately 6 (six) percent of the project area is covered in weak desert pavement. This area will not be disturbed by the proposed development; the area will not be graded but will be mowed to remove vegetation. The properties of desert pavement are discussed further in Section 7.1, Fluvial Geomorphologic Assessment Methodology. A curve number of 72 (i.e. dirt roads) was used for future conditions to account for compaction and loss of vegetation within the DSSF site. Outside the project site the existing conditions assignment of 63 representing barren land was retained.

A Manning's "n" value of 0.043 was used for existing conditions and was based on guidelines established by the USGS for developing Manning's roughness coefficients in floodplains (USGS Water-supply Paper 2339). For the post-development conditions, the Manning's "n" is reduced to 0.034, reflecting both the reduction in roughness due to smoothing the grade and removing existing vegetation and takes into account the increase in roughness due to the presence of the piles supporting the solar panels. See Appendix B for a detailed review of the Manning's value assignments.

## 5.2 Results: Future Conditions

The results presented in this section show the future hydraulic conditions without stormwater mitigation measures. The FLO-2D model was simulated for a 48-hour period for the 100- and 10-year design storm events. Plots of peak storm water depth and velocity for both future and existing conditions were produced with the FLO-2D model results. To be conservative in terms of peak velocities, sediment transport was not taken into account during these simulations. In reality, when sediment transport (scour) takes place flow depth will increase and the peak velocities will therefore decrease. Sediment transport models were developed separately, the results of the sediment transport analysis can be found in Section 6. Sediment transport models were developed separately, the results of the sediment transport analysis can be found in Section 6. Figure 5 through Figure 16 present the results of the 2D model without the sediment transport module activated. The results included on these figures include the peak flow depth and peak velocity at each 200-foot by 200-foot cell for both existing and future conditions, as well as plots for the change in these values between the existing and future conditions.

As shown on Figure 6 the 100-year future conditions model indicates that the storm water peak flow depth would be less than 2.1 feet in the center of the DSSF and towards the east due to the Pinto Wash. In general, the modeling results demonstrate that there would be very little change (less than one tenth (1/10) foot of difference) in flow depth as a result of Project-related changes to the site. Figure 7 presents the difference in the storm water peak flow depth at each modeling cell for the post-development future condition as compared to the existing conditions.

The modeling results also demonstrate that there would be a slight increase in storm water peak flow velocities as a result of the changes to the Project site. Figure 10 presents the difference in the storm water peak velocity at each modeling cell for the future conditions compared to the existing conditions. This shows an increase in velocity of up to eight-tenths of a foot per second at certain locations within the DSSF.

The increase in velocity, combined with the increased runoff due to compaction, will have some impact on the downstream peak flows and volumes from the study area. A summary of the hydraulic analysis for the 100-year storm is contained in Table 3 below. In this table, “on-site location” essentially indicates the changes within the Project site and “off-site location” indicates the impacts to the areas immediately downstream of the DSSF site.

**Table 3. Hydraulic Analysis Summary: 100-year**

| Parameter | Location | Existing Conditions | Future Conditions | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 24,811 cfs | 26,253 cfs | 1,442 cfs (5.8%) |
| Total Outflow Volume | Off-site | 7,154 acre-ft | 7,319 acre-ft | 165 acre-ft (2.3%) |
| Maximum Peak Flow Depth | On-site | 2.2 ft | 2.1 ft | -0.1 ft (-4.5%) |
| Average Peak Flow Depth | On-site | 0.8 ft | 0.7 ft | -0.1 ft (-12.5%) |
| Peak Velocity | On-site | 4.6 ft/s | 5.4 ft/s | 0.8 ft/s (17.4%) |
| Average Velocity | On-site | 2.0 ft/s | 2.2 ft/s | 0.2 ft/s (10.0%) |

The hydraulic model results of the 10-year storm can be found in Table 4, below. Figure 12 shows the grid element maximum flow depths and Figure 13 shows the change in flow depth from existing to proposed. The change in peak flow depth decreased one-tenth of a foot from existing to proposed conditions and the average flow depth remained the same. Maximum velocities at each grid element are shown in Figure 15 and the change in velocity is shown in Figure 16. Peak flow velocity and average velocities will increase as a result of development for the 10-year storm.

**Table 4. Hydraulic Analysis Summary: 10-year**

| Parameter | Location | Existing Conditions | Future Conditions | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 5,376 cfs | 5,738 cfs | 362 cfs (6.7%) |
| Total Outflow Volume | Off-site | 2,030 acre-ft | 2,142 acre-ft | 112 acre-ft (5.5%) |
| Maximum Peak Flow Depth | On-site | 1.4 ft | 1.3 ft | -0.1 ft (-7.1%) |
| Average Peak Flow Depth | On-site | 0.4 ft | 0.4 ft | 0.0 ft (0.0%) |
| Peak Velocity | On-site | 3.1 ft/s | 3.7 ft/s | 0.6 ft/s (19.4%) |
| Average Velocity | On-site | 1.2 ft/s | 1.3 ft/s | 0.1 ft/s (8.3%) |

Table 3 and Table 4 do not reflect storm water mitigation measures that will be incorporated into the final design of the DSSF. See Section 5.3 for the model results with incorporated LID design mechanisms.

### 5.3 Results: Future Conditions with Storm Water Mitigation Measures

The results presented in this section show the future hydraulic conditions with decompaction or rip-rap as stormwater mitigation. The FLO-2D model was simulated for a 48-hour period for the 100- and 10-year design storm events. Infiltration rates were adjusted to represent decompaction of the soil between the rows of the arrays. Plots of peak storm water depth and velocity for both future and existing conditions were produced with the FLO-2D model results. To be conservative in terms of peak velocities, sediment transport was not taken into account during these simulations. Sediment transport models were developed separately, the results of the sediment transport analysis can be found in Section 6.

The goal of the design is to minimize the change of hydraulics and sediment transport. Since the results of the future conditions modeling analysis (presented in Section 5.2) has not achieved this goal, additional storm water mitigation measures were modeled to determine the effect of each measure on the changes to post development hydraulic conditions. Low Impact Development types of storm water and erosion control measures including decompaction of the soil after array installation or placement of rip-rap were identified and modeled in order to reduce post-development hydraulic parameters.

#### *5.3.1 Results: Future Conditions with Decompaction Mitigation Measure*

The second mitigation measure modeled involves decompacting the soil after the arrays have been installed. Soil decompaction would be implemented between the rows of tables within each of the arrays. The decompaction operation will restore the infiltration to the pre-development original state. The intent of the decompaction mitigation measure is to increase the post-development soil infiltration that results in a lower total storm water outflow volume.

For the project areas located on existing desert pavement, the decompaction measure is not anticipated to restore the pre-development conditions. Project areas that are currently covered with desert pavement already have a low infiltration capacity. Although the decompaction measure is intended to increase post-development soil infiltration, the decompaction measure is not anticipated to significantly change the infiltration capacity as compared to pre-development conditions for desert pavement areas.

The values presented in Table 5 are the results from simulating decompaction of 37.3% of the total project site. This percentage was calculated based on the current array configuration and site layout that allows for approximately 9.4 feet of the area between rows to be decompacted with an allowance to minimize damage to the panels . Figure 17 shows the maximum peak flow depths, Figure 18 shows the change in maximum peak flow depth, Figure 19 shows the maximum peak velocity and Figure 20 shows the change in peak velocity. The change in total outflow volume was reduced from 165 to 76 acre-feet or a 1.1% increase from existing conditions when decompaction was considered.

**Table 5. Hydraulic Analysis Summary: 100-year with Decompaction**

| Parameter | **Location** | **Existing Conditions** | **Future Conditions with Decompaction Measure** | **Change** |
|---|---|---|---|---|
| Peak Outflow | Off-site | 24,811 cfs | 26,070 cfs | 1,259 cfs 5.1% |
| Total Outflow Volume | Off-site | 7154 acre-ft | 7,230 acre-ft | 76 acre-ft 1.1% |
| Maximum Peak Flow Depth | On-site | 2.2 ft | 2.1 ft | -0.1 ft -4.5% |
| Average Peak Flow Depth | On-site | 0.8 ft | 0.7 ft | -0.1 ft -12.5% |
| Peak Velocity | On-site | 4.6 ft/s | 5.3 ft/s | 0.7 ft/s 15.2% |
| Average Velocity | On-site | 2.0 ft/s | 2.2 ft/s | 0.2 ft/s 10.0% |

The 10-year decompaction simulation resulted in a change in total outflow volume of 50 acre-feet or a 2.5% increase from existing conditions. Figure 21 shows the maximum peak flow depths, Figure 22 shows the change in maximum peak flow depth, Figure 23 shows the maximum peak velocity and Figure 24 shows the change in peak velocity.

**Table 6. Hydraulic Analysis Summary: 10-year with Decompaction**

| Parameter | Location | Existing Conditions | Future Conditions with Decompaction Measure | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 5,376 cfs | 5,517 cfs | 141 cfs 2.6% |
| Total Outflow Volume | Off-site | 2,030 acre-ft | 2,080 acre-ft | 50 acre-ft 2.5% |
| Maximum Peak Flow Depth | On-site | 1.4 ft | 1.3 ft | -0.1 ft -7.1% |
| Average Peak Flow Depth | On-site | 0.4 ft | 0.4 ft | 0.0 ft 0.0% |
| Peak Velocity | On-site | 3.1 ft/s | 3.7 ft/s | 0.6 ft/s 19.4% |
| Average Velocity | On-site | 1.2 ft/s | 1.3 ft/s | 0.1 ft/s 8.3% |

The results presented in Table 5 and Table 6 do not include sediment transport functions.

### *5.3.2 Results: Future Conditions with Rip-Rap Mitigation Measure*

The addition of rip rap to the final graded surface was identified as the first mitigation measure to reduce the hydraulic effects of proposed development at the DSSF site. Placing riprap on the final graded surface at the project site increases the Manning's roughness values for the post-development condition as well as protects the array supports from localized scour (See Section 8). This measure will counteract the reduction in the Manning's roughness from pre- to post-development conditions that occurs from vegetation removal during DSSF grading activities. The intent of this measure is to return the post-development roughness to the value of the existing conditions. The model assumes a 6-inch rip-rap, 108 ft across placed in every 200 ft cell (i.e. 54% of the project area), following the graded contours.

It is reasonable to assume that the placement of rip-rap would increase the Manning's roughness value across the DSSF site. If the overall site post-development roughness is increased by 0.005 (to a total value of 0.39) for the 100-year event, the change in flow depth and velocity from pre to post-development would be significantly decreased compared to post-development results without mitigation measures. Assuming that the placement of rip-rap increases the post-development roughness value to 0.39, the changes in peak outflow and total outflow volume from the pre to post-development conditions for the 100-year storm event would limit the change to less than 5%. Figure 25 shows the maximum flow depths for each grid element and Figure 26 shows the difference from existing conditions. The maximum peak flow depth increased by one-tenth of a foot and the average peak flow depth remained the same as existing conditions. Peak velocity and average velocity remained the same for existing and proposed conditions. Figure 27 shows the maximum velocities at each grid element and Figure 28 shows the change in velocity. Table 7, below, summarizes the hydraulic analysis for the 100-year storm using rip rap.

**Table 7. Hydraulic Analysis Summary: 100-year with Rip Rap**

| Parameter | Location | Existing Conditions | Future Conditions with Rip-Rap Mitigation | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 24,811 cfs | 24,954 cfs | 143 cfs (0.6%) |
| Total Outflow Volume | Off-site | 7154 acre-ft | 7,317 acre-ft | 163 acre-ft (2.3%) |
| Maximum Peak Flow Depth | On-site | 2.2 ft | 2.3 ft | 0.1 ft (4.5%) |
| Average Peak Flow Depth | On-site | 0.8 ft | 0.8 ft | 0.0 ft (0.0%) |
| Peak Velocity | On-site | 4.6 ft/s | 4.6 ft/s | 0.0 ft/s (0.0%) |
| Average Velocity | On-site | 2.0 ft/s | 2.0 ft/s | 0.0 ft/s (0.0%) |

For the 10-year storm event, several iterations of models found that the Manning's roughness value would need to be increased by 0.023 to decrease the effect of development. These iterations resulted in a roughness value for the post-development conditions that was higher than the existing condition value. Figure 29 through Figure 32 show the results of the storm water modeling with a roughness value of 0.57. Table 8 shows the hydraulic results for the 10-year storm. Even by increasing the site roughness value to a value greater than existing conditions did not limit the change to less than 5% for pre to post-development conditions for the 10-year storm event.

**Table 8. Hydraulic Analysis Summary: 10-year with Rip Rap**

| Parameter | Location | Existing Conditions | Future Conditions with Rip-Rap Mitigation | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 5,376 cfs | 5,216 cfs | -160 cfs -3.0% |
| Total Outflow Volume | Off-site | 2,030 acre-ft | 2,142 acre-ft | 112 acre-ft 5.5% |
| Maximum Peak Flow Depth | On-site | 1.4 ft | 1.5 ft | 0.1 ft 7.1% |
| Average Peak Flow Depth | On-site | 0.4 ft | 0.4 ft | 0.0 ft 0.0% |
| Peak Velocity | On-site | 3.1 ft/s | 2.9 ft/s | -0.2 ft/s -6.5% |
| Average Velocity | On-site | 1.2 ft/s | 1.2 ft/s | 0.0 ft/s 0.0% |

The results presented in Table 7 and Table 8 do not include sediment transport functions. In order to achieve a roughness of 0.039 for the 100-year future conditions approximately 54% of the project site would need to be covered in six (6) inch diameter rip-rap. The roughness value of 0.057 for the 10-year storm event cannot be obtained with six (6) inch rip-rap (See Manning's roughness calculations in Appendix B). Introducing rip rap will decrease the depths and velocities at the project site but rip rap as the only mitigation measure implemented, by itself does not provide the storage that would be required to decrease the outflow volume and outflow discharge. Additional mitigation measures can be implemented to further reduce the impact of the storm water outflows.

#### *5.3.3 Discussion of Results: Future Conditions with Mitigation Measures*

Decompaction of soils is the most significant measure to mitigate post-development conditions to within 5% of the pre-development conditions, by reducing added runoff. Decompacting the soil provides additional infiltration capacity which reduces runoff volume, peak flow rate, flow velocities and sediment transport. Placement of riprap provides a less significant benefit to mitigate post-development conditions to within 5% of the pre-development conditions. Increasing surface roughness (e.g. use of riprap) slows down the velocities, decreases sediment transport and increases flow depth.

Neither the rip-rap nor the decompaction measures alone will mitigate the post development conditions to within 5% of the pre-development hydraulic conditions. A combination of these two mitigation measures and/or addition of further mitigation measures should be considered to achieve a change from pre to post development conditions of less than 5%.

#### *5.3.4 Discussion of Additional Mitigation Measures*

An additional mitigation measure such as retention basins can be implemented to address specific post-development hydraulic characteristics that remain after implementation of the decompaction measure. These retention basins could be located along the upstream western boundary of the project site to intercept run on storm water flows. The intent of this measure is to reduce overall flow depths, velocities and outflow volume by retaining run-on storm water volume. They will also reduce sediment transport within the project site. Due to the size of the grid elements in FLO-2D (200 foot by 200 foot) an accurate representation of the basins cannot be distinguished in the model. However, it can be assumed that the basins can be designed to retain the excess total storm water volume. Once the basins are designed, their retention capacity volume can be subtracted from the total outflow volume of any of the simulations. Retentions basins would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 50 ac-ft for the 10-year storm event.

An additional mitigation measure such as check dams can be implemented to address specific post-development hydraulic characteristics that remain after implementation of the decompaction measure. Check dams could be located near the downstream southern boundary of the project site to intercept run off storm water flows. The intent of this measure is to reduce outflow volume by retaining run-off storm water volume. Check dams would have an effect on the storm water upstream of each dam because the storm water would back up behind each dam. Check dams would also reduce flow velocities and sediment transport leaving the project site. Check dams would change the Manning's roughness ("n") values used in the model at their immediate vicinity. It can be assumed that the check dams can be designed to retain the excess total storm water volume. Once the check dams are designed, their detention capacity volume can be subtracted from the total outflow volume of any of the simulations. Check dams would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 50 ac-ft for the 10-year storm event.

An additional mitigation measure such as strip detention basins can be implemented to address specific post-development hydraulic characteristics that remain after the implementation of the decompaction measure. The strip detention basins would be approximately 6-inches deep and 70 feet wide. The strip detention basins would be designed to follow the contours and so the lengths would be dependent on the locations of the basins on the site. These detention basins could be located near the downstream southern boundary of the project site to intercept run off storm water flows. The intent of this measure is to reduce outflow volume by detaining run-off storm water volume, similar to the check dam measures. Strip detention basins would not have an effect on the storm water upstream of each basin but would reduce flow velocities and sediment transport leaving the project site. Strip basins would not appreciably change the Manning's roughness ("n") values used in the model for the project. The strip detention basins would not be as effective a measure as the check dams. Check dams can be designed to hold more volume than the strip detention basins when placed on flatter slopes and also check dams will act as a bigger obstacle than strip detention basins attenuating storm water flow. It can be assumed that the strip detention basins can be designed to retain the excess total storm water volume and would have a retention volume capacity equivalent to that for the check dams. Strip detention basins would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 50 ac-ft for the 10-year storm event. Once the strip detention basins are designed, their detention capacity volume can be subtracted from the total outflow volume of any of the simulations.

#### *5.3.5 Discussion of Effect on the Pinto Wash*

As shown on the pre-development and post-development figures, the development will not significantly affect the storm water flow in the Pinto Wash. For the most part, the storm water flow in the Pinto Wash will encroach onto the DSSF for 10-year and 100-year storm events. The figures show that the flow on the DSSF does not enter the Pinto Wash along the DSSF boundary (or within the boundaries of the model), rather the storm water outflow from the site will enter the Pinto Wash in an area several miles downstream of the DSSF. The volume of storm water in the Pinto Wash is on the order of 4,072 ac-ft for the 100-year storm event and 1,545 ac-ft for the 10-year storm event. The DSSF does not increase Pinto Wash flows at the downstream end of the project, however, an additional 76 ac-ft for the 100-year event from the DSSF would eventually make its way into Pinto Wash at which point the increase is expected to be less than 1%. Velocities and depths within the pinto wash will not change as a result of development. The DSSF development would not have a significant impact to a storm water flow in the Pinto Wash.

# 6 SEDIMENT TRANSPORT ANALYSIS

This section describes sediment transport for the project as predicted by FLO-2D. The sediment transport analysis is conservative because degradation depths presented do not reflect sediment deposition which may occur within the same model cell. The model does not account for local scour at the supports for the solar panels. Local scour is evaluated later in this report; see Section 8 LOCAL SCOUR ANALYSIS

## 6.1 Methodology

The existing and proposed model configurations discussed in the Hydraulics Section were modified to account for sediment transport. FLO-2D has the capability of simulating sediment transport and offers several different methodologies. The Zeller and Fullerton methodology was selected for sediment transport analysis of the DSSF since this methodology is appropriate for alluvial floodplain conditions (FLO-2D User's Manual, 2007). Sediment profile information was obtained from the geotechnical study (EUC, 2007).

## 6.2 Results

The existing and future conditions with decompaction were modeled under AMC II conditions to determine the loss in depth of the sediment (degradation or scour) during the 100- and 10-year storm events. Maps presenting the results of the 100-year and 10-year peak degradation are shown in Figure 34 and Figure 37 respectively. Graphs showing change in sediment transport depth can be found in Figure 35 and Figure 38. Table 9 presents average degradtion depths for the 100-year storm event within the DSSF for the simulations. The modeling results determined that the average degradation for the 100-year storm event within the project site does not change (the difference is 0.0%) for the future conditions with decompaction.

**Table 9. Sediment Transport Summary: 100-year storm**

| Simulation | Average Degradation Depth | Change |
|---|---|---|
| Existing Conditions | 0.04 ft | NA |
| Future Conditions with Decompaction | 0.04 ft | 0.00 ft (0.0%) |

The 10-year simulation results are presented below in Table 10. The modeling results determined that the average degradation for the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions.

**Table 10. Sediment Transport Summary: 10-year storm**

| Parameter | Average Degradation Depth | Change |
|---|---|---|
| Existing Conditions | 0.01 ft | NA |
| Future Conditions with Decompaction | 0.01 ft | 0.00 ft (0.0%) |

Sediment transport, based on the sediment particle size, showed that the proposed installation did not have any impact on degradation; the average degradation depth is 0.04 feet for the 100-year storm and 0.01 feet for the 10-year storm over most of the DSSF for both pre- and post-development conditions. The results show that the average degradation within the project site remains the same for existing conditions and all development options.

Although the modeling results indicate that the average degradation depth is not significant for both pre- and post-development conditions, sediment transport may occur as a result of either a large storm event or a series of smaller storm events. This issue can be mitigated by periodic monitoring and maintenance of the site. For example, monitoring conducted after storm events would indicate sediment depth at that time and maintenance activities would be conducted as/if needed to add/remove material to restore design conditions. A Monitoring and Response Plan will be incorporated into the final design of the DSSF to ensure that the storm water infrastructure is in good working order on an ongoing basis during Project operation.

# 7 FLUVIAL GEOMORPHOLOGIC ASSESSMENT

## 7.1 Methodology

AECOM reviewed existing data including geologic literature, site reports, aerial mapping and topographical survey to qualitatively determine the fluvial geomorphology of the DSSF. Aerial photographs from the years 1978, 1996 and 2002 were analyzed to determine changes in land use and stream channel configurations.

As noted earlier, the DSSF is located in the Chuckwalla Valley, which is bounded by a series of alluvial fans that slope gently to moderately toward the southwest and southeast. The Pinto Wash runs through the center of the valley. The DSSF facilities are to be located to the west of the Pinto Wash. Vegetation at the site generally consists of sage and other scrub-type brush that is typical for the arid regions of southern California (EUC, 2007).

The geomorphology of alluvial fans is described by John Field and Philip Pearthree in their article "Geomorphologic Flood-Hazard Assessment of Alluvial Fans and Piedmonts" published in the Journal of Geoscience Education, Vol. 45, 1997:

> "Alluvial fans are generally cone-shaped depositional landforms with distributary drainage patterns that emanate from a discrete source and increase in width downslope. Older, inactive, alluvial fans commonly are isolated from active depositional processes and dendritic drainage patterns are developed on them."
>
> "Surfaces that are subject to flooding are undissected, display well preserved bar-and-swale topography, and lack desert pavement and varnish. In contrast, surfaces that have not been flooded for hundreds of thousands of years are moderately to deeply dissected, have well developed desert pavements and abundant shattered cobbles on the surface; their soils include substantial accumulations of clay and calcium carbonate (caliche)."
>
> "Several criteria can be used to distinguish between a permanent and temporary trench. Fanhead trenches dissecting inactive surfaces with well developed soils, desert pavement, and rock varnish are permanent features, since it is the incision of the trench itself that is largely responsible for the isolation of the adjacent old surfaces. A trench dissecting a young surface, on the other hand, is potentially only a transient feature. The depth of incision alone should not be used to determine whether a trench is permanent. Trenches as deep as 8 m can be filled and/or cut during a single debris flow event. …Regardless of the absolute depth of the incision, a fanhead trench is not a permanent feature if floodwaters can overtop or backfill the channel under the prevailing hydrologic conditions."

Review of recent aerial imagery and site photographs indicates that there are two significant geologic environments occurring at the DSSF. The first geologic environment is characterized as older alluvial sediments with developed desert pavement. This environment occurs in the northwest portion of the site in the vicinity of Power Line Road. It also occurs in the southwest corner of the site adjacent to Kaiser Road (Co Route R2). Based on LIDAR topographic survey data, alluvial stream channel depths near Power Line Road approach four feet at the northwest end of the project while the channels near Kaiser Road are generally two (feet or less.

The second significant geologic setting at the DSSF site consists of an area of active younger sediments with no evidence of desert pavement. Topography in these areas tends to be very consistent with channels depths generally less than one foot deep.

The EUC "Phase 1 Geologic Reconnaissance Report" corroborates the two significant conditions encountered at the site. EUC describes the established alluvial sediments as follows:

> "Older alluvial fan deposits consisting of Pleistocene nonmarine sediments extend outward into the valley from both the Eagle Mountains on the west and the Coxcomb Mountains on the east. Desert pavement type deposits (manganese and iron oxidized coatings on cobbles and sand) blanket the top three (3) to six (6) inches of the older alluvial fan material."

EUC describes the area near Power Line Road and Kaiser Road as the “Northwest fan – includes sediments derived from the Eagle Mountain Quartz Monzonite, Pleistocene volcanic rocks, and Pre-Cretaceous metamorphosed sediments.” In contrast, they describe the younger active sediments as “of Holocene age. These soils consist of fine to coarse sand, interbedded with clay, silt and gravel.”

Lateral migration of stream channels is typically evaluated based on the analysis of historical aerial photographs. AECOM reviewed aerial photographs from the years 1978, 1996 and 2002 at the proposed site. Based on the data available, stream channels at the site have been relatively stable over the period evaluated. It is more difficult to determine the stability of smaller channels located in the more active portions of the site due to their scale. Based on knowledge of similar environments, it would be expected that alluvial stream channels in the older alluvial regions remain relatively stable. It is anticipated that the shallow channels that exist within the younger sediment would exhibit frequent channel avulsion and lateral migration during flood flows.

### 7.2 Results

Changes to the vertical profile of the stream channels are difficult to quantify without detailed survey data of Project site topography over time. However, existing conditions at the site indicate channel depths of two to four feet in the older alluvial sediments and less than two feet in the younger sediments.

The grading design of the DSSF includes grading of the entire site with varying levels of compaction depending on proposed land use (primary road, secondary road, etc.). Existing slopes on the site vary from zero to two percent in the active alluvial areas to two to four percent in the regions of less active older alluvial sediments. Planned slopes will be zero to two percent across the entire site.

The proposed changes to the site will have an impact on future geomorphic conditions. Instead of relatively inactive areas characterized by desert pavement in combination with more active areas, the geologic conditions at the site will change to a more consistent geological condition. Changes to existing site grades will also have an impact on flood flows. It is anticipated that these changes will create a geologic environment conducive to rapidly migrating shallow channels, approximately two feet deep or less. Channel formation from fluvial geomorphology occurs as a result of multiple storm events over time. This long term scour or channel formation can be mitigated by periodic monitoring to identify changes to the site grading, followed by maintenance measures to address these changes as/if needed. Development of a Monitoring and Response plan would address monitoring of the drainage control devices after storm events and development of appropriate maintenance responses so that the drainage control devices are operational for subsequent storm events. Flatter slopes may also contribute to areas of sediment deposition during storm events.

If further evaluation of existing and post-development conditions at the site is needed, a detailed quantitative fluvial geomorphologic assessment will be conducted. The quantitative evaluation would include a detailed analysis of stream migration based on historical aerial images, additional historical information including interviews with local inhabitants, and site reconnaissance to determine channel characteristic, extent of desert pavement and soil properties.

**Photo 1. Stream channel in older alluvial sediments (desert pavement)**

**Photo 2. View of desert pavement material**

# 8 LOCAL SCOUR ANALYSIS

The total predicted scour depth is the sum of the following components: general scour, long term scour and local scour. General scour is discussed in the Sediment Transport Analysis Section 6 of this report. Long term scour depth is estimated in the previous Fluvial Geomorphologic Assessment Section 7. It is assumed that the long term scour can be mitigated by periodic monitoring to identify changes to the site grading and followed by maintenance measures to address these changes as/if needed. Therefore, the total scour depth presented in this section is assumed to be the local scour and general scour that the site structures could experience. The local scour is discussed herein for the future conditions 100-year storm event. Local scour is measured at an instantaneous point in time as a result of turbulent flow at the pylons. Sediment is suspended at the base of these structures within the turbulent flow. As the sediment moves away from the turbulent zone the flow can no longer support the sediment load and it is deposited a short distance downstream. Local scour occurs at the base of a structure as a result of the change in direction and velocity of storm water as the water flows around the structure. The effect of the local scour is limited to the area immediately adjacent to the base of the PV solar panel support structures.

## 8.1 Methodology

For the purpose of this study, local scour was analyzed at the base of the PV solar panel support structures. Scour depths were calculated using a local pier scour equation from the Federal Highway Administration's Hydraulic Engineering Circular No. 18 (HEC-18), "Evaluating Scour at Bridges" (4th Edition).

Scour depths were calculated for each element in the 2D model within the DSSF. Velocity and depth outputs from the model were used to determine scour at each element. The dimensions of a model element are 200-feet by 200-feet and velocities and depths predicted by the model are averaged across the element area. Therefore, the velocities may not be conservative because high concentrations at portions of the element are lost and larger scour depths than predicted may occur.

The local scour equation and the various parameters and assumptions are as follows:

$$\frac{y_s}{a} = 2.0K_1K_2K_3K_4\left(\frac{y}{a}\right)^{0.35} Fr^{0.43}$$ **(Equation 1)**

Where:

$y_s$ = Local scour depth (ft);
$K_1$ = Correction factor for pier nose shape;
$K_2$ = Correction factor for angle of attack of flow;
$K_3$ = Correction factor for bed condition;
$K_4$ = Correction factor for armoring;
a = Pier width (ft);
y = Flow depth (ft);
Fr = Froude number:

$$Fr = \frac{V}{\sqrt{gy}}$$ **(Equation 2)**

Where:

V = Average velocity (ft/s);
g = Acceleration due to gravity ($ft/s^2$).

## 8.2 Approach

Two (2) different scour depth analyses were performed to encompass the best and worst case scour depths by varying the pile geometry. The only parameters of the scour equation that change in each case are the pier width (a) and the correction factor for angle of attack ($K_2$). All other values (velocity, depth, etc.) remain the same for a given element within the modeled domain. A plane bed was assumed for the bed condition, resulting in a $K_3$ factor of 1.1. The grain size analyses collected during the EUC Phase 1 Geologic Reconnaissance Report all contained a median particle diameter of less than two (2) millimeters, resulting in a $K_4$ factor of 1.0.

### 8.3 Inputs and Assumptions

The proposed pile configuration consists of steel wide flange I-beams (W6X9). The shape correction factor was assumed to be square for both cases, resulting in a $K_1$ factor of 1.1. The worst case analysis assumed the pier width was the largest flange dimension (5.9 inches) and the angle of attack was assumed to be 90 degrees. A 90 degree angle of attack produces the largest $K_2$ value (1.3). The equation for determining $K_2$ is shown below (HEC-18):

$$K_2 = \left( Cos\theta + \frac{L}{a} Sin\theta \right)^{0.65}$$ **(Equation 3)**

Where:

L = Length of pile (ft);
Θ = Angle of attack of flow (degrees).

The worst case angle of attack assumptions mentioned above produce the most conservative scour depth results. The best case scour analysis assumed the pier width was the smallest flange dimension (3.94 inches) and the angle of attack was assumed to be zero degrees. A zero degree angle of attack produces the smallest $K_2$ value (1.0). The best case angle of attack assumptions produce less conservative scour depths and are not presented herein. A visual representation of the 100-year worst case scenario is shown on Figure 39.

### 8.4 Results

The maximum local scour depth (i.e. when the flow is aligned with the widest part of the support structure) for the DSSF using the worst case assumptions described above for the 100-year storm was 2.1 feet. The maximum total scour within the project site was 2.9 feet. This was the combination of local scour and general scour within the same model cell. This scour depth occurred for both the future conditions and future conditions including the decompaction mitigation measure. The areas of maximum scour potential are along the northwest portion of the site. The average scour depth was found to be 1.2 feet. Table 11 shows the frequency of occurrence for the more-erosive scour depths within the project site. Figure 39 shows the distribution of maximum local scour depths using worst case assumptions within the Project area for the future conditions 100-year storm.

Formation of local areas of scour can occur as a result of a large storm event or a series of smaller storm events. Local scour can be mitigated by periodic monitoring and maintenance of the site. A Monitoring and Response Plan will be utilized during operations of the DSSF to ensure that PV supports remain in stable operational condition and are not compromised by local scour impacts.

**Table 11. Local Scour Summary: 100-year Worst Case Frequency of Occurrence within the Project Site for Decompaction**

| Depth of Scour | Local Scour | Total Scour |
|---|---|---|
| 0.0 to 0.5 feet | 0.2% | 0.2% |
| 0.5 to 1.0 foot | 20.6% | 20.0% |
| 1.0 to 1.5 feet | 63.3% | 57.5% |
| 1.5 to 2.0 feet | 15.9% | 20.6% |
| 2.0 to 2.5 feet | 0.1% | 1.5% |
| 2.5 to 3.0 feet | 0.0% | 0.2% |
| Average Scour Depth | 1.2 ft | 1.3 ft |
| Maximum Scour Depth | 2.1 ft | 2.9 ft |

The less erosive-case (i.e. when flow direction is aligned with the narrow side of the support structure) maximum scour depth was 1.2 feet and total scour was 2.2 feet. Frequency of occurrence can be found in Table 12 for the less-erosive case.

**Table 12. Local Scour Summary: 100-year Best Case Frequency of Occurrence within the Project Site for Decompaction**

| Depth of Scour | Local Scour | Total Scour |
|---|---|---|
| 0.0 to 0.5 feet | 11.3% | 10.8% |
| 0.5 to 1.0 foot | 86.1% | 79.6% |
| 1.0 to 1.5 feet | 2.5% | 8.9% |
| 1.5 to 2.0 feet | 0.0% | 0.7% |
| 2.0 to 2.5 feet | 0.0% | 0.1% |
| Average Scour Depth | 0.7 ft | 0.8 ft |
| Maximum Scour Depth | 1.2 ft | 2.2 ft |

## 9 CONCLUSIONS

The results of the storm water modeling are:

1 Results of the hydrologic analysis for the DSSF development indicated that implementing decompaction of the areas between the panels will reduce the post development hydraulic conditions to within +/-5% of the pre-development hydraulic conditions. An additional on-site mitigation measure such as basins with rip-rap protection, check dams or strip detention basins can be implemented to retain the remaining excess total off-site storm water volume increase. Please note that the accuracy of the model is approximately +/- 5% and so the differences (i.e. within 5%) calculated by the model are within this range.

2 Results of the hydrologic analysis for the post-development DSSF grading design without the addition of a mitigation measure indicated that, in general, storm water off-site peak flow rates and volumes increased 5.8% and 2.3%, respectively for the 100-year storm event and 6.7% and 5.5respectively for the 10-year storm event. On-site velocities increased 17.4% for the 100-year and 19.4% for the 10-yearand on-site flow depths decreased 4.5% for the 100-year and 7.1% for the 10-year, as compared to the pre-development existing conditions

3 Results of the hydrologic analysis for post-development design that only includes a decompaction mitigation measure indicated that the storm water off-site peak flow rate and volume increased 5.1% and 1.1%, respectively for the 100-year storm event and 2.6% and 2.5%, respectively for the 10-year storm event. On-site velocity increased 15.2% for the 100-year and 19.4% for the 10-year, and on-site peak depth decreased 4.5% for the 100-year and 7.1% for the 10-year storm event, as compared to the existing conditions.

4 Results of the hydrologic analysis for post-development design that only includes a rip-rap mitigation measure indicated that the storm water off-site peak flow rates and volume, and on-site depth slightly increased 0.6%, 2.3%, and 4.5%, respectively for the 100-year storm event. On-site peak velocity did not change, as compared to the pre-development existing conditions for the 100-year storm event. However, for the 10-year storm event, storm water total off-site outflow volume and on-site peak flow depth increased, 5.5% and 7.1%, for the 10-year storm event. Off-site peak flow rate and on-site peak velocity decreased 3.0% and 6.5% for the 10-year storm event, compared to the existing conditions.

5 The addition of mitigation measures such as basins with rip-rap protection, check dams, or strip detention basins to the DSSF development in addition to decompaction, will address excess post-development hydraulic impacts that are not addressed by decompaction. These additional measures are based on implementing storm water best management practices and have not been rigorously modeled, however they would be designed to retain excess total off-site storm water volume. The intent of an additional mitigation measure is to reduce overall flow depths, velocities and outflow volume by detaining run-on storm water volume. The additional measures would also be successful at reducing potential increases in sediment transport and would be designed to retain the excess total volume capacity which is on the order of 50 ac-ft for the 10-year storm event. Results of the sediment transport analysis for post-development determined that the average degradation for the 100-year and the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions. The average degradation depth for the 100-year storm would be 0.04 feet, and 0.01 feet for the 10-year storm (i.e., general scour).

6 Results of the total scour analysis for post-development found that the average on-site scour depth would be 0.8 to 1.3 feet at the base of the PV supports for the 100-year storm, depending on the angle of flow to the supports. Placement of riprap will provide a less significant benefit to mitigate for additional runoff. However, riprap placed at the base of each support structure will help reduce the effects of local scour and lower storm water runoff velocities.

7 Results of the qualitative fluvial geomorphologi c analysis indicates existing areas of relatively inactive sediments characterized by desert pavement and more active areas consisting of finer sand and gravel. The changes to the site resulting from Project development will create an area that has

consistent compaction, soil type and grading compared to existing conditions. It is anticipated that these changes will create a geologic environment conducive to the formation of shallow channels up to two feet or less in depth (i.e. long-term scour). This long term scour can be mitigated by periodic monitoring to identify changes to the site grading and maintenance activities as/if needed to restore design conditions.

The results of the modeling indicate that the DSSF development would have a small impact on off-site peak flow rate and a negligible increase in maximum degradation depth comparing pre-development conditions to post-development conditions. These impacts are relatively small. However, the implementation of storm water mitigation measures will minimize impacts of the DSSF development on sedimentation and erosion characteristics in downstream areas with the result that post-development downstream conditions are essentially the same as pre-development existing conditions.

Along with the mitigation measures, a Monitoring and Response Plan will be prepared and submitted to the BLM. The Monitoring and Response Plan will indicate the procedures that will be followed to mitigate potential impacts to the site structures, storm water infrastructure or site grading that can occur from local scour, sediment transport and long term degradation (i.e. fluvial geomorphology) during the operation of the DSSF. This plan will address monitoring of the mitigation measures after storm events and development of appropriate maintenance responses so that the mitigation measures are in good working order and continue to be effective for subsequent storm events. Because the differences are so small (i.e. within +/- 5%) and there are a number of unknowns associated with real life conditions (i.e. compared to computer simulation), it is recommended that after each significant event (e.g. a 1-year storm or larger) hydrologic, hydraulic and sediment transport characteristics to be monitored. If acute or chronic problems are detected then modifications can be made as necessary.

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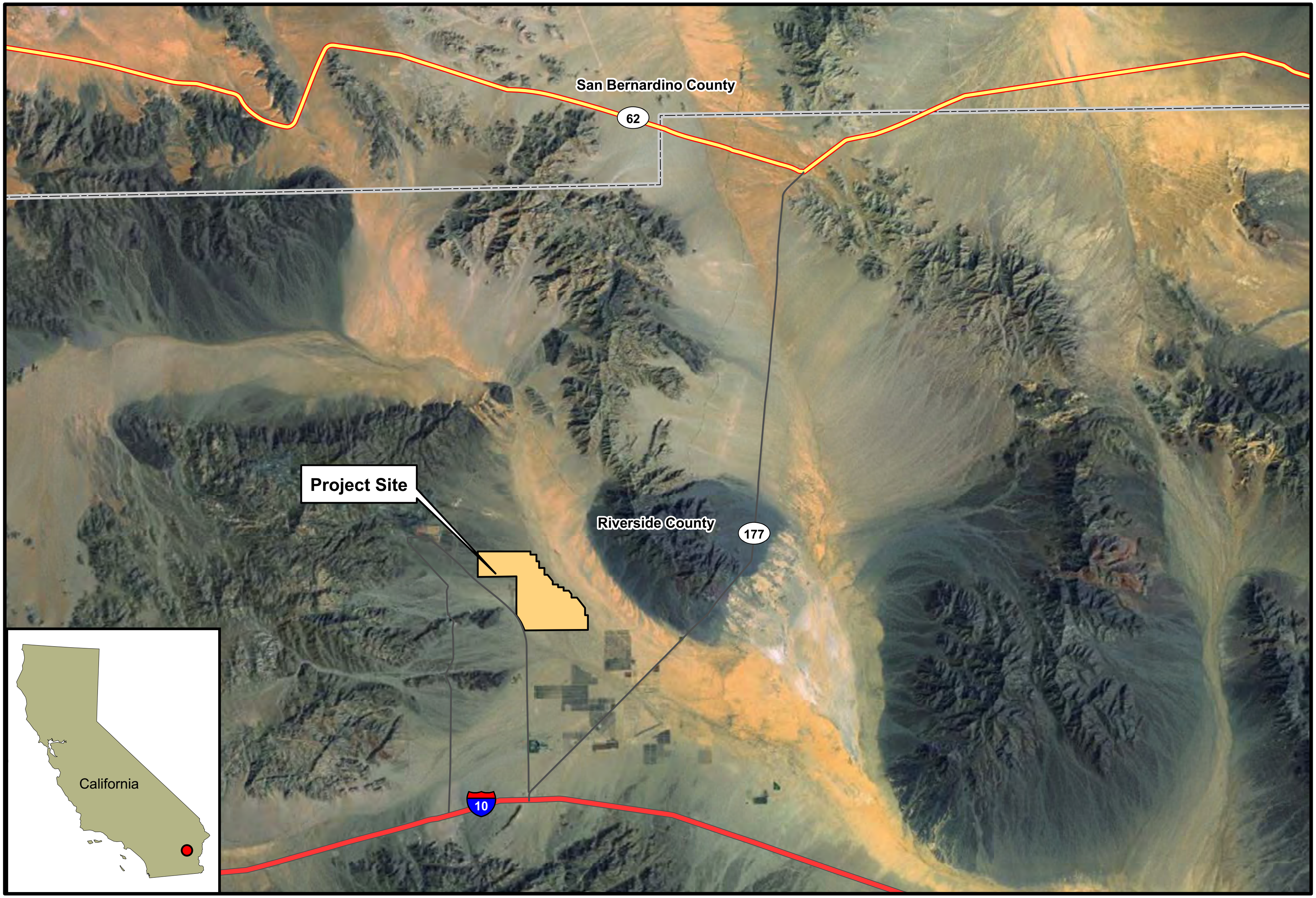


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Figure 1
Desert Sunlight Solar Farm
Locus Map

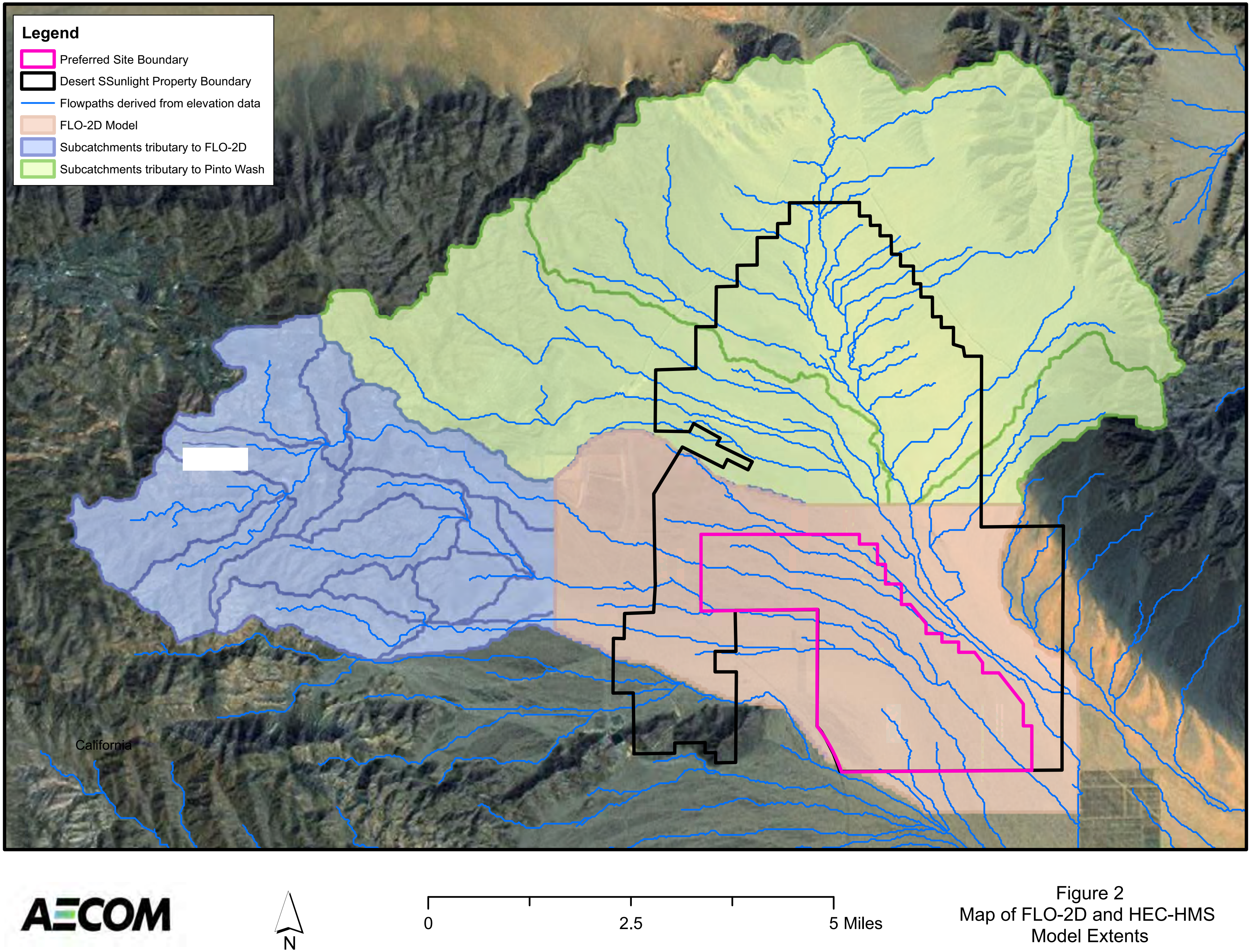


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Figure 2
Map of FLO-2D and HEC-HMS
Model Extents

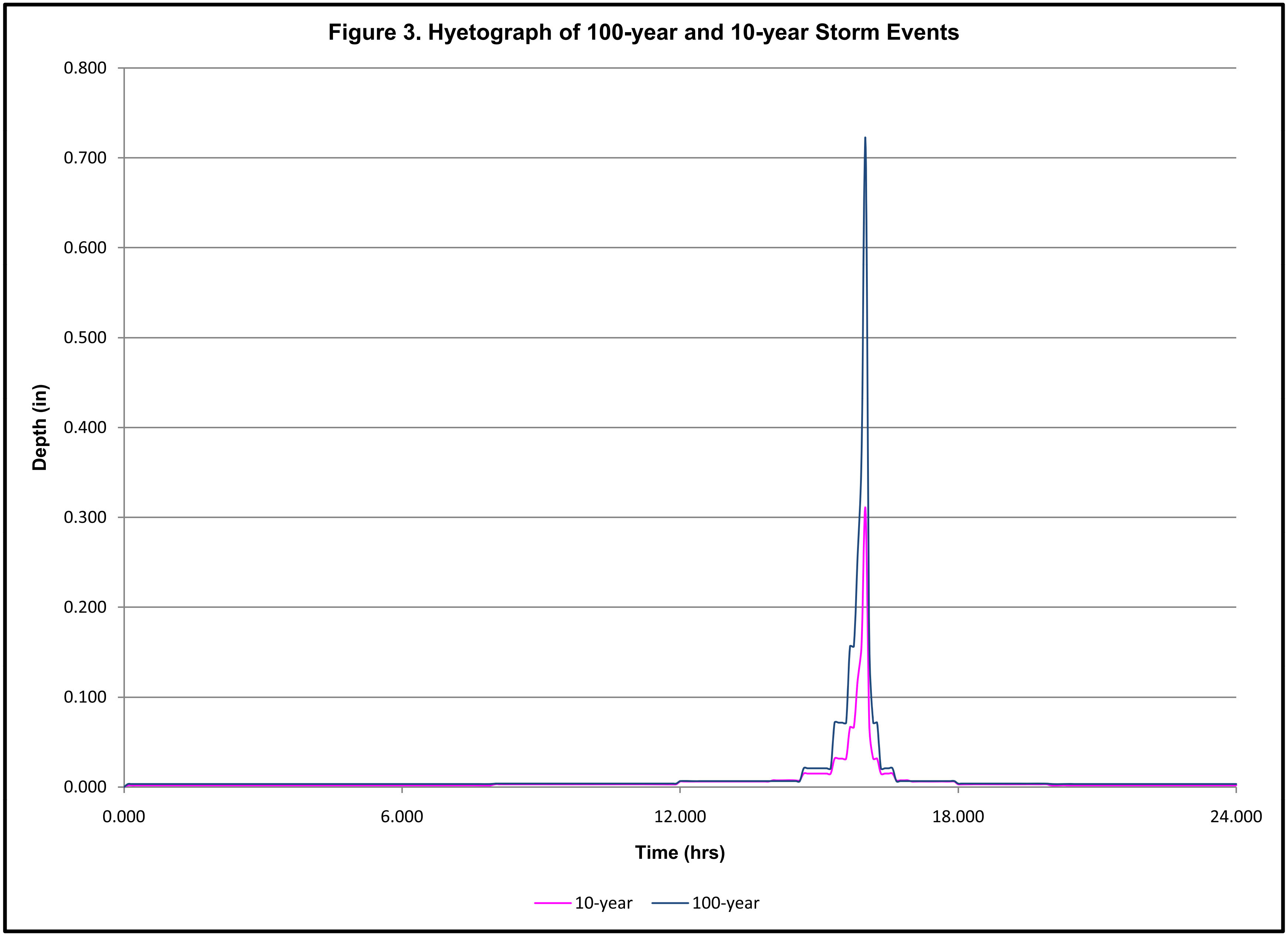


Figure 3. Hyetograph of 100-year and 10-year Storm Events
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Depth (in)
0.000
6.000
12.000
18.000
24.000
Time (hrs)
10-year
100-year

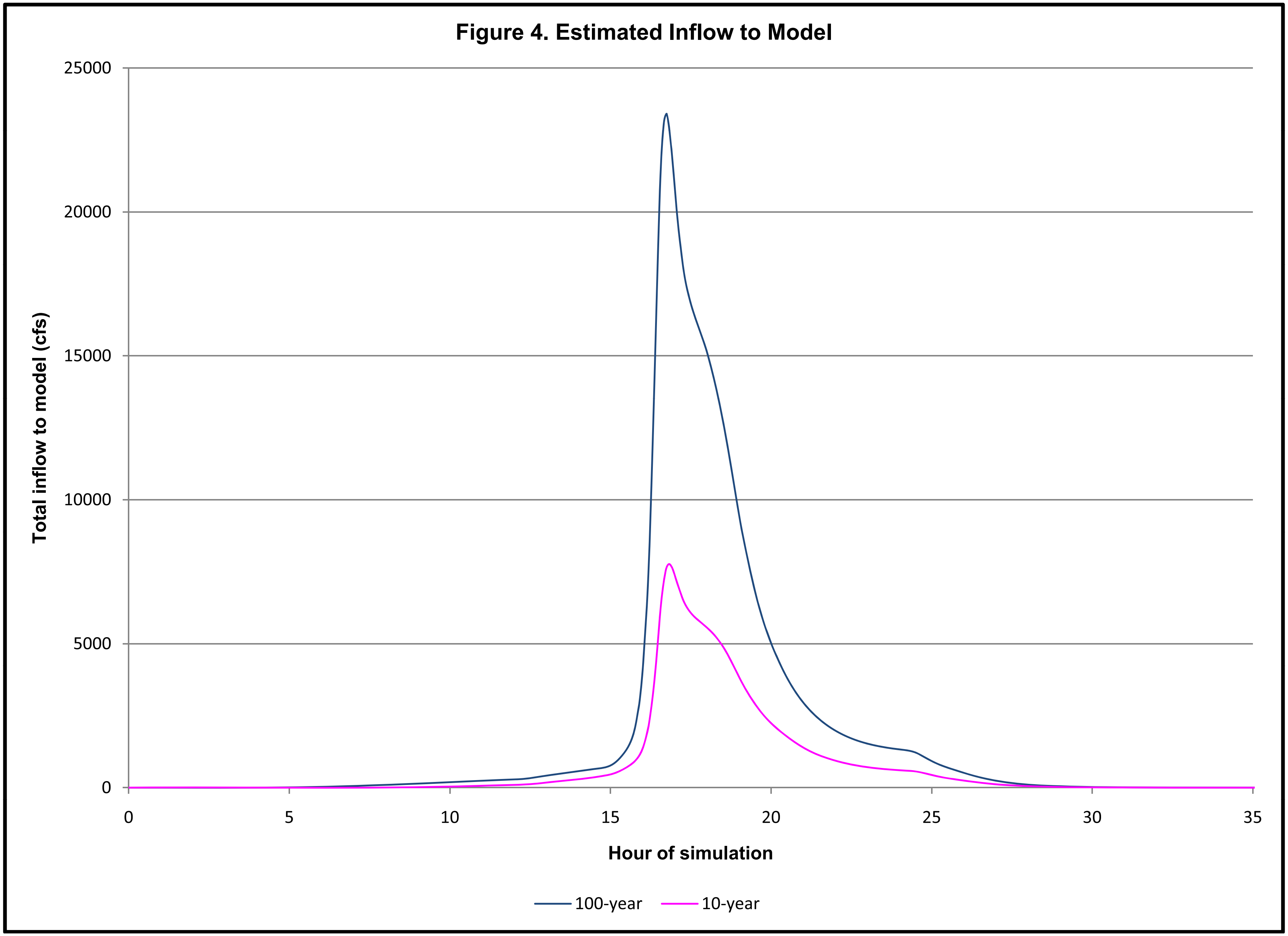
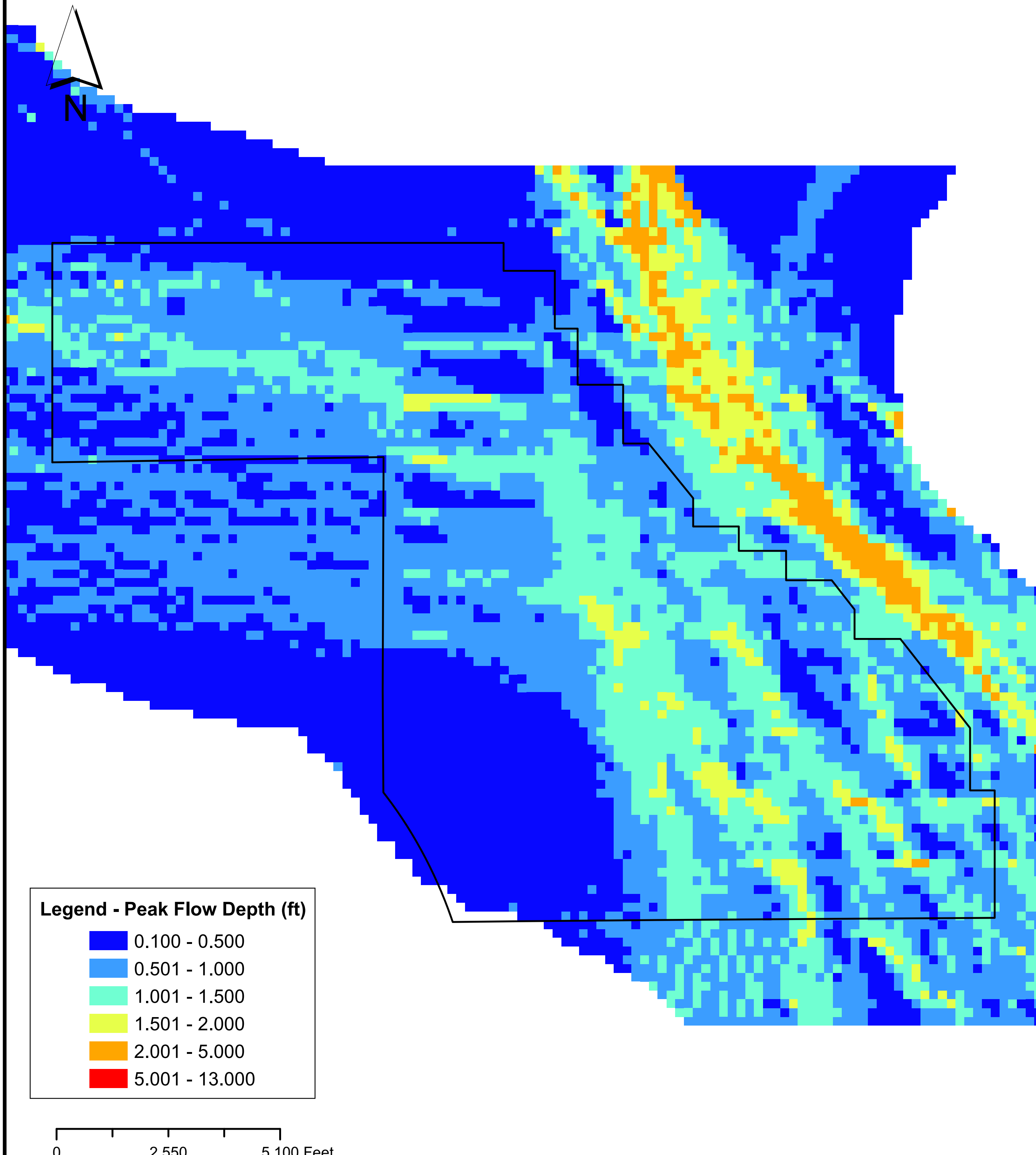


Figure 4. Estimated Inflow to Model
25000
20000
15000
10000
5000
0
Total inflow to model (cfs)
0
5
10
15
20
25
30
35
Hour of simulation
100-year
10-year




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 03/05/2010 | Figure 5 |
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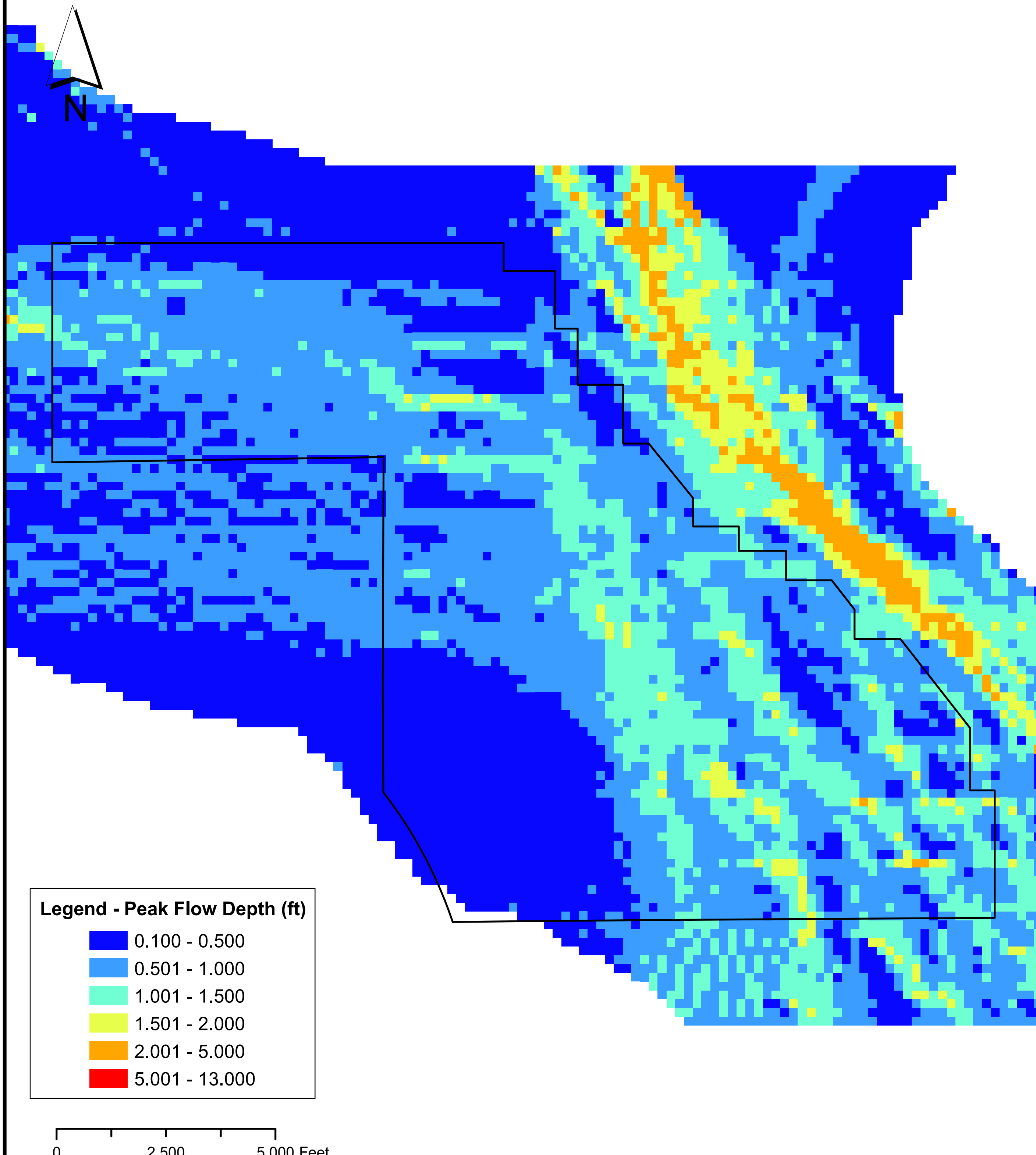


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 6 |
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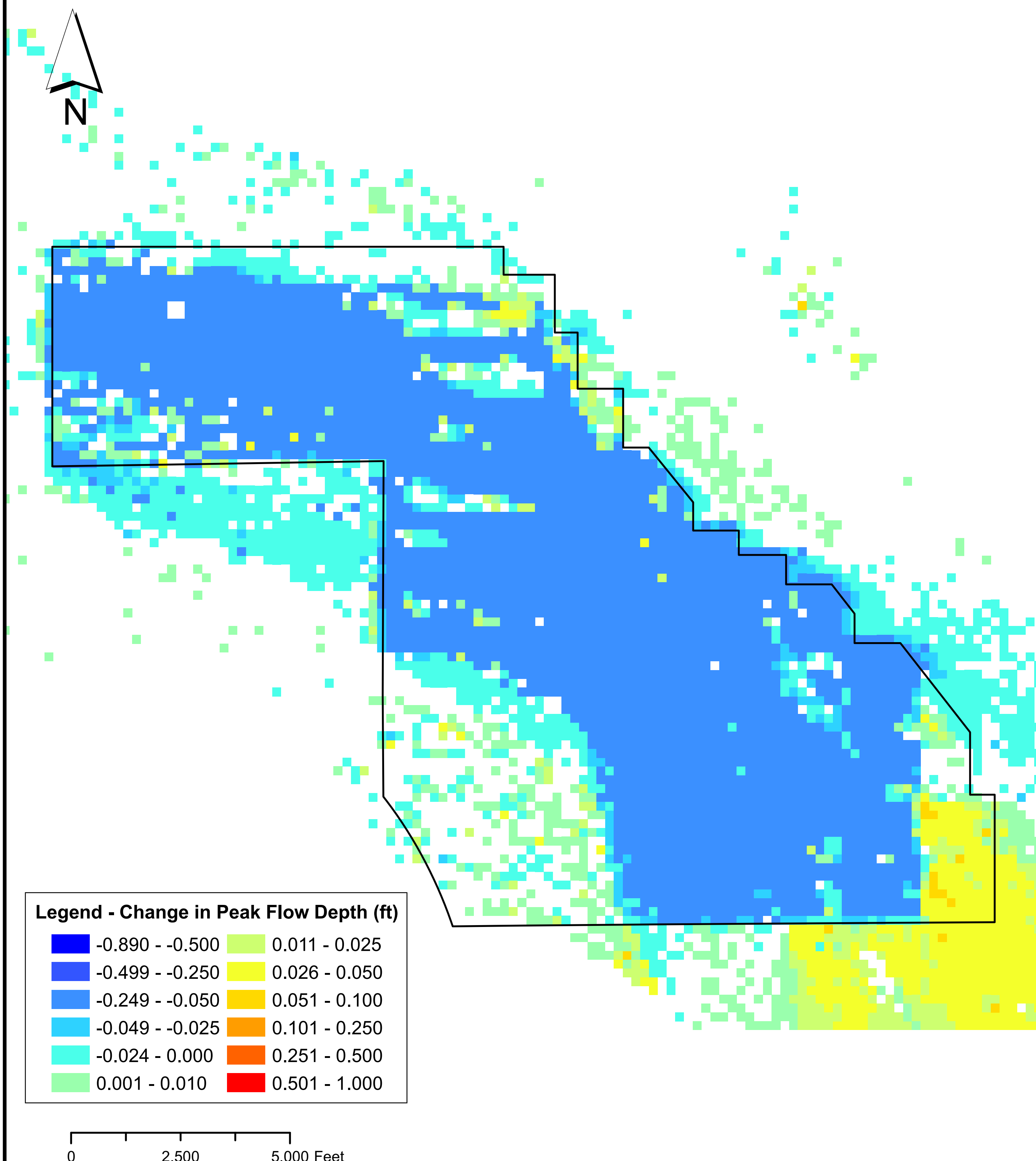


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Flow Depth (Future - Existing)

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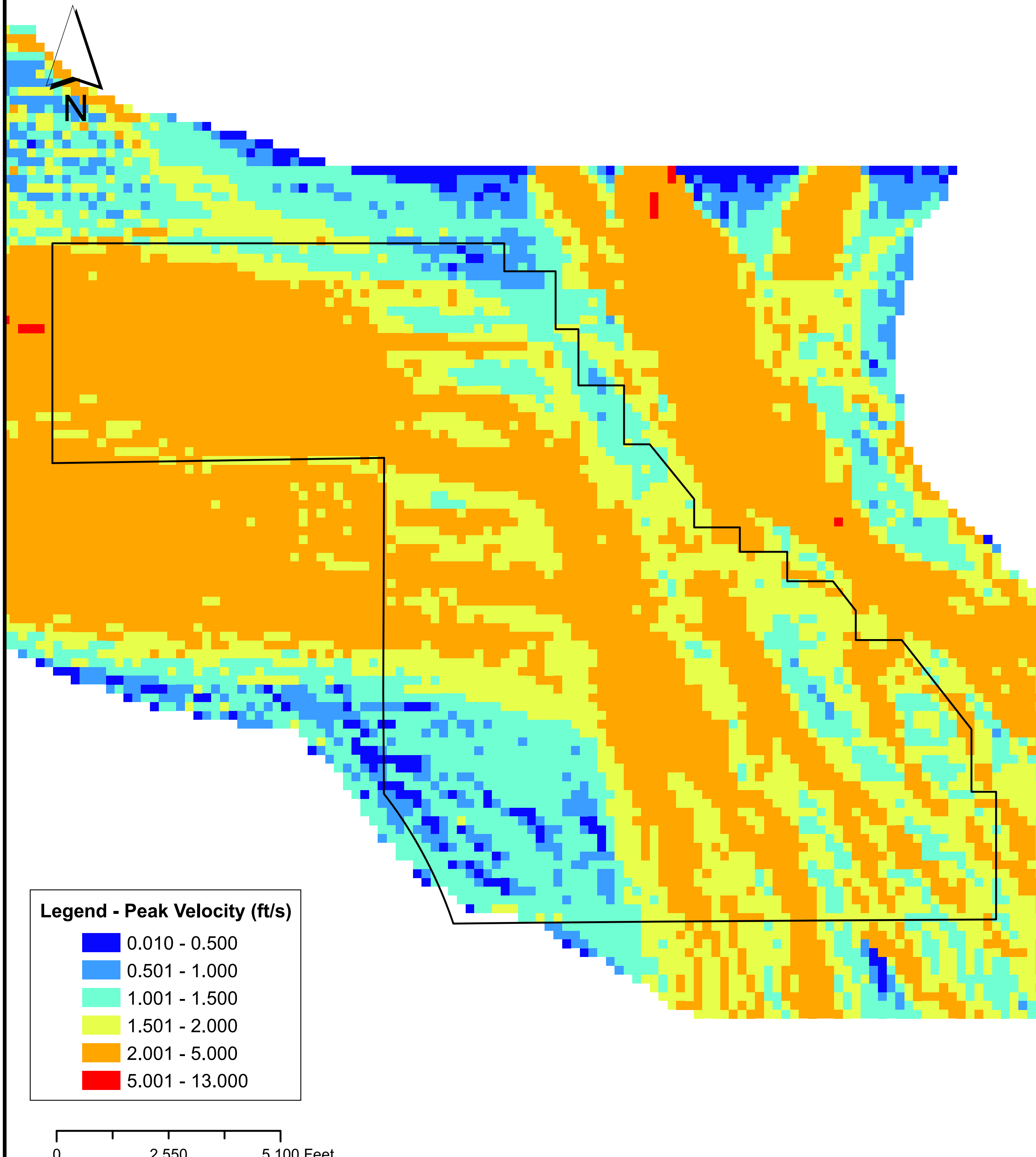


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/05/2010 | Figure 8 |
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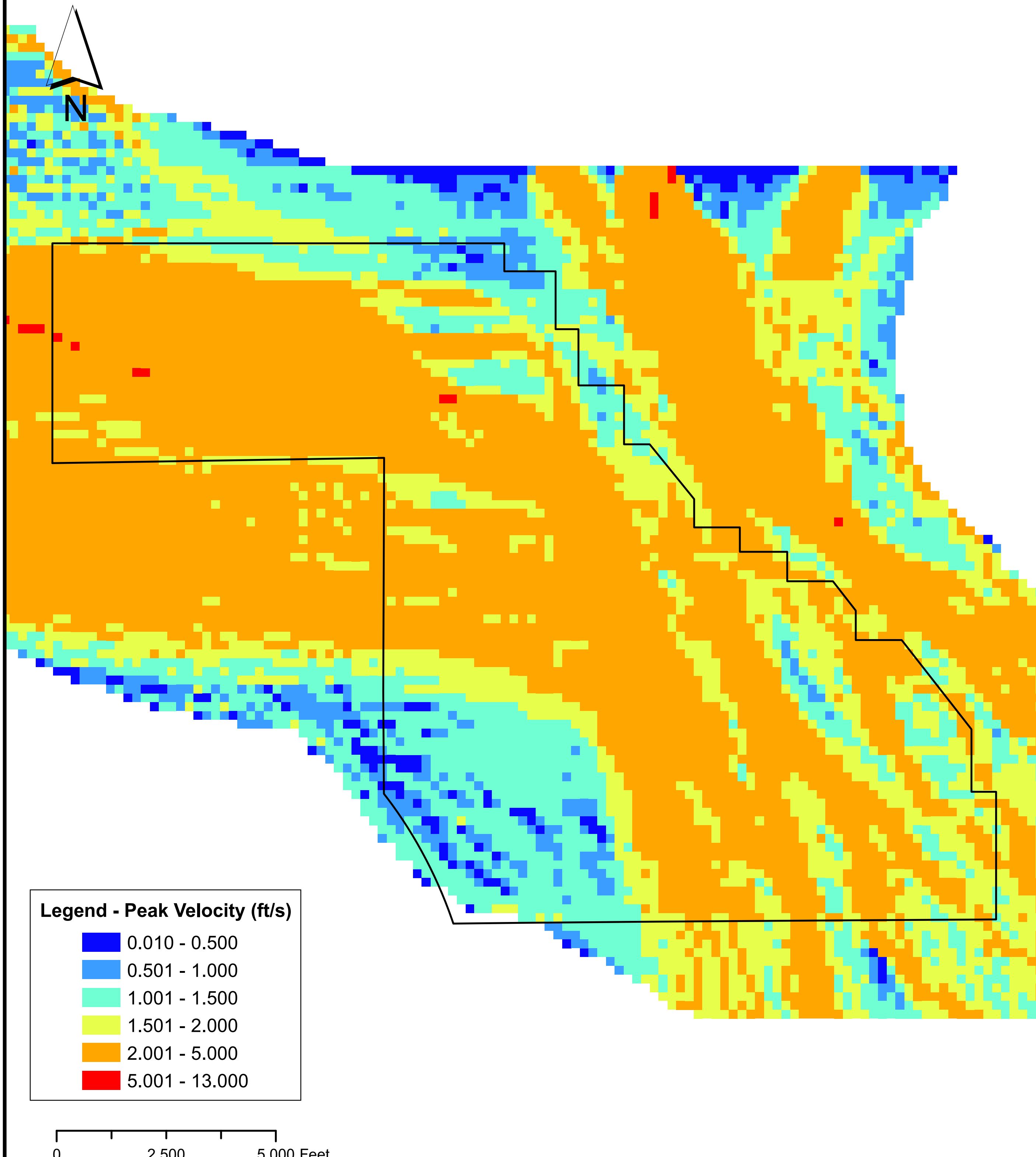


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 9 |
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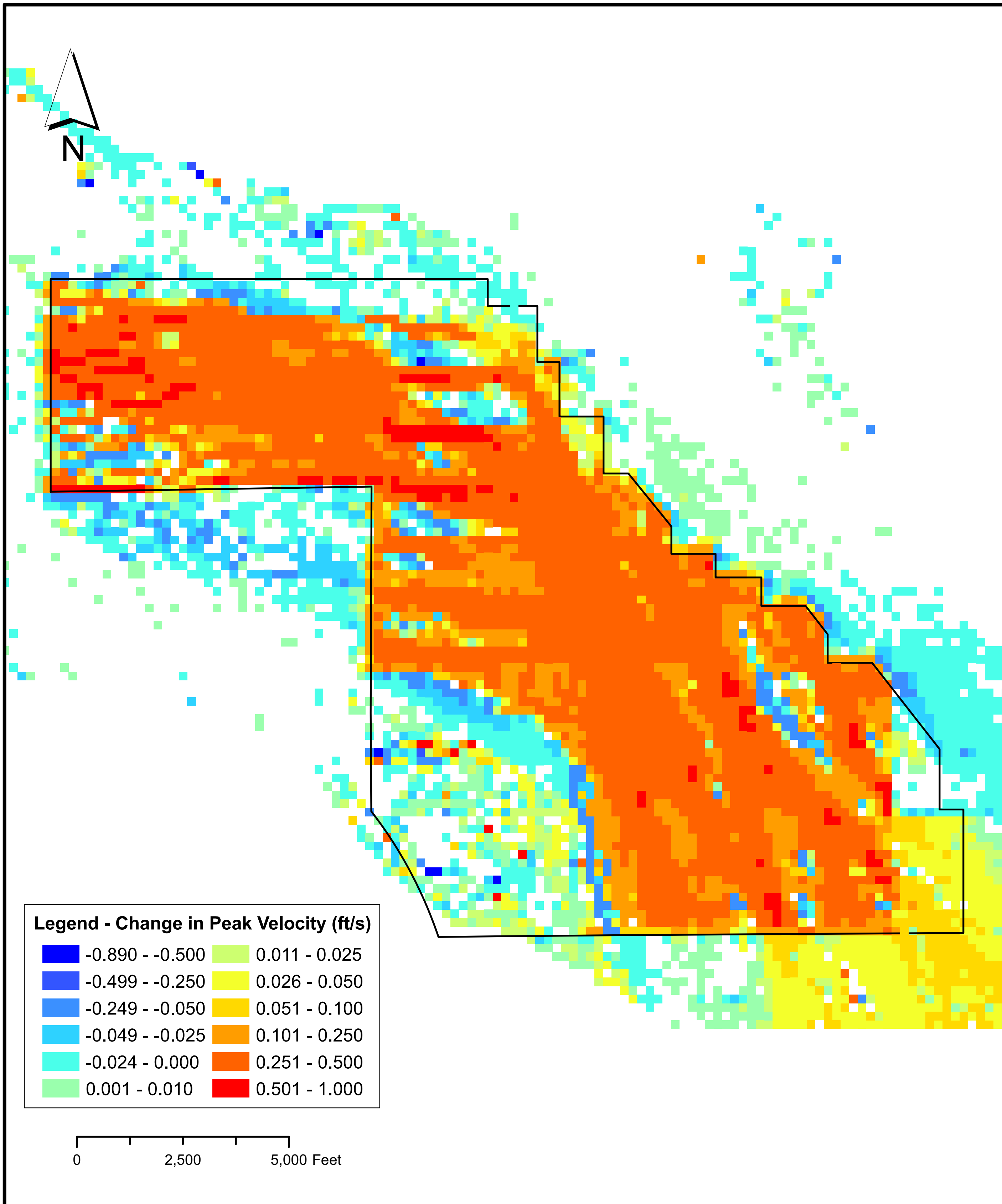


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Velocity (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 10 |
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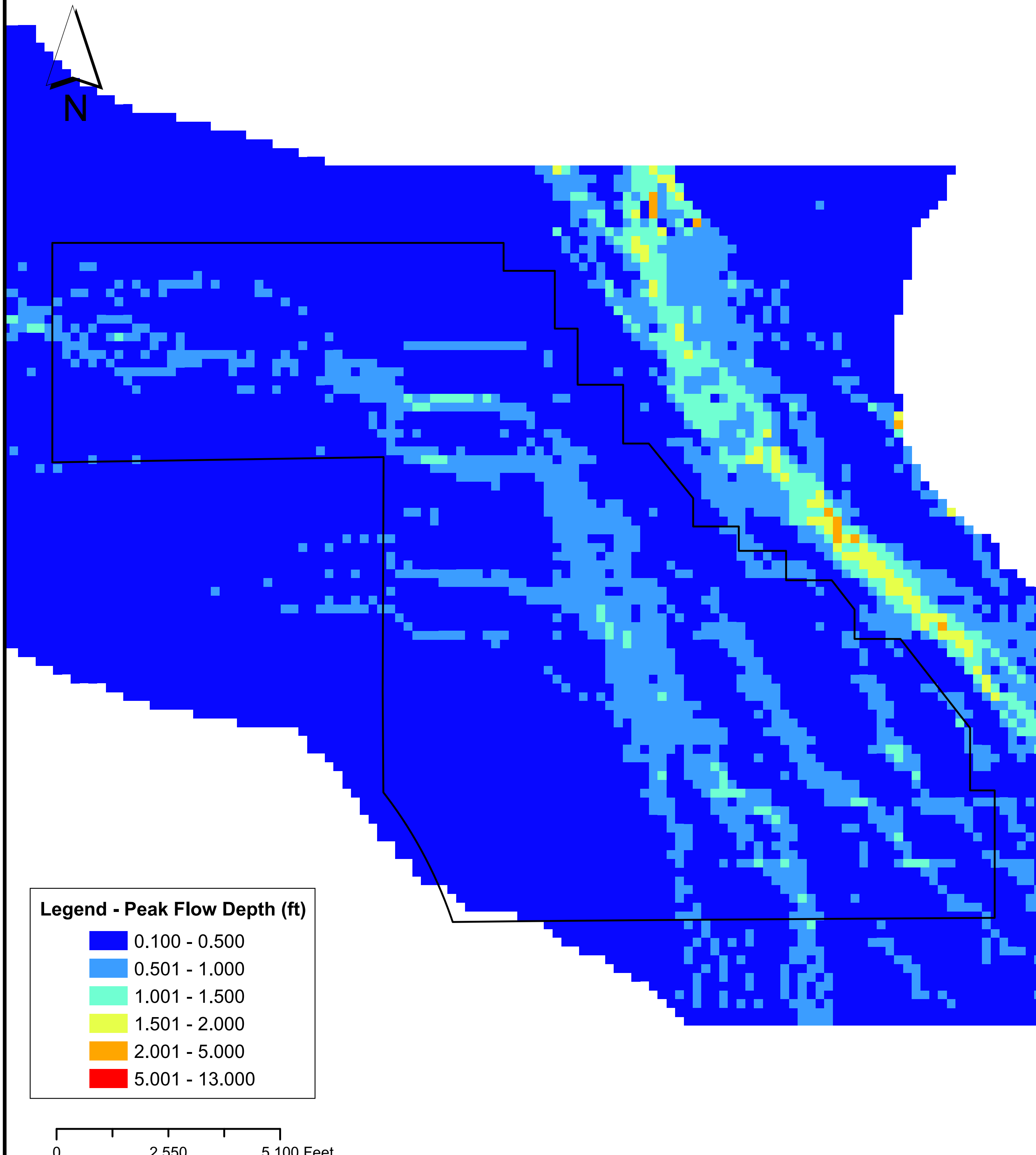
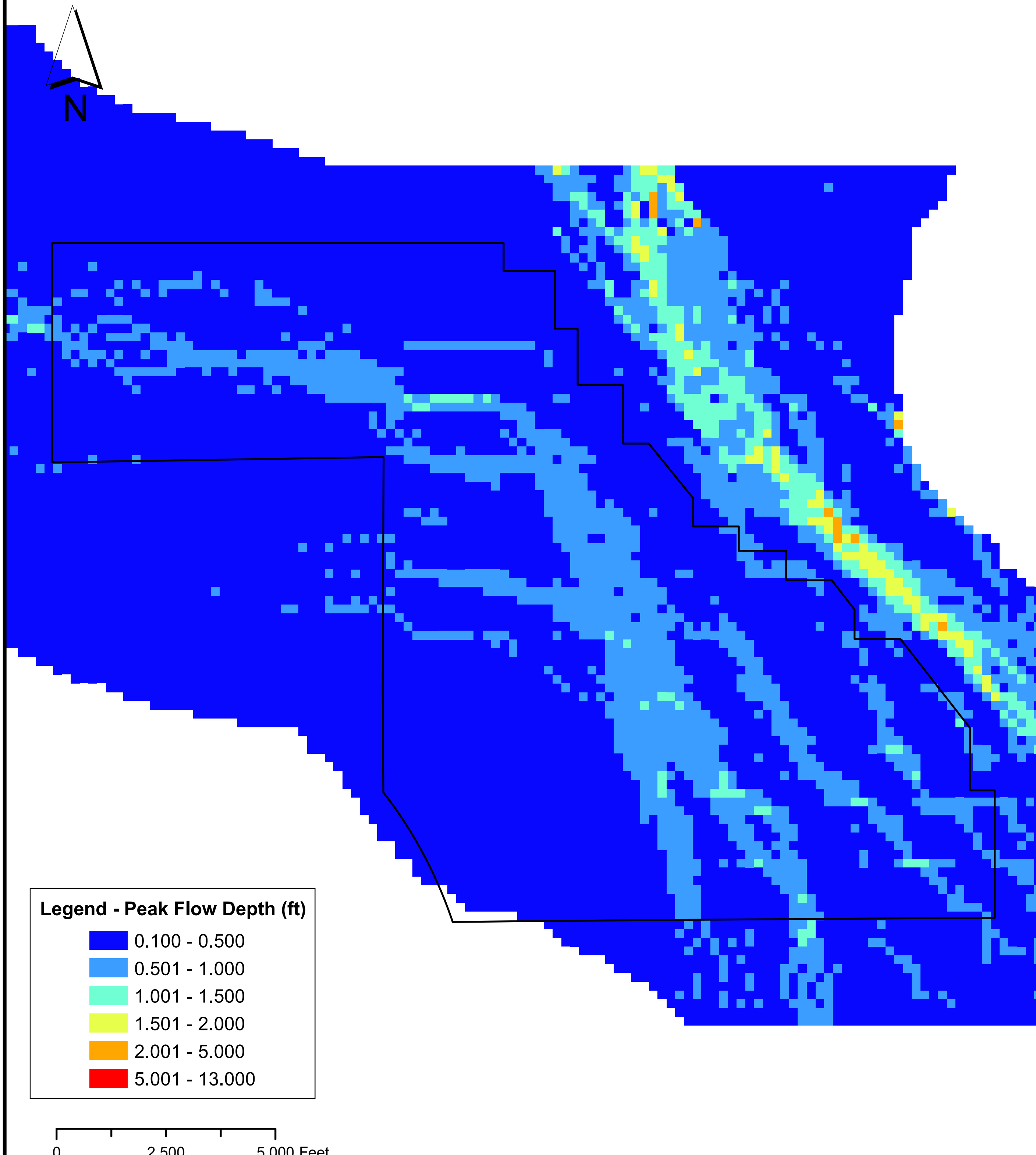



AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Existing Conditions Peak Flow Depth

| | | | |
|---|---|---|---|
| GIS FILE: | SCALE: AS NOTED | DATE: 03/05/2010 | Figure 11 |




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 12 |
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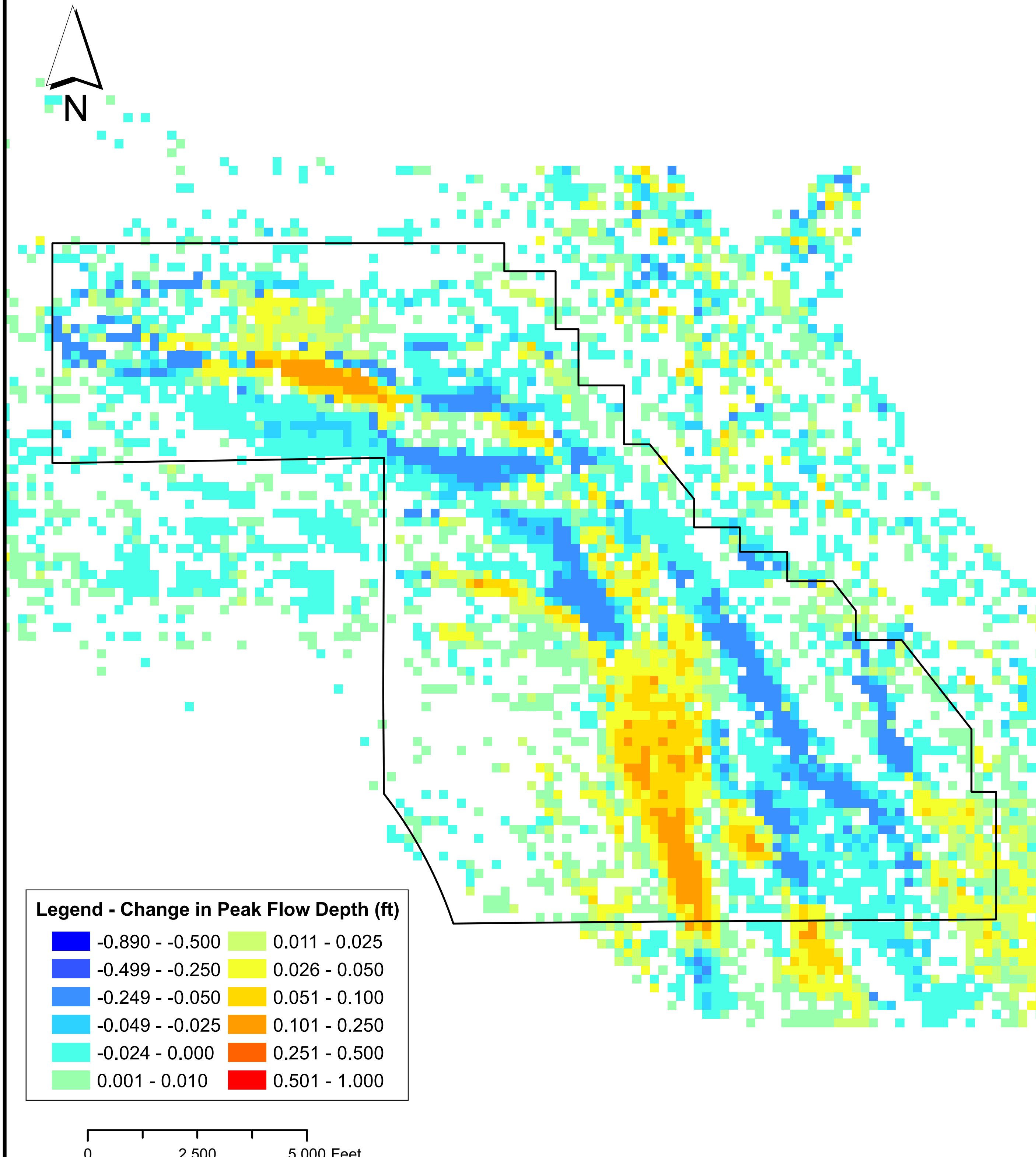


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Flow Depth (Future - Existing)

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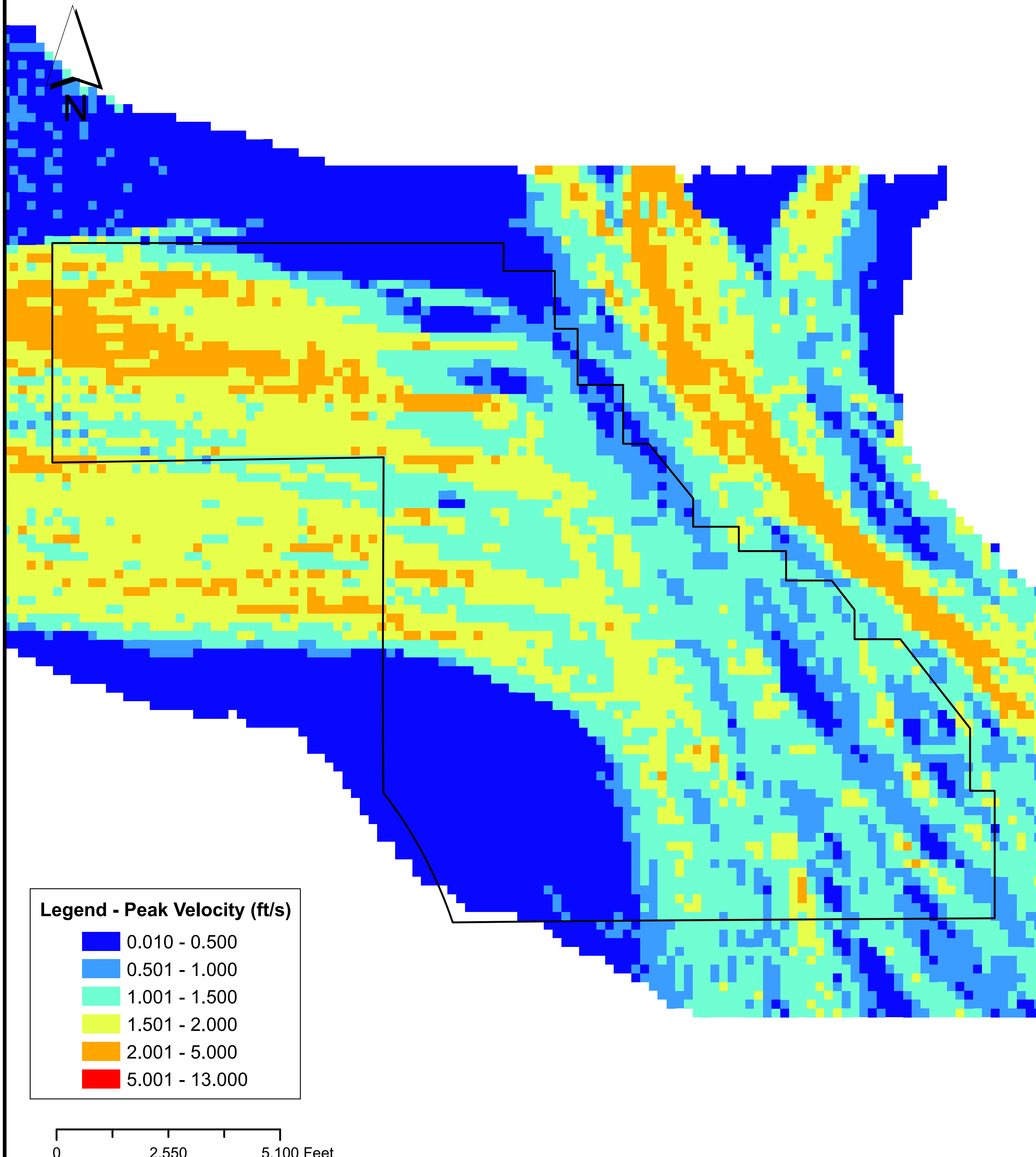


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Existing Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/05/2010 | Figure 14 |
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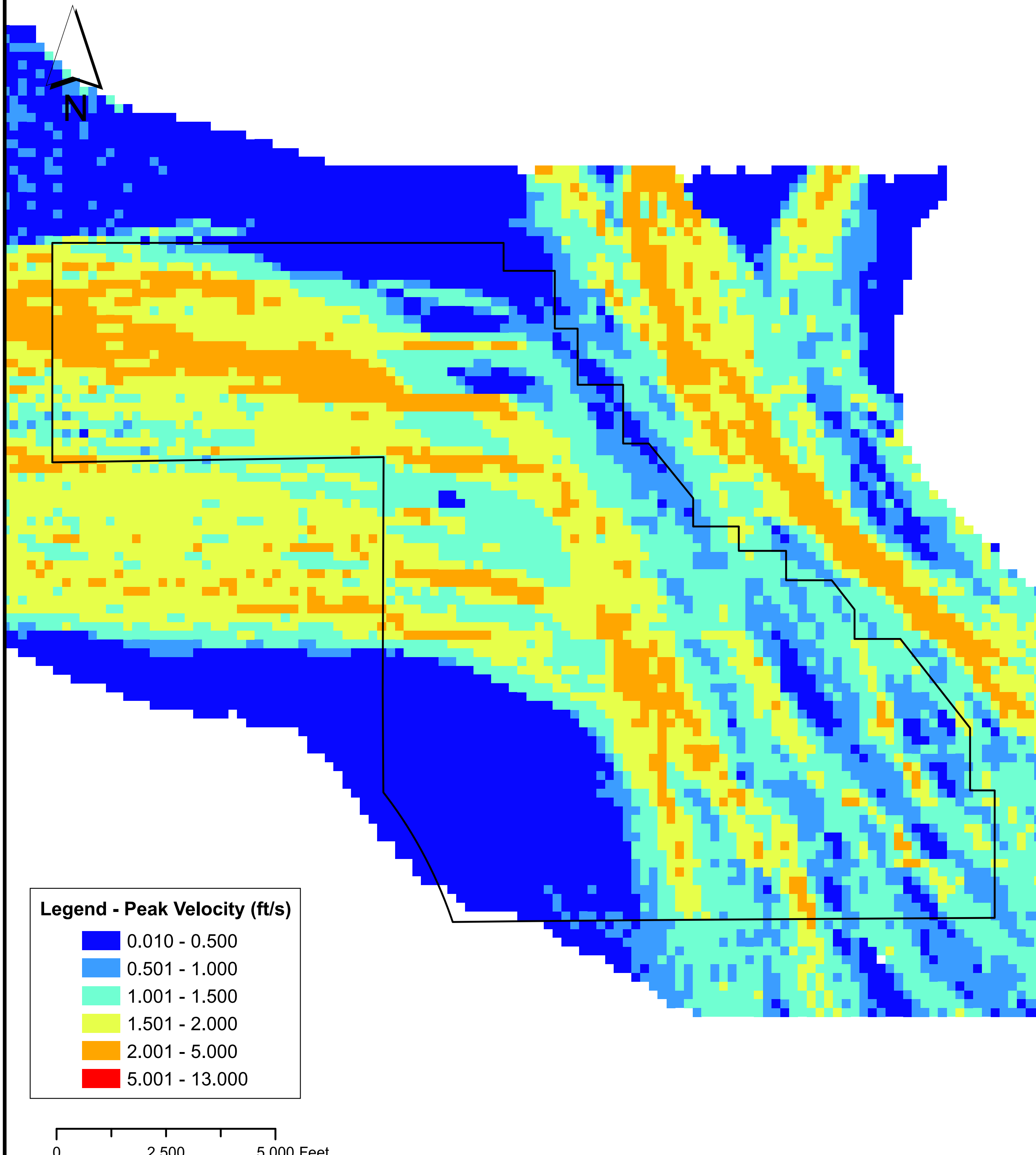



AECOM

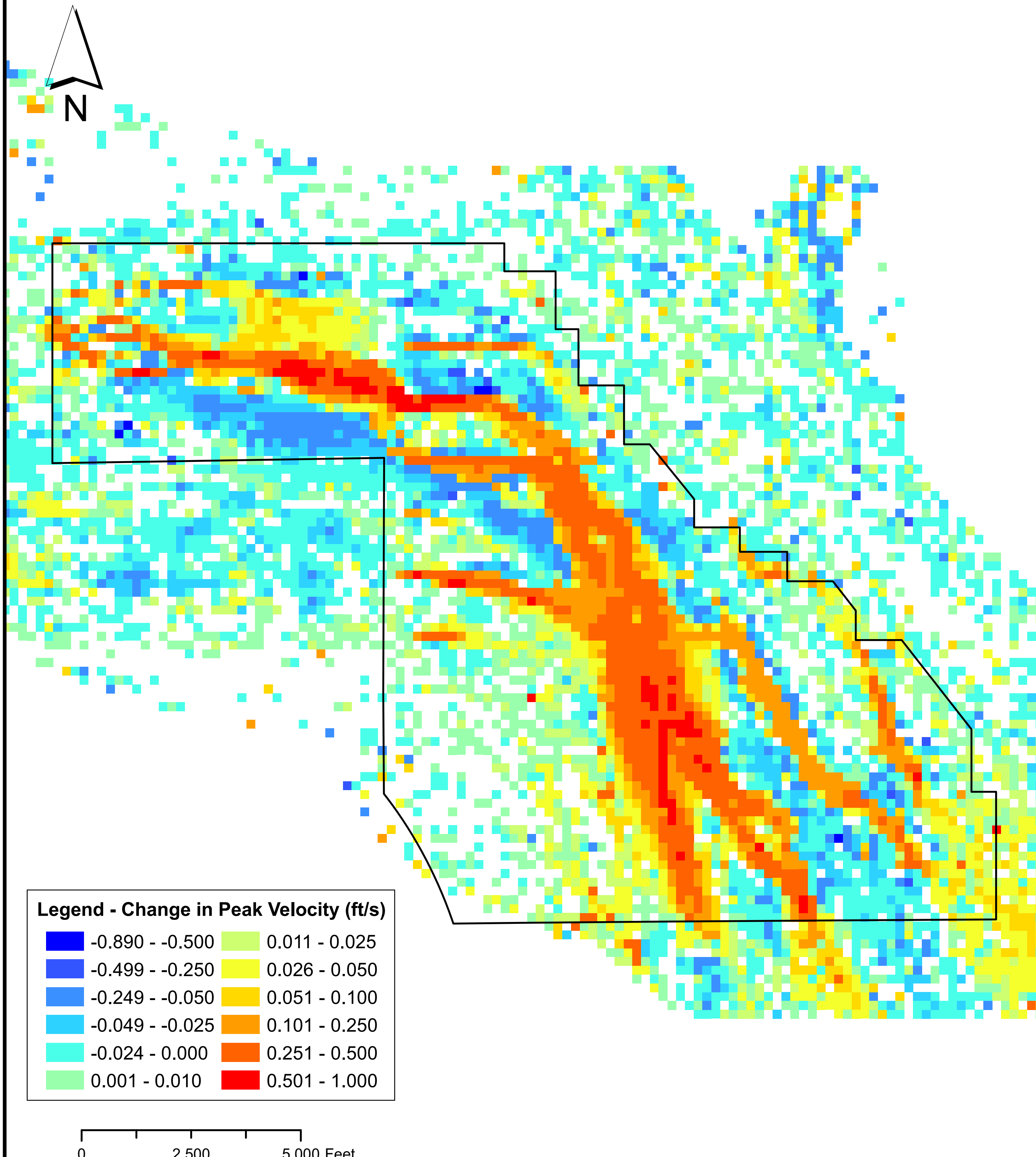
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Peak Velocity

GIS FILE:

SCALE: AS NOTED

DATE: 02/17/2010

Figure 15




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Velocity (Future - Existing)

| | | | |
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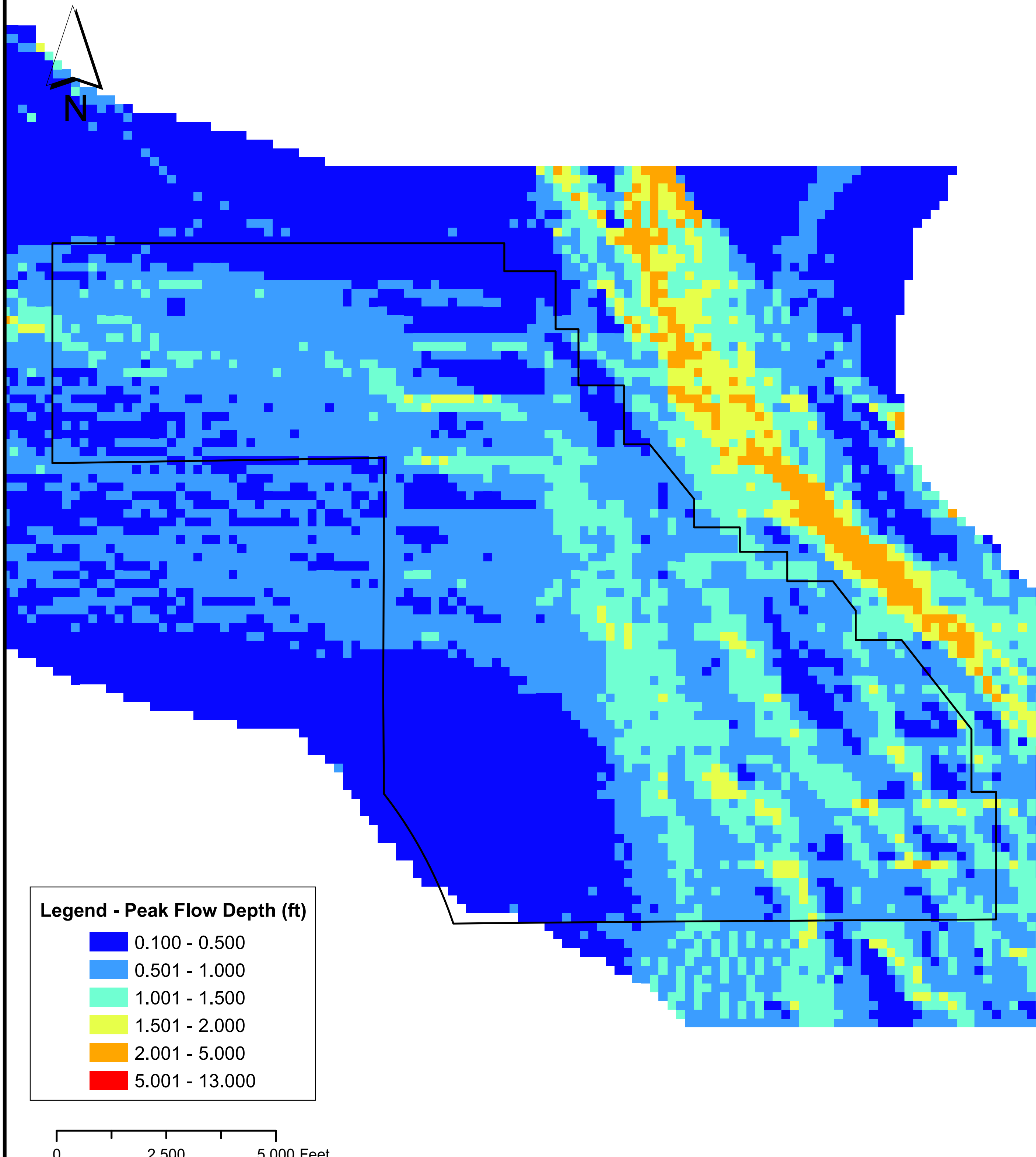
| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 16 |




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Decompact Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 17 |
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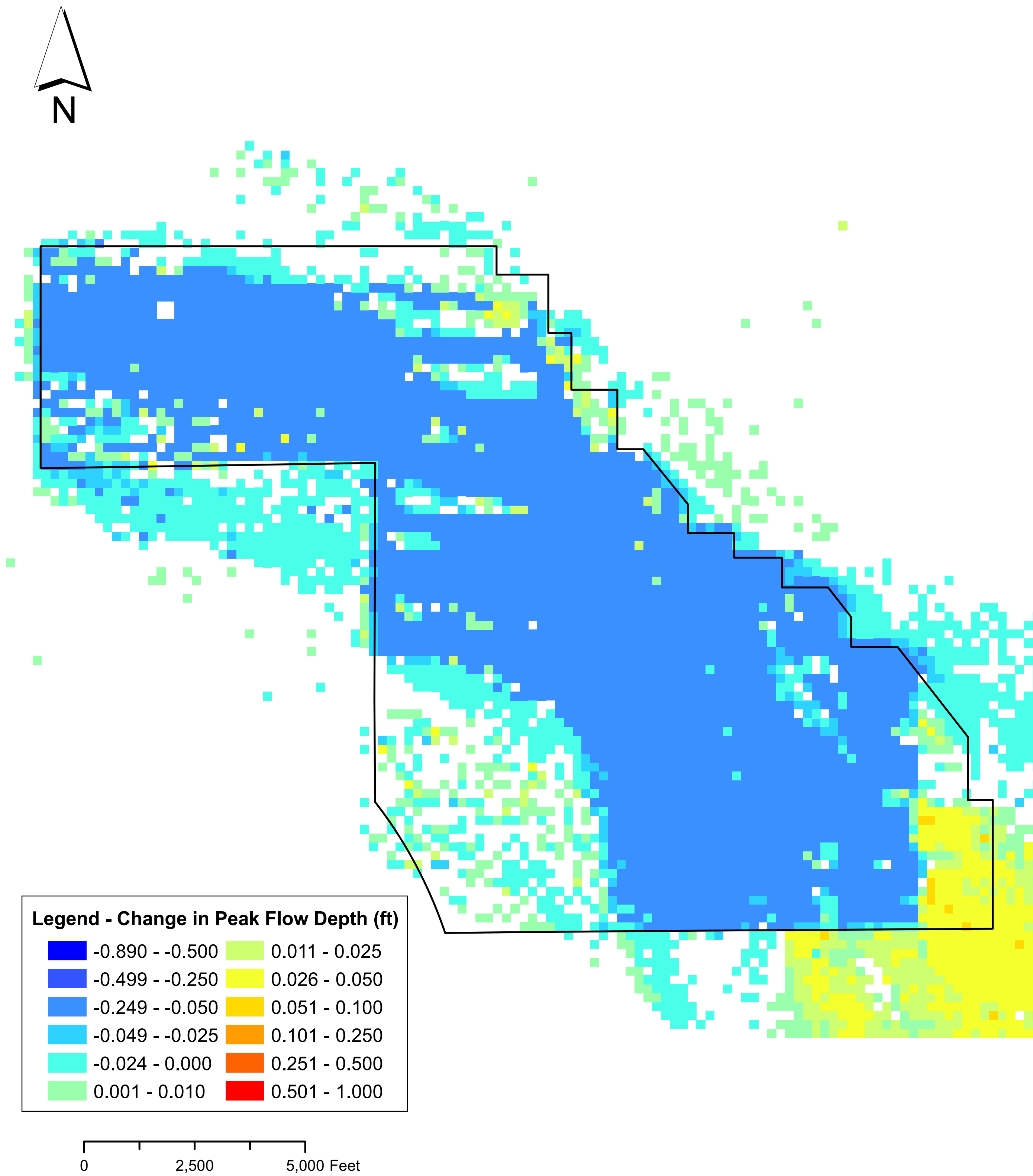


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change Peak Flow Depth (Future Decomp - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 18 |
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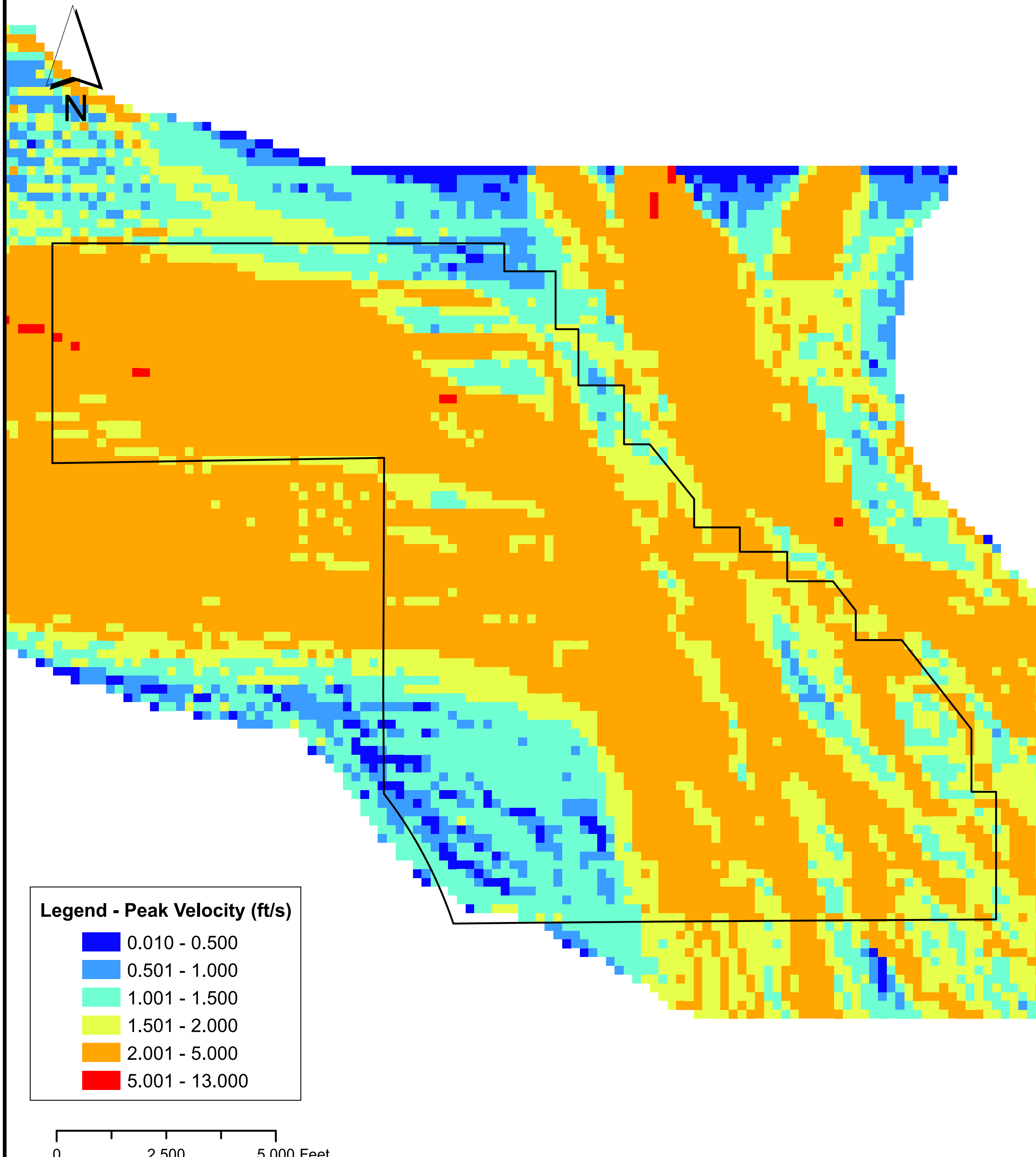
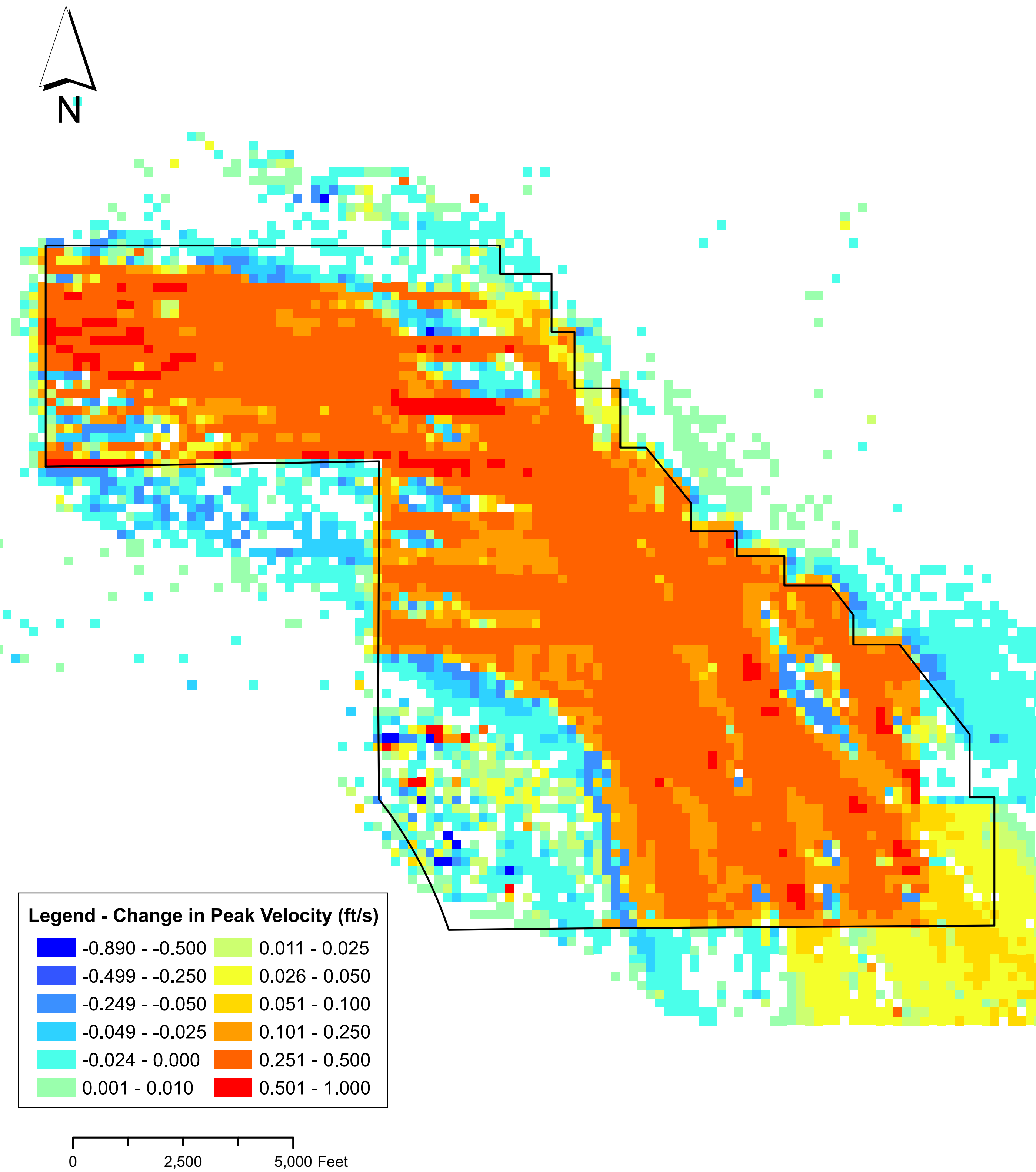



AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Decompact Peak Velocity

| | | | |
|---|---|---|---|
| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 19 |




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change Peak Velocity (Future Decomp - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 20 |
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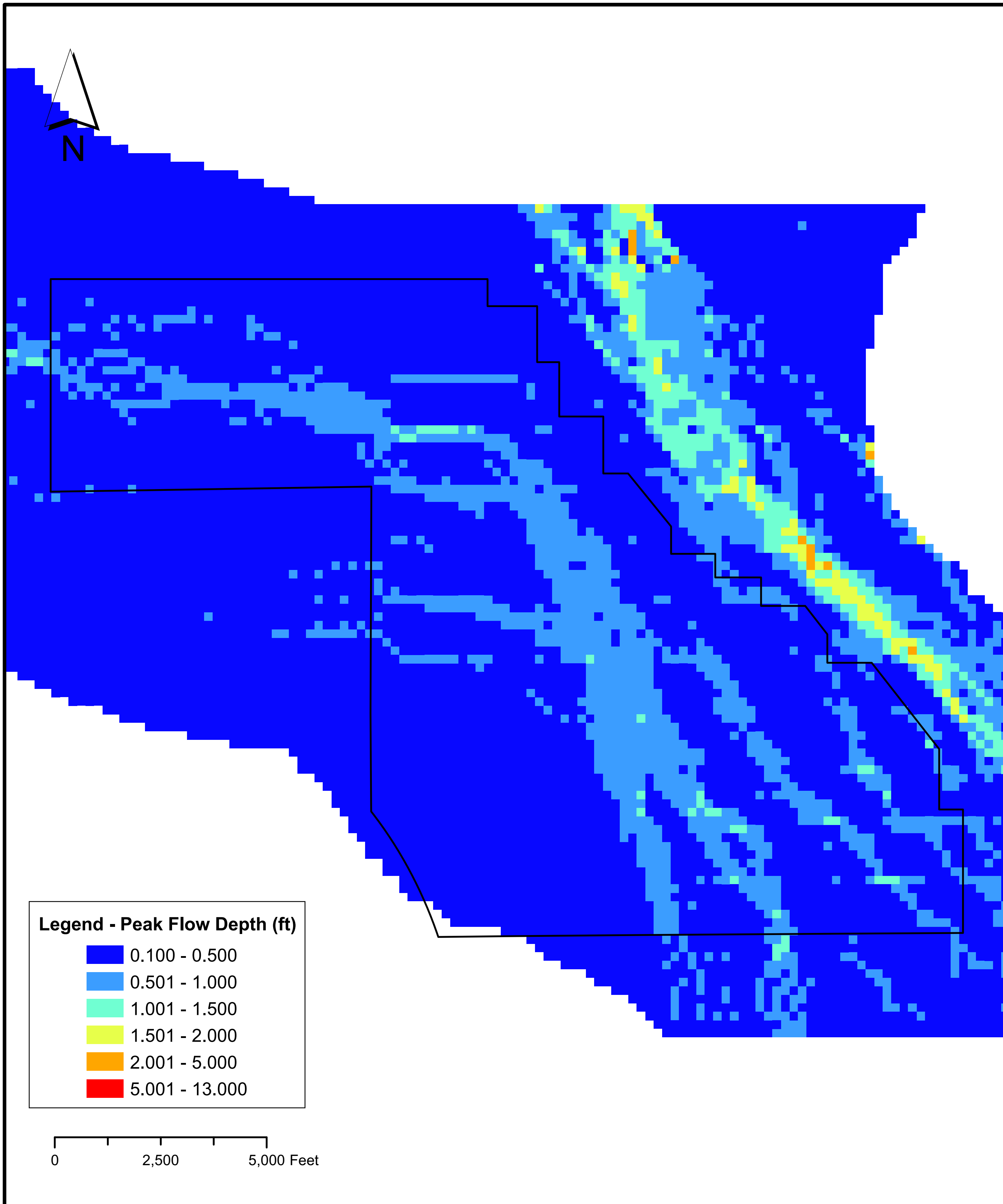


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Decompact Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 21 |
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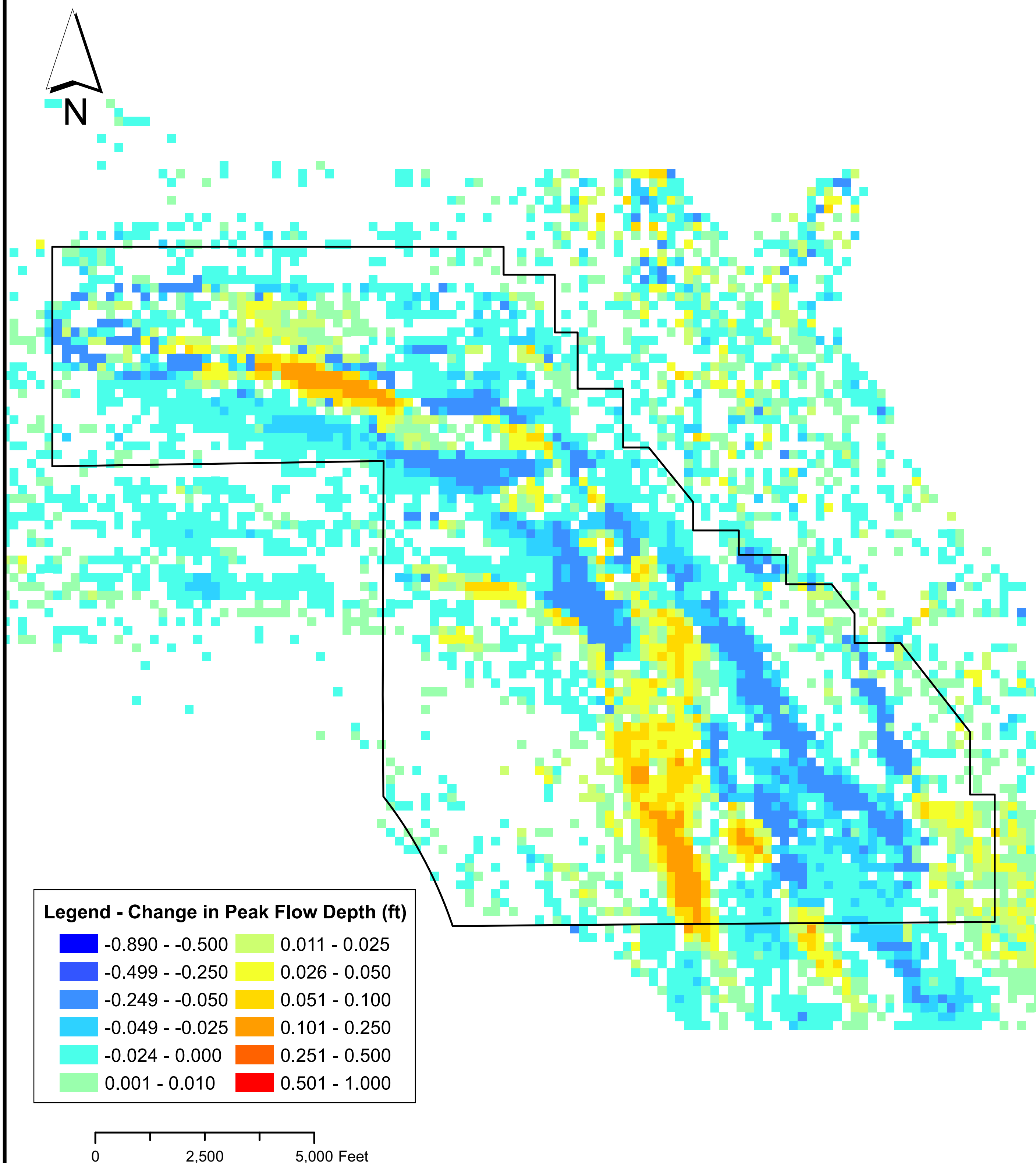
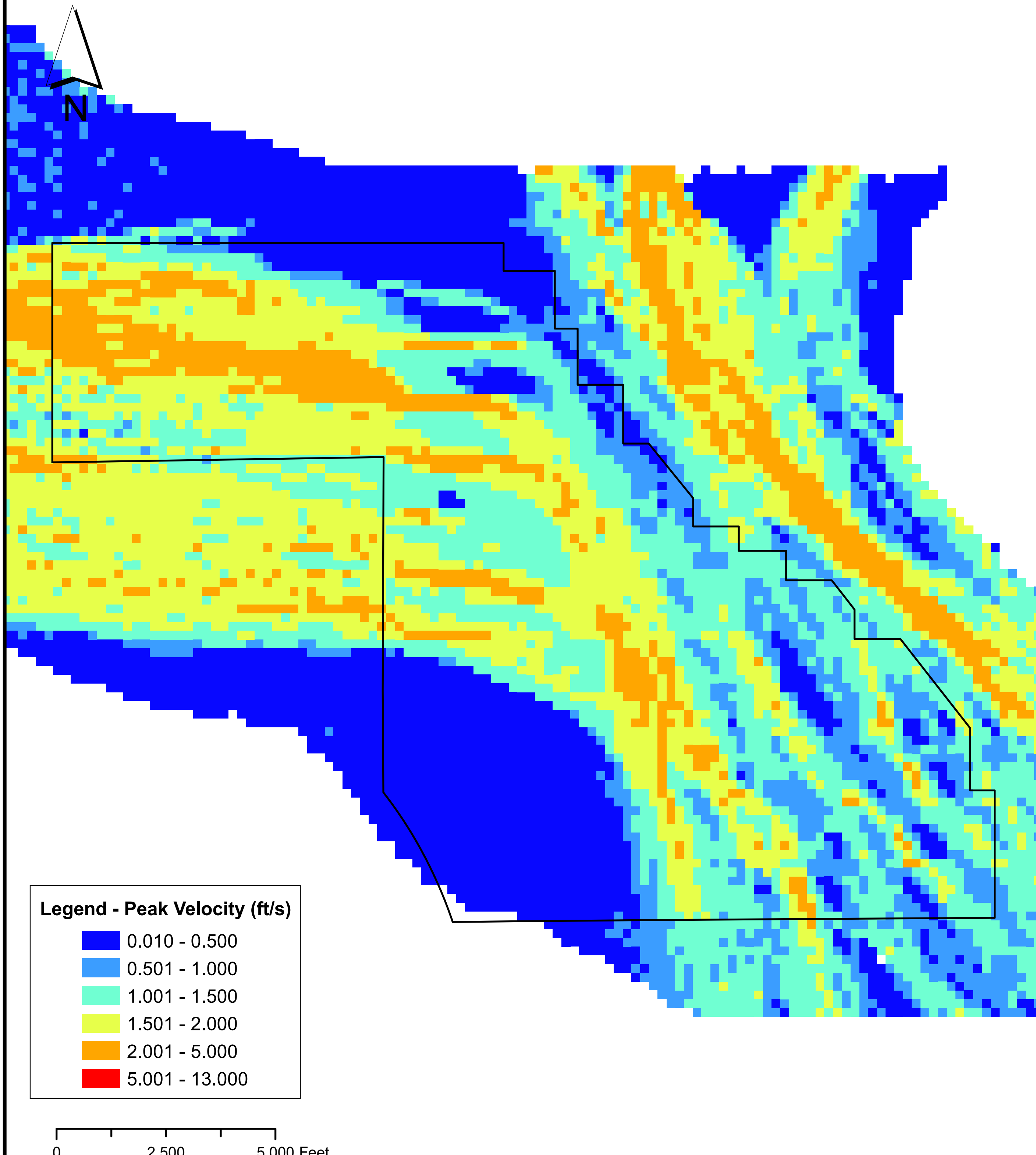



AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change Peak Flow Depth (Future Decomp - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 22 |
| --- | --- | --- | --- |




AECOM

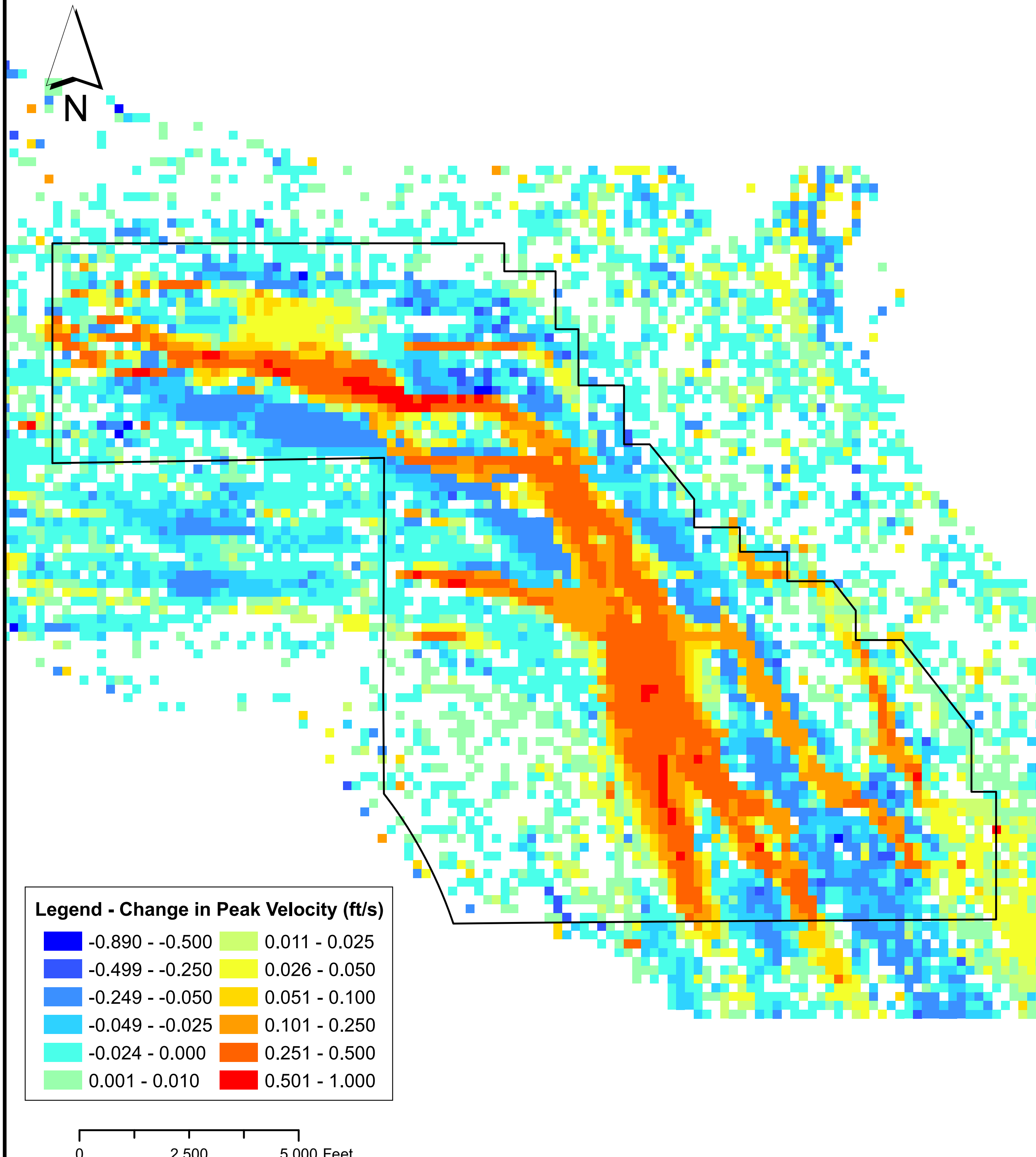
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Decompact Peak Velocity

GIS FILE:

SCALE: AS NOTED

DATE: 02/17/2010

Figure 23




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change Peak Velocity (Future Decomp - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 24 |
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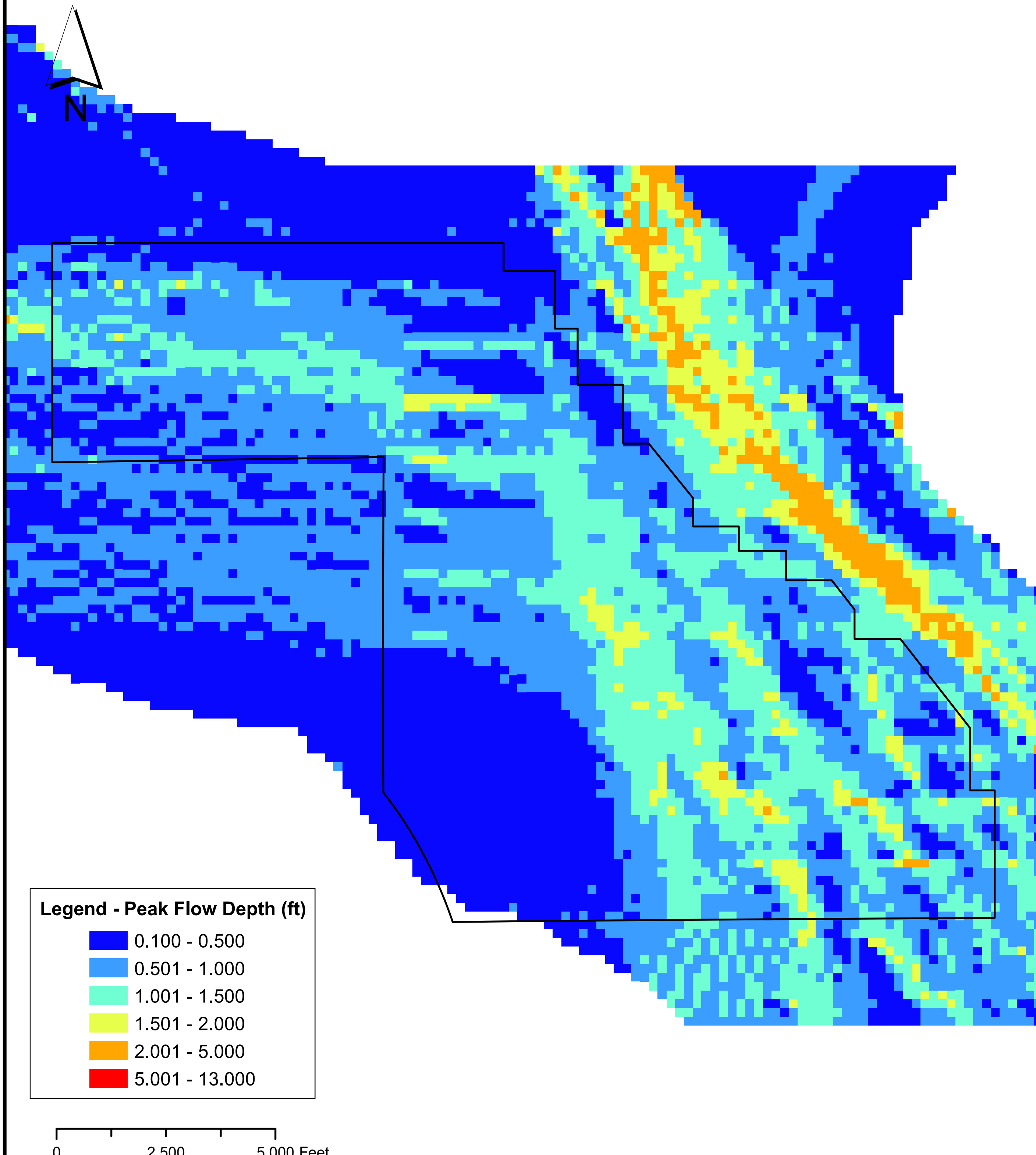


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions with Rip-Rap Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 25 |
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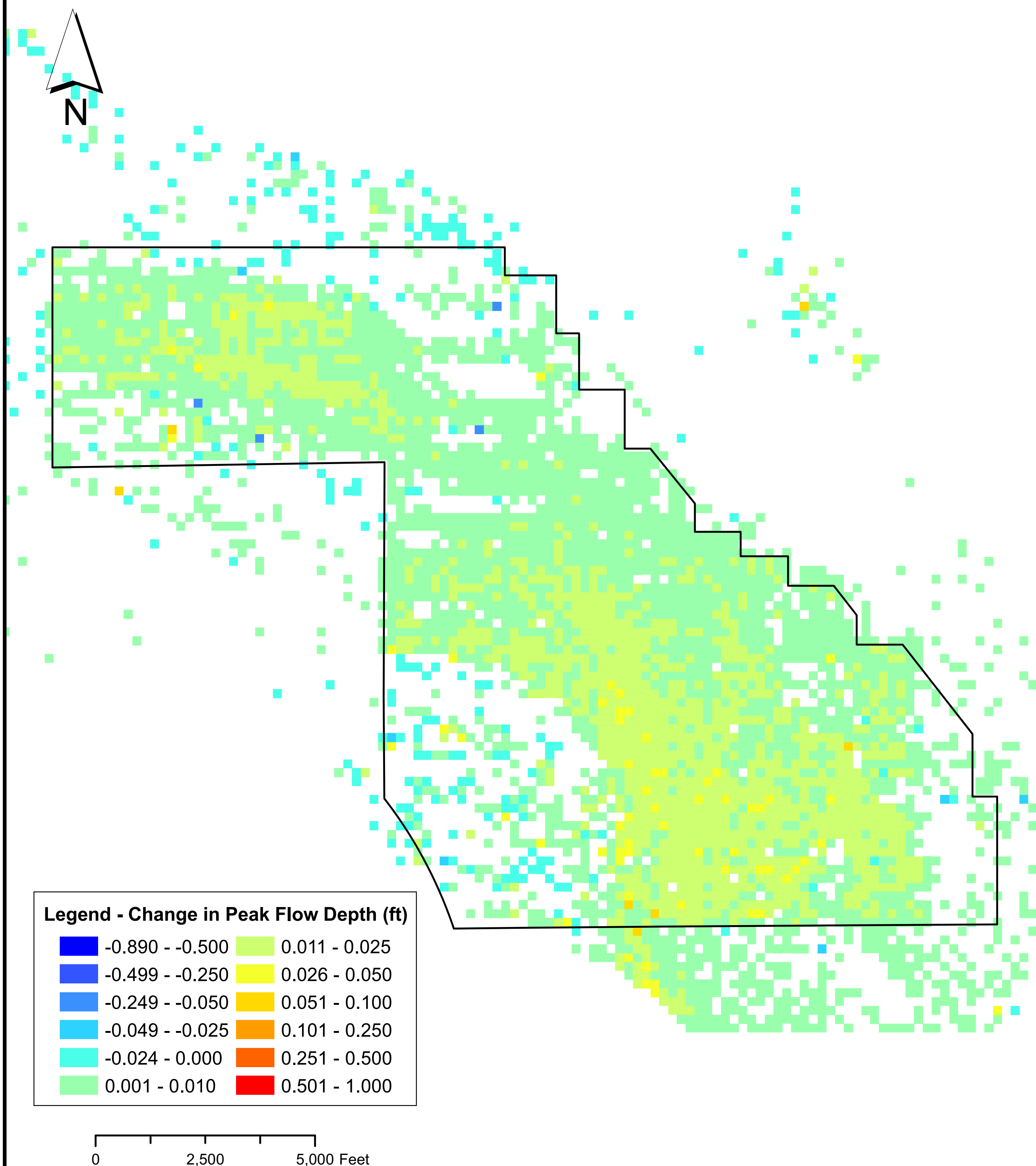


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Flow Depth (Future Rip-Rap - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 26 |
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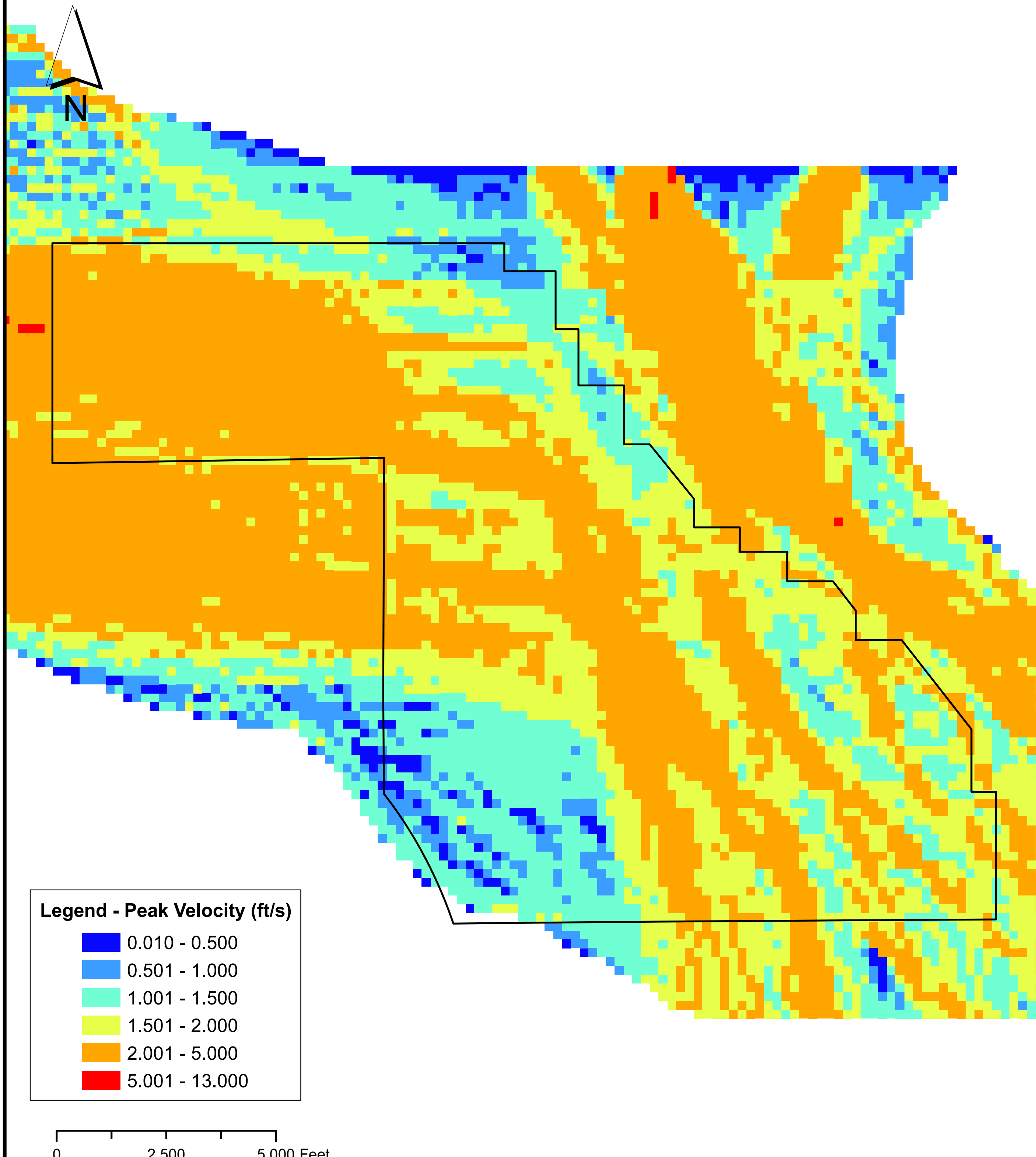


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Rip-Rap Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 27 |
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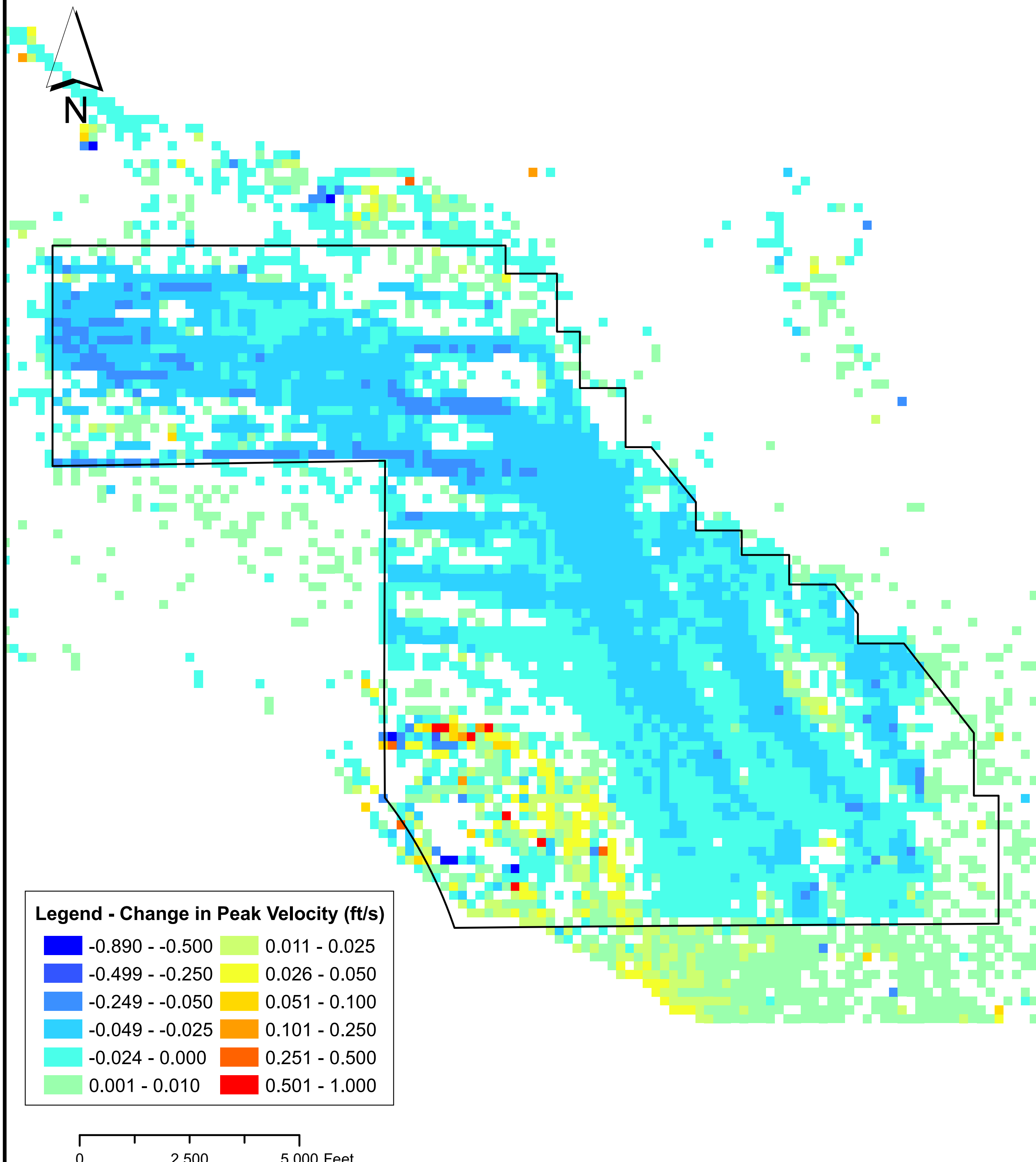


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Velocity (Future Rip-Rap - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 28 |
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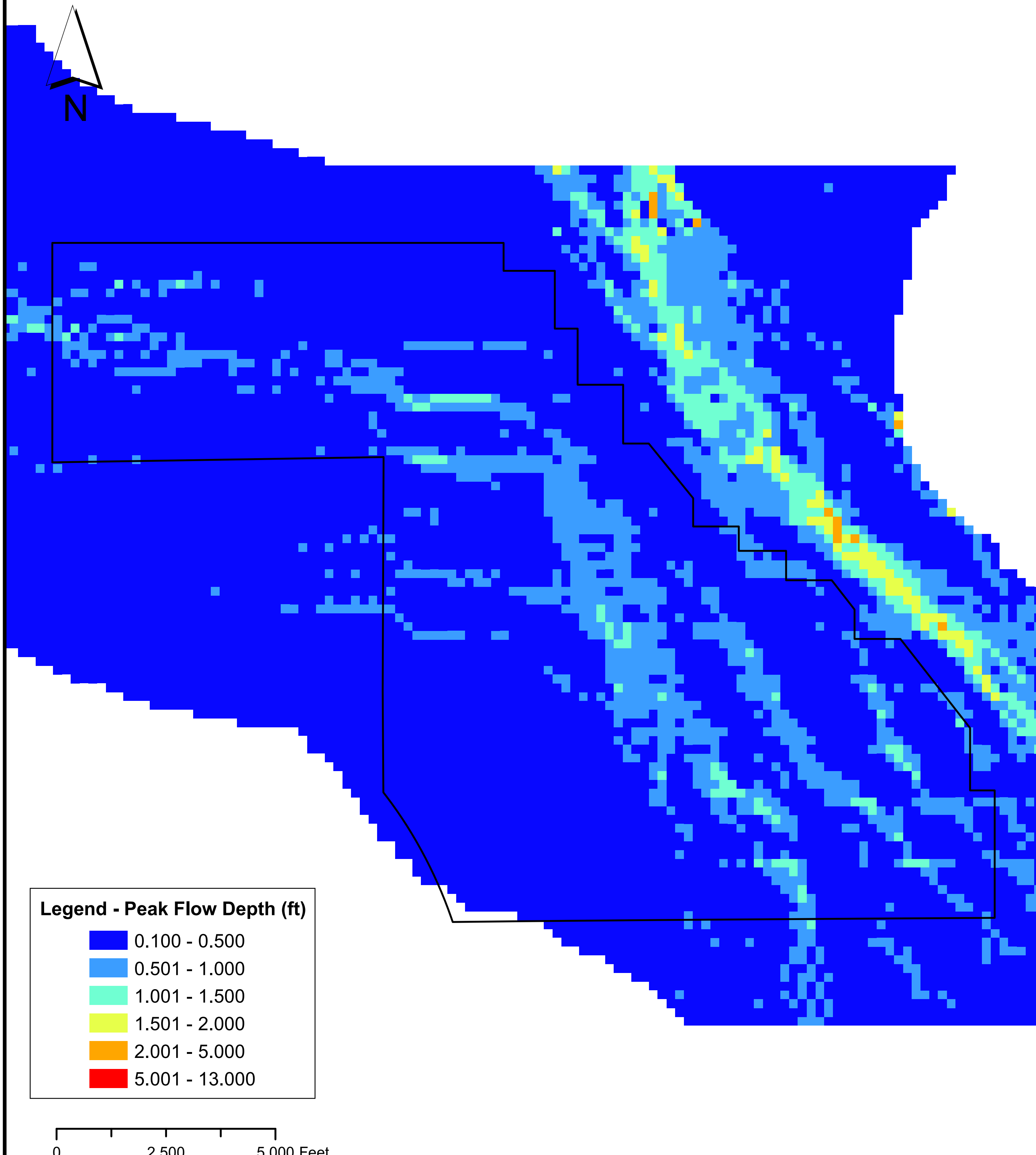


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Rip-Rap Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 29 |
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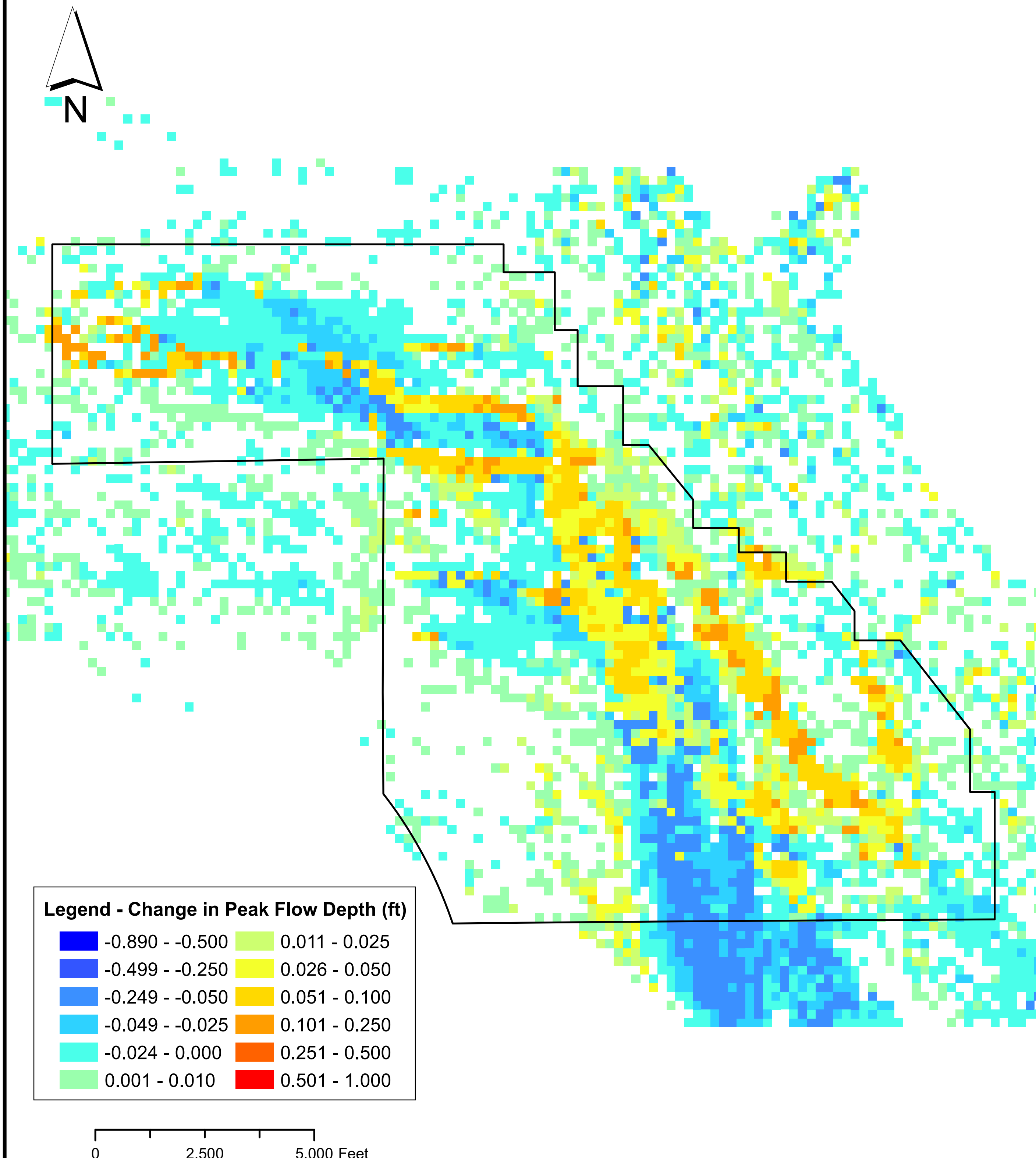


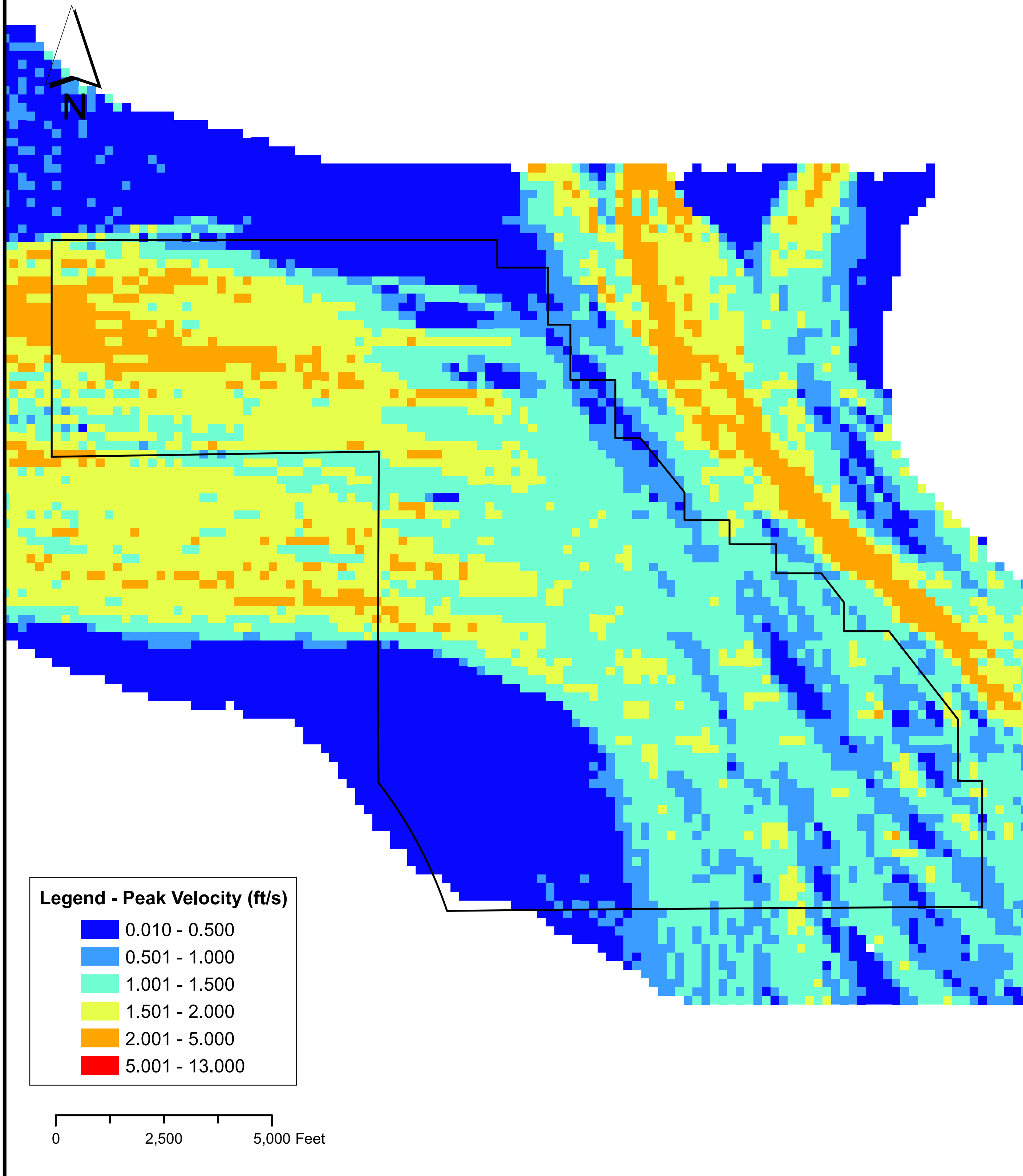

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Flow Depth (Future Rip-Rap - Existing)

GIS FILE:

SCALE: AS NOTED

DATE: 03/09/2010

Figure 30




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Rip-Rap Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 31 |
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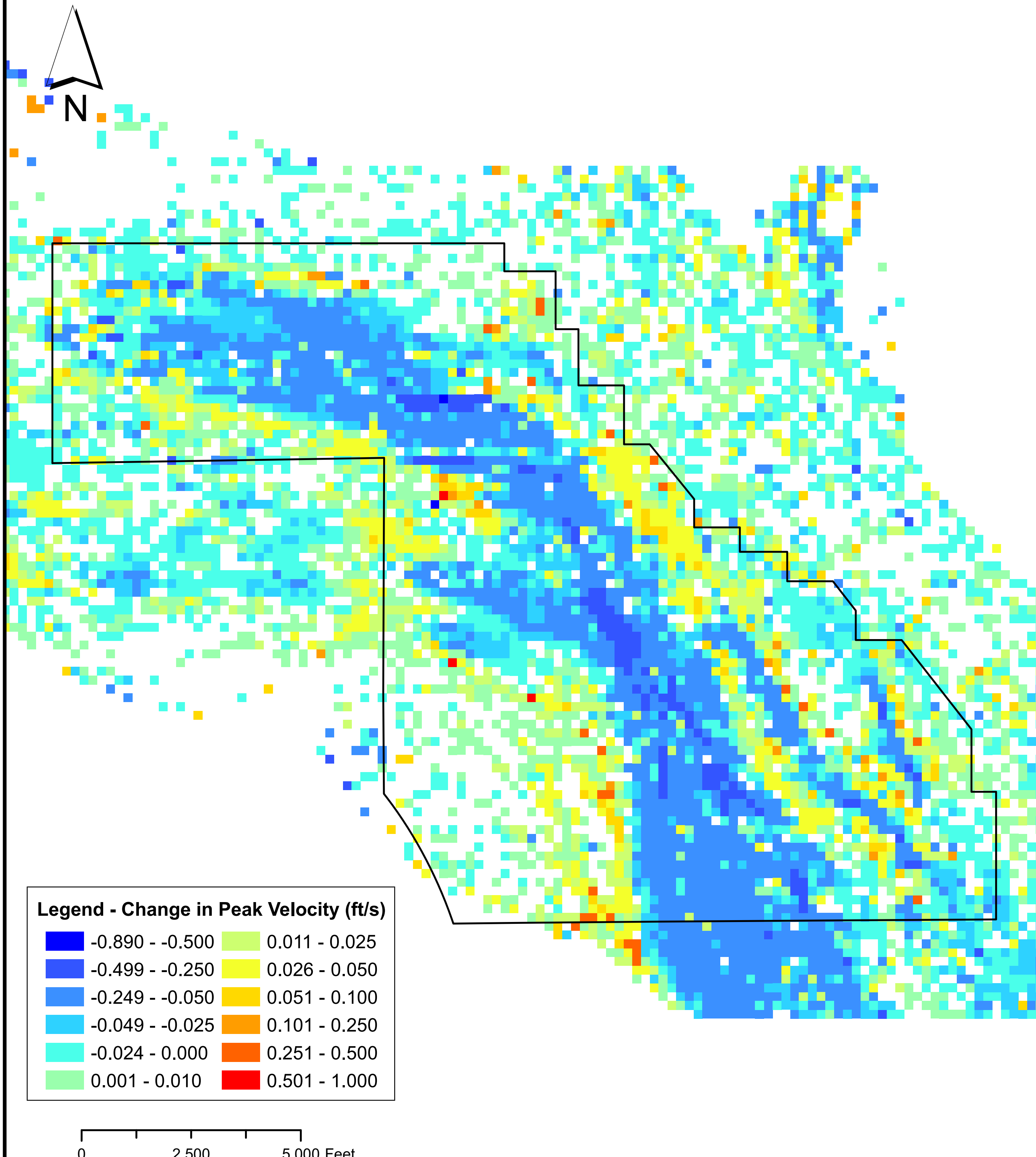


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Velocity (Future Rip-Rap - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/09/2010 | Figure 32 |
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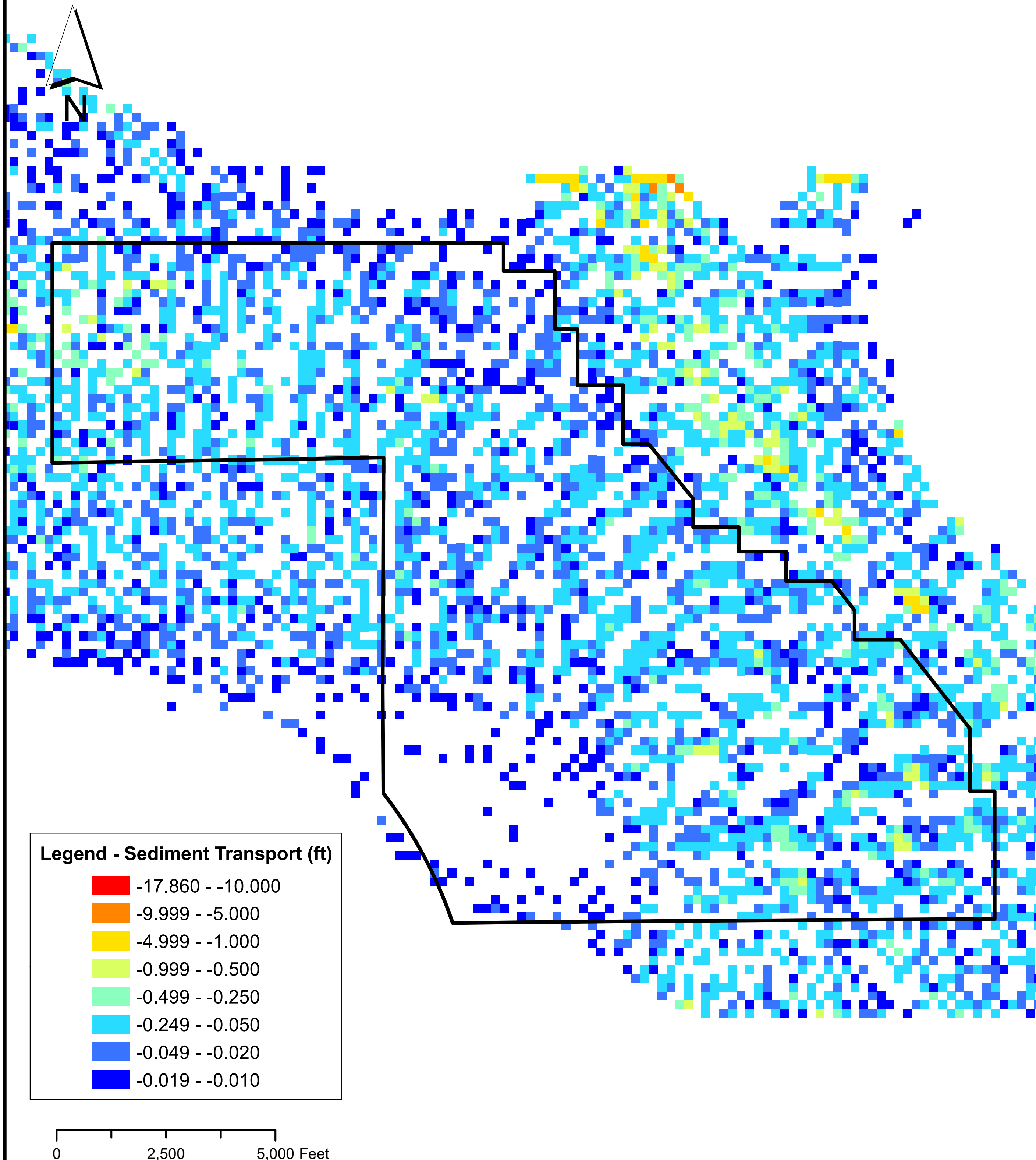


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Maximum Sediment Transport

| GIS FILE: | SCALE: AS NOTED | DATE: 03/11/2010 | Figure 33 |
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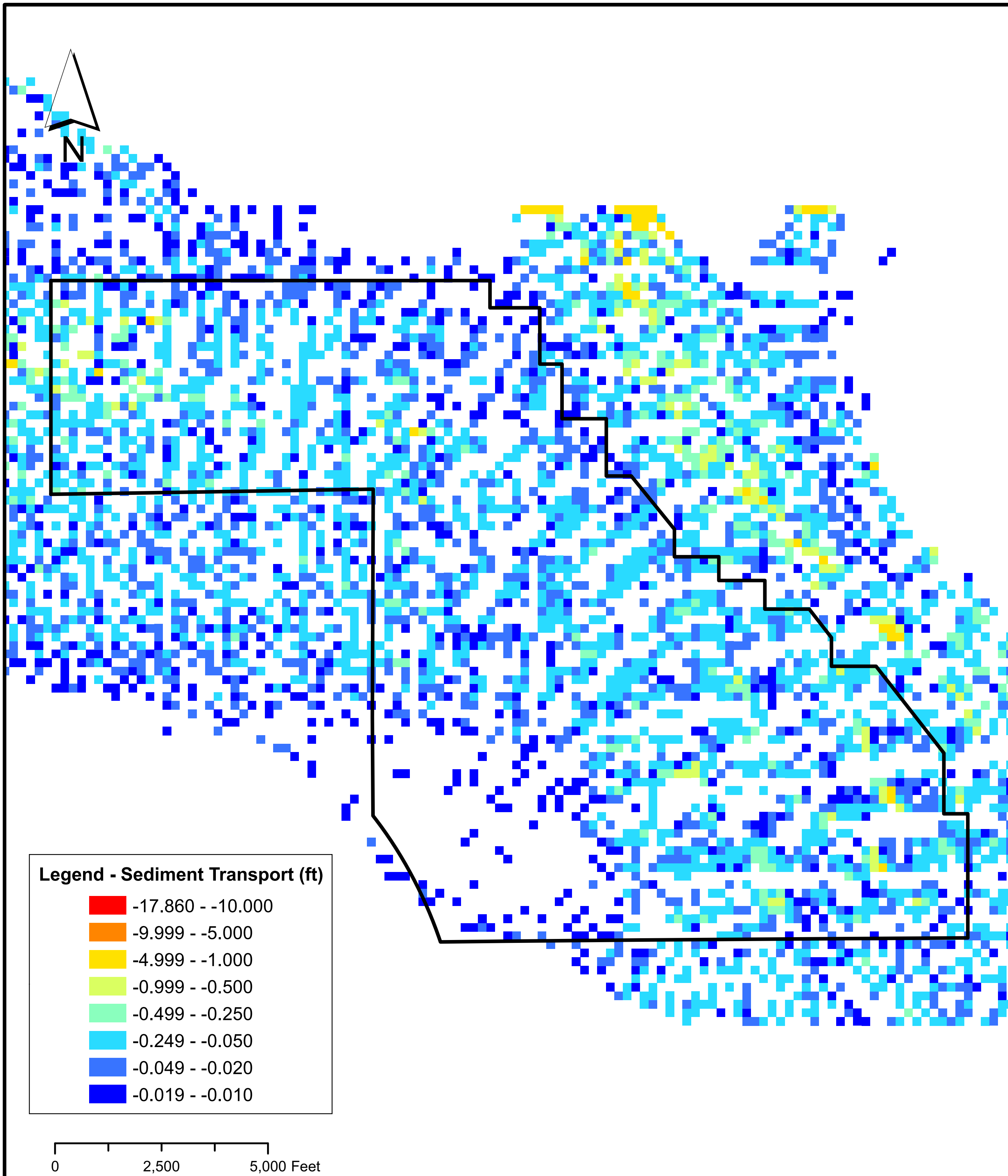


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Maximum Sediment Transport

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 34 |
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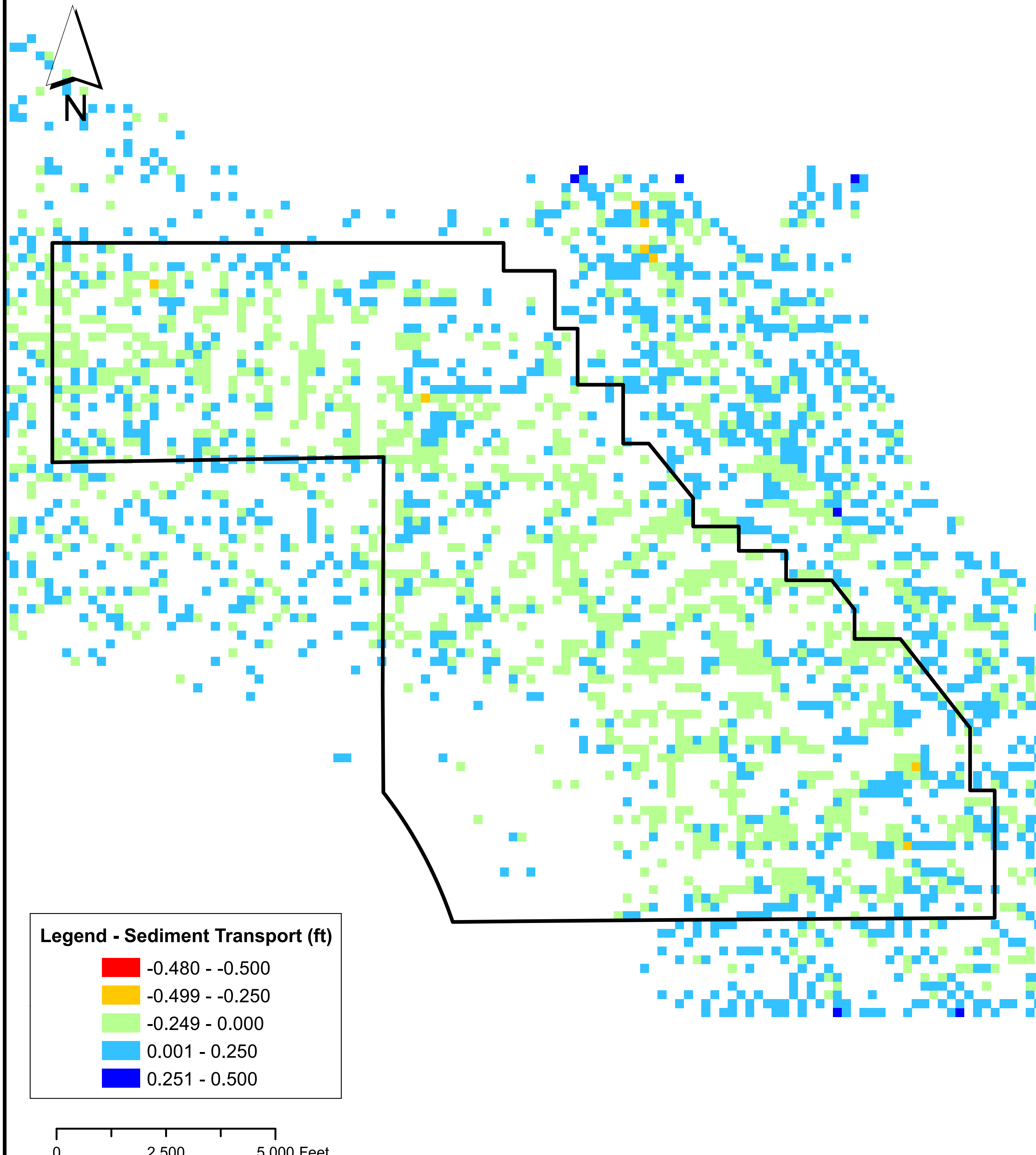


AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Max Sediment Transport Change (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/11/2010 | Figure 35 |
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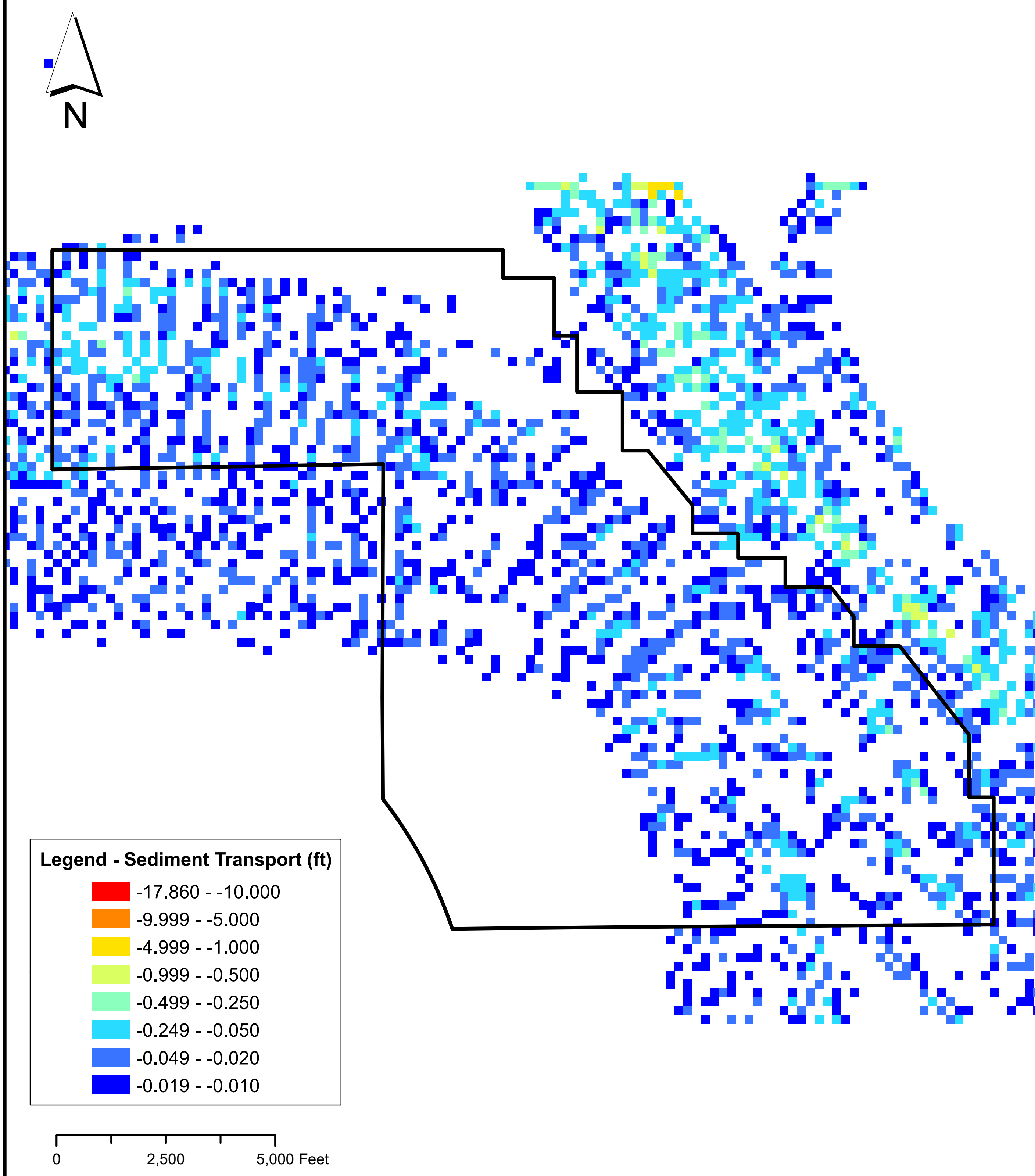
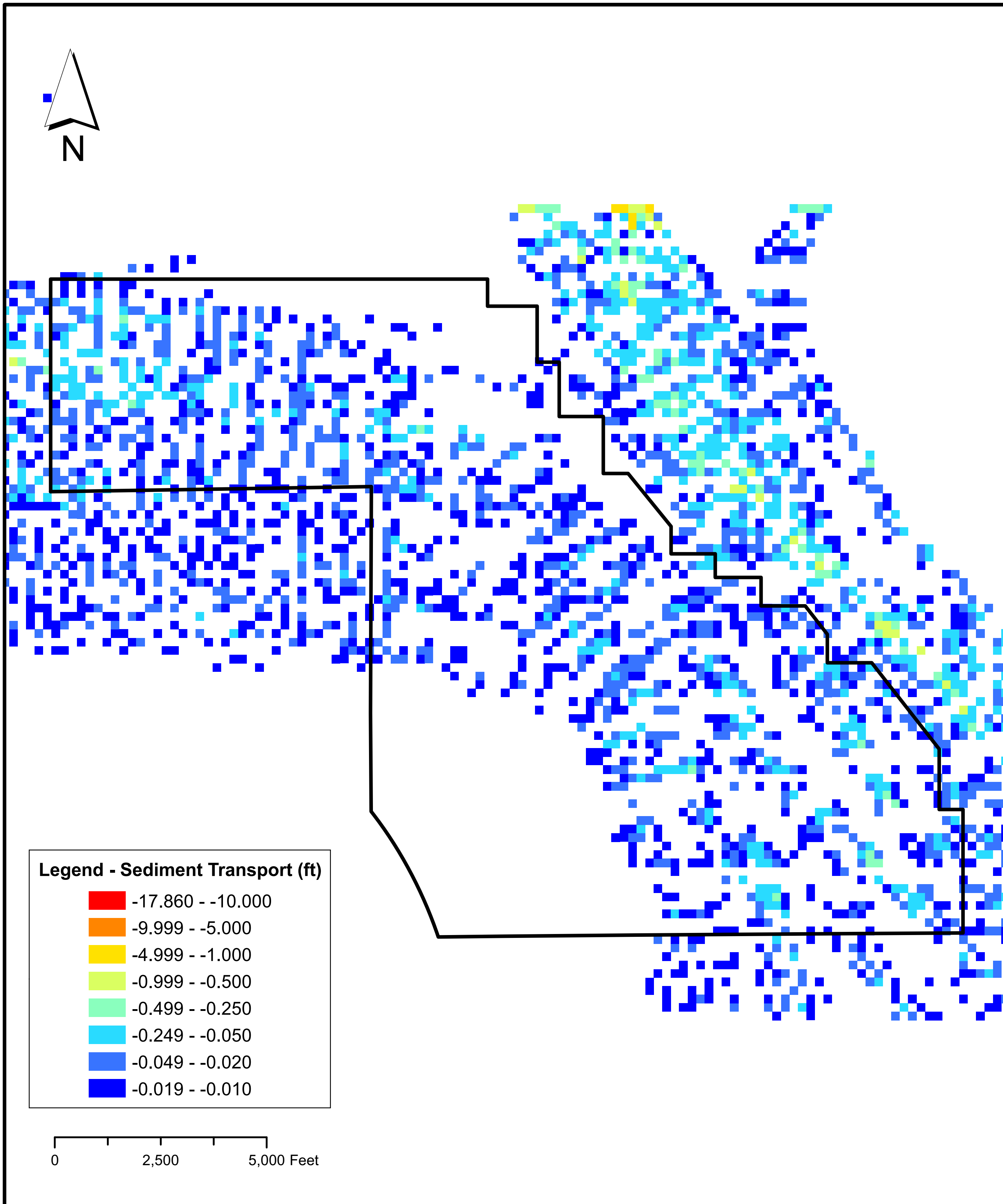



AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Maximum Sediment Transport

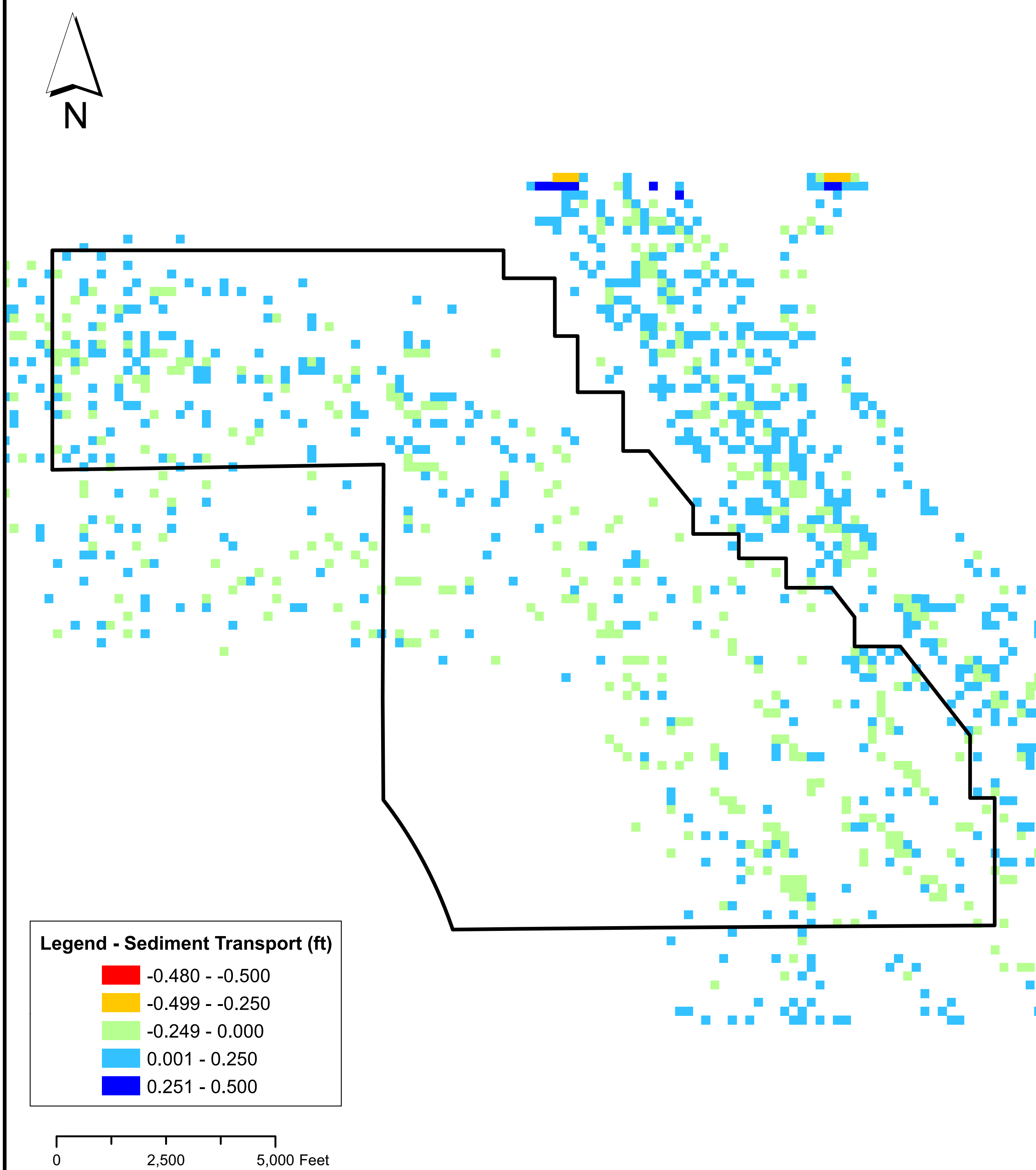
| | | | |
|---|---|---|---|
| GIS FILE: | SCALE: AS NOTED | DATE: 03/11/2010 | Figure 36 |




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Maximum Sediment Transport

| | | | |
|---|---|---|---|
| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 37 |




AECOM

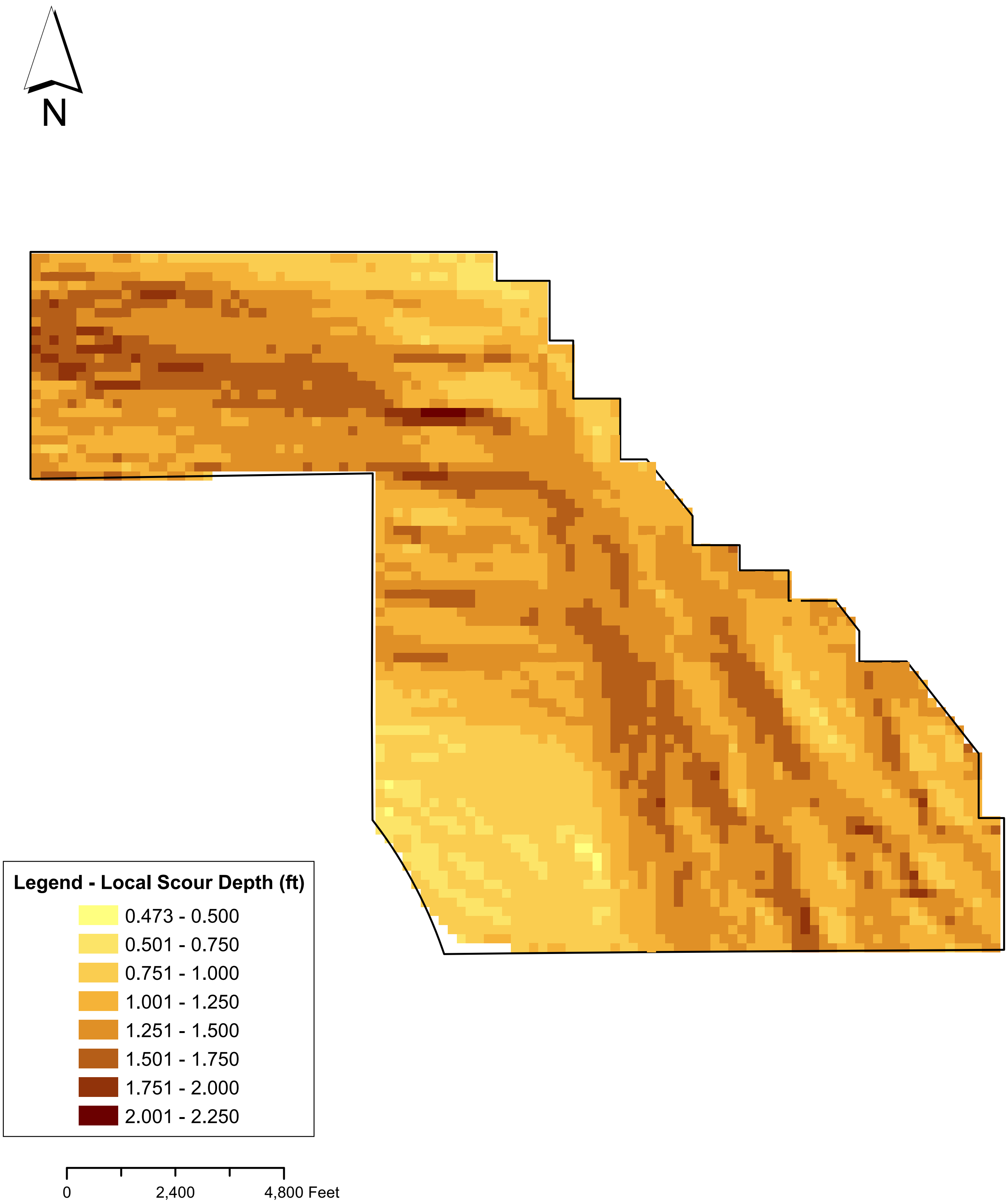
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Max Sediment Transport Change (Future - Existing)

GIS FILE:

SCALE: AS NOTED

DATE: 03/11/2010

Figure 38




AECOM

DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Local Scour Depth (Worst Case Scour)

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 39 |
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**Appendix A: Hydrologic Analysis Supporting Data**

U.S. Department of Agriculture, Natural Resources Conservation Service, Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) dated June 1986 was used to estimate runoff/infiltration characteristics. Following is the table from TR-55 that contains the curve numbers used in this analysis.

**Table 2-2a** Runoff curve numbers for urban areas [1]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type and hydrologic condition | Average percent impervious area [2] | A | B | C | D |
| *Fully developed urban areas (vegetation established)* | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| *Developing urban areas* | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

**Appendix B: Hydraulic Analysis Supporting Data**

Manning's n value was used to describe surface roughness. The roughness was calculated as shown below:

Estimate for existing conditions n

| | |
|---|---|
| Coarse Sand Floodplain | 0.03 |
| Minor irregularities | 0.003 |
| Small-Medium Vegetation | 0.01 |
| Total | **0.043** |

Estimate for future conditions n

| | |
|---|---|
| Coarse Sand Floodplain | 0.03 |
| Add Poles/Obstructions | 0.004 |
| Total | **0.034** |

The addition of poles and other obstructions was assumed to be negligible to minor; occupying between 5% and 15% of the cross-sectional area.

Estimate for six (6)-inch rip-rap n

| | |
|---|---|
| Cobble | 0.039 |
| Add Poles/Obstructions | 0.004 |
| Total | **0.043** |

In order to achieve a roughness of 0.039 for the 100-year future conditions approximately 54% of the project site would need to be covered in six (6) inch diameter rip-rap. The roughness value of 0.057 for the 10-year storm event cannot be obtained with six (6) inch rip-rap

The methodology is based on the following USGS methodology:

Arcement, Jr., G.J., Schneider, V.R., "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains," United States Geological Survey Water-Supply Paper 2339.

**Appendix C: Sediment Transport Analysis Supporting Data**

Zeller and Fullerton equation was used in sediment transport modeling within the Flo2D modeling software framework. Flo2D model user manual states the following:

*"Zeller-Fullerton Equation. Zeller-Fullerton is a multiple regression sediment transport equation for a range of channel bed and alluvial floodplain conditions. This empirical equation is a computer generated solution of the Meyer-Peter, Muller bed-load equation combined with Einstein's suspended load to generate a bed material load (Zeller and Fullerton, 1983). The bed material discharge qs is calculated in cfs per unit width as follows:*

*qs = 0.0064 n1.77 V4.32 G0.45 d-0.30 D50-0.61*

*where n is Manning's roughness coefficient, V is the mean velocity, G is the gradation coefficient, d is the hydraulic depth and D50 is the median sediment diameter. All units in this equation are in the ft-lb-sec system except D50, which is in millimeters. For a range of bed material from 0.1 mm to 5.0 mm and a gradation coefficient from 1.0 to 4.0, Julien (1995) reported that this equation should be accurate with 10% of the combined Meyer-Peter Muller and Einstein equations. The Zeller-Fullerton equation assumes that all sediment sizes are available for transport (no armoring). The original Einstein method is assumed to work best when the bedload constitutes a significant portion of the total load (Yang, 1996)."*

Also the Flo2D model user manual recommends the following:

*"Summary. Yang (1996) made several recommendations for the application of total load sediment transport formulas in the absence of measured data. These recommendations have been expanded to all the equations in the FLO-2D and are slightly edited:*

- *Use Zeller and Fullerton equation when the bedload is a significant portion of the total load.*
- *Use Toffaleti's method for large sand-bed rivers.*
- *Use Yang's equation for sand and gravel transport in natural rivers.*
- *Use Ackers-White or Engelund-Hansen equations for subcritical flow in lower sediment transport regime.*
- *Use Lausen's formula for shallow rivers with silt and fine sand.*
- *Use MPM-Woo's relationship for steep slope, arroyo sand bed channels and alluvial fans. "*

**Appendix D: Fluvial Geomorphology Analysis Supporting Data**

The following historical aerial photos were used in studying fluvial geomorphology of the Project site.

**Desert Solar Farm Site**
Riverside County
Desert Center, CA 92239

Inquiry Number: 2624402.1
October 30, 2009

# The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

# EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDRs professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

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***Thank you for your business.***
Please contact EDR at 1-800-352-0050
with any questions or comments.

## Date EDR Searched Historical Sources:

Aerial Photography October 30, 2009

## Target Property:

Riverside County

Desert Center, CA 92239

| ***Year*** | ***Scale*** | ***Details*** | ***Source*** |
|---|---|---|---|
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| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |
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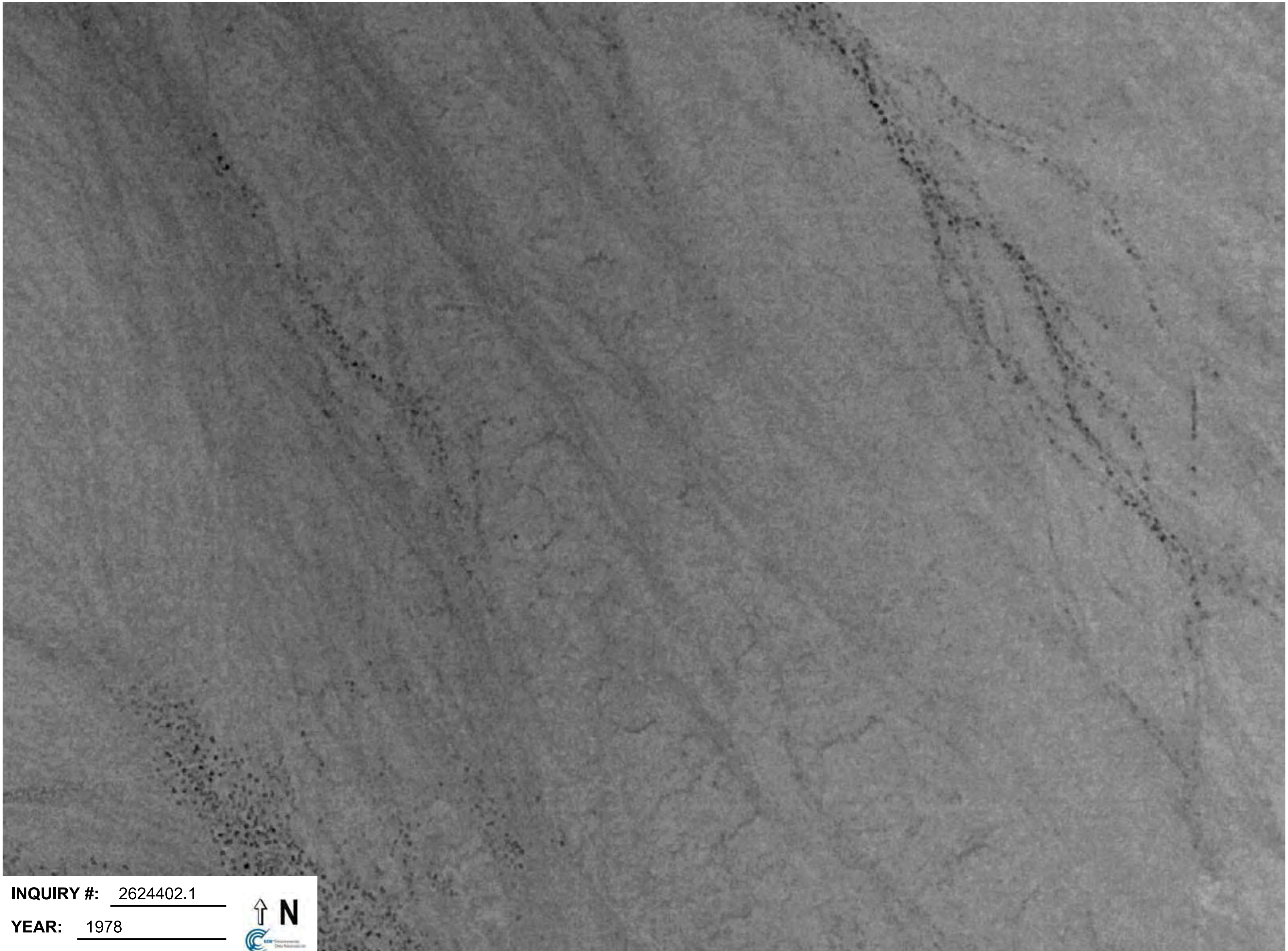
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |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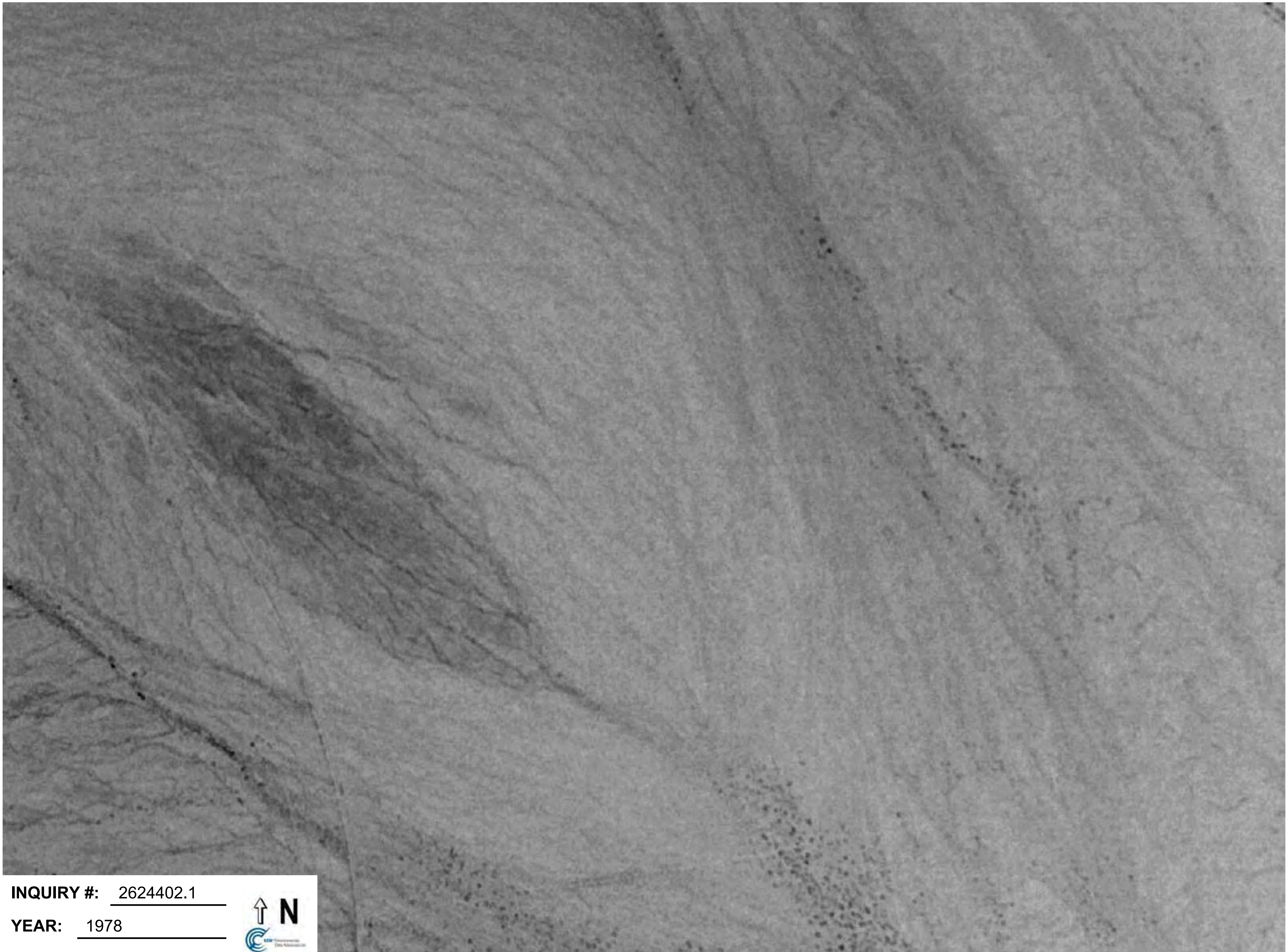
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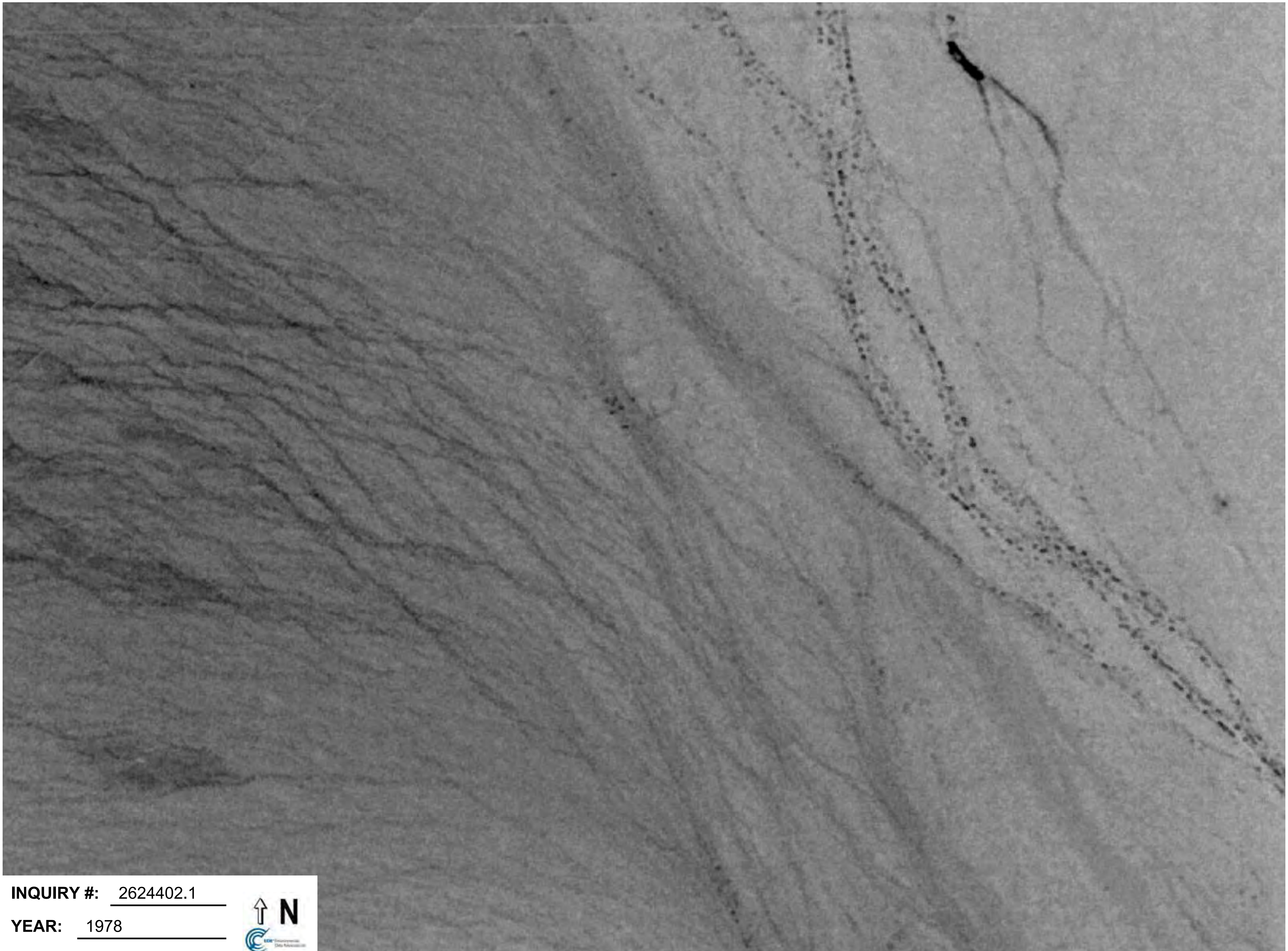

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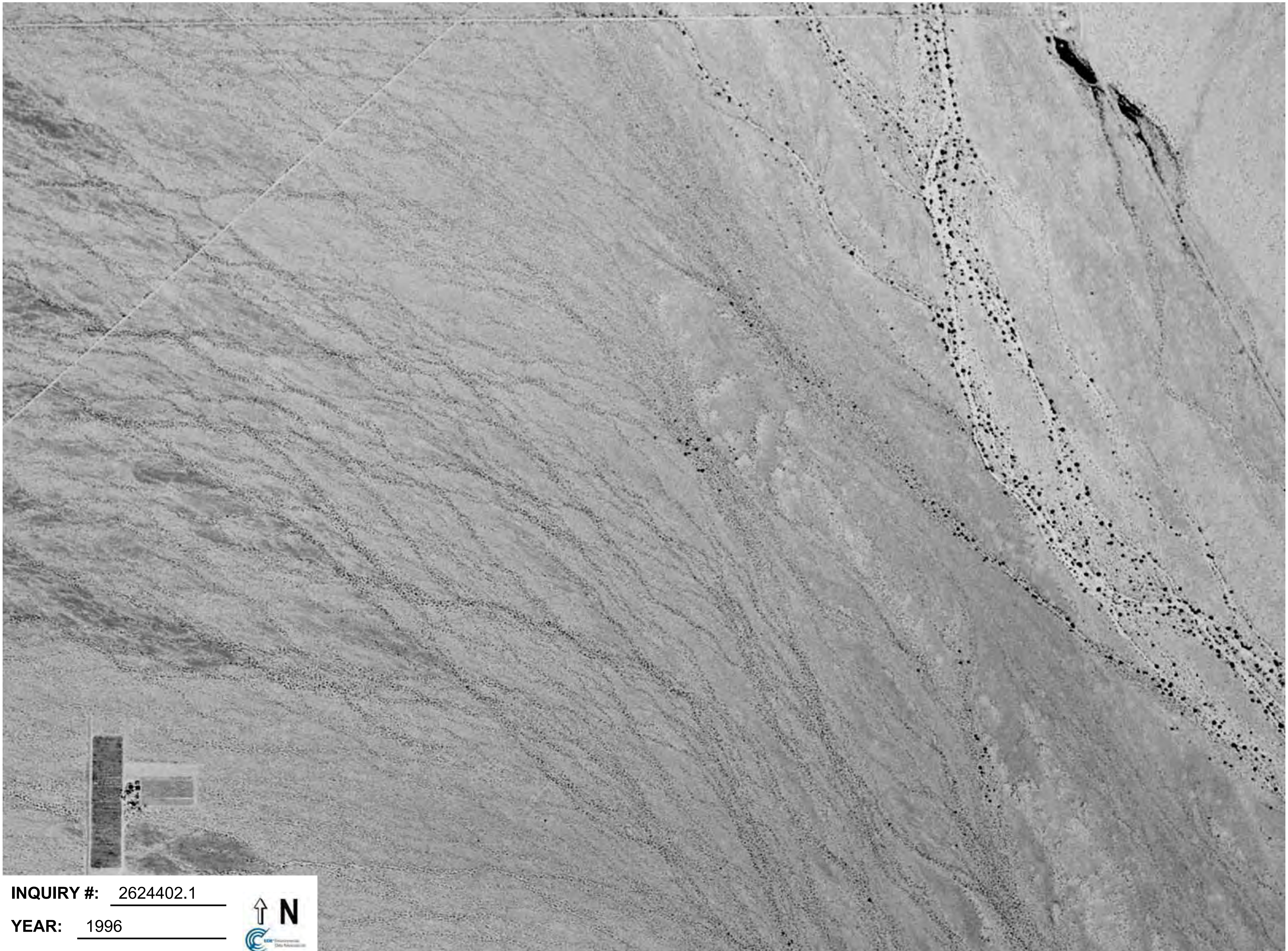

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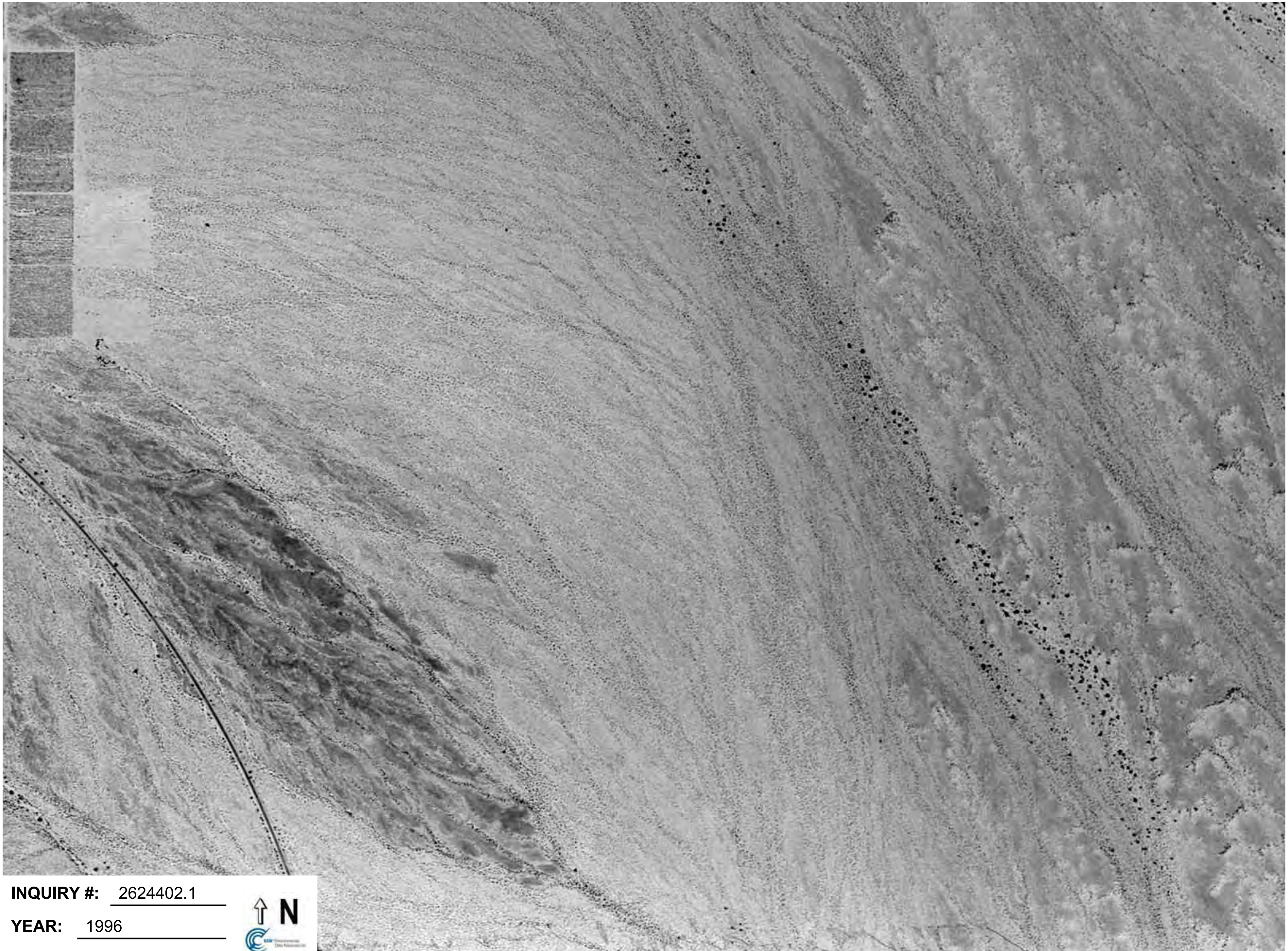

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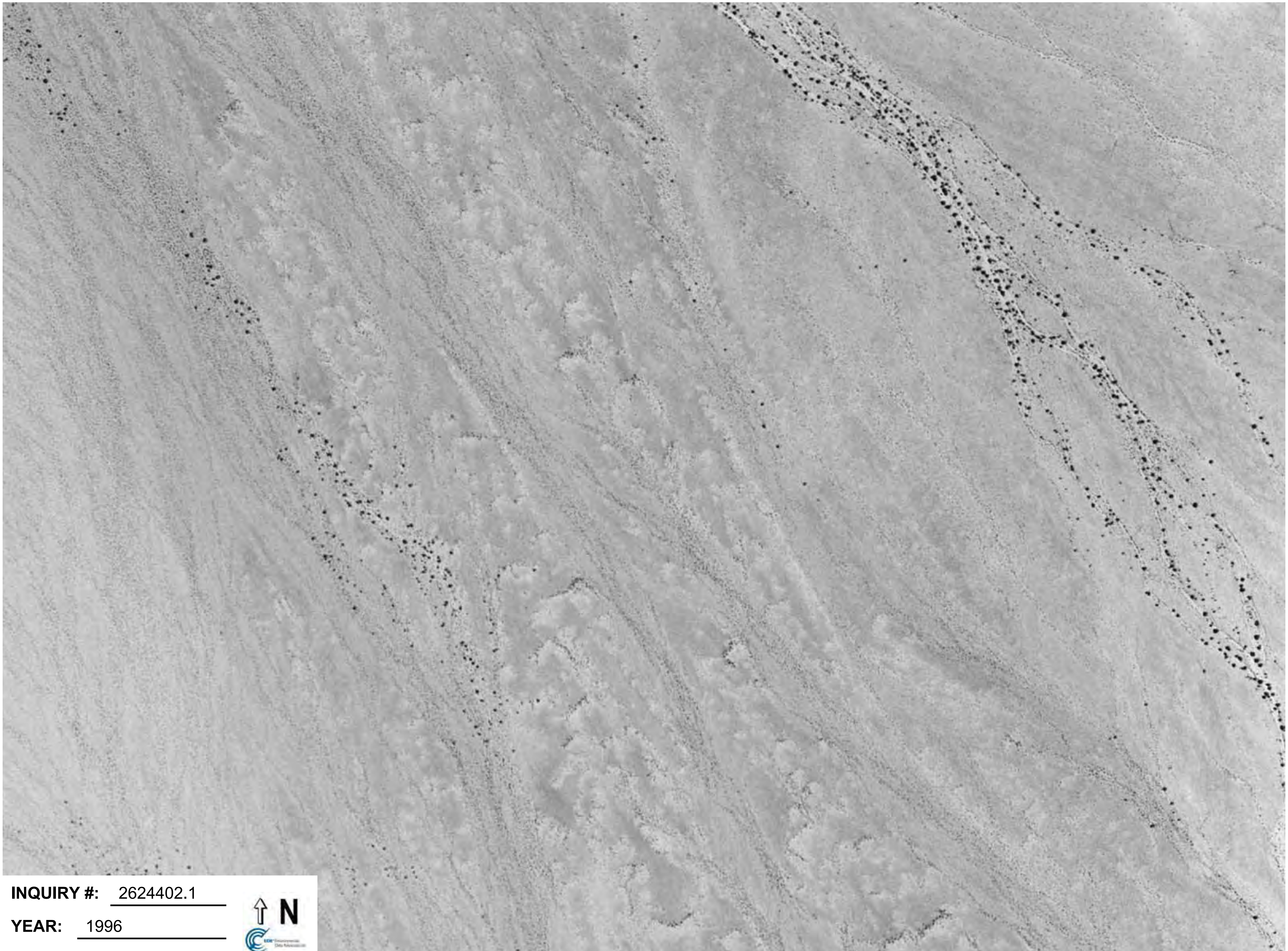

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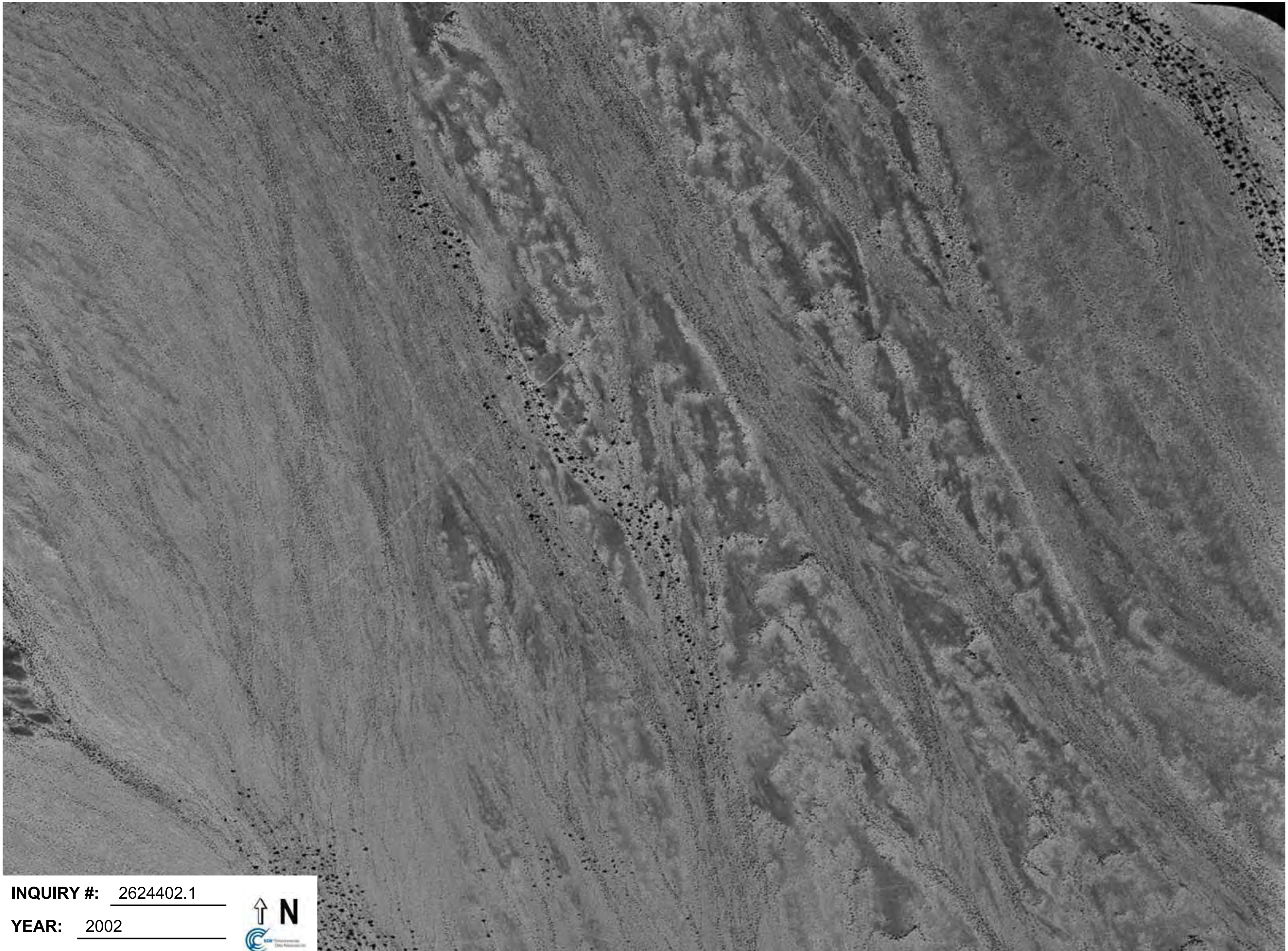

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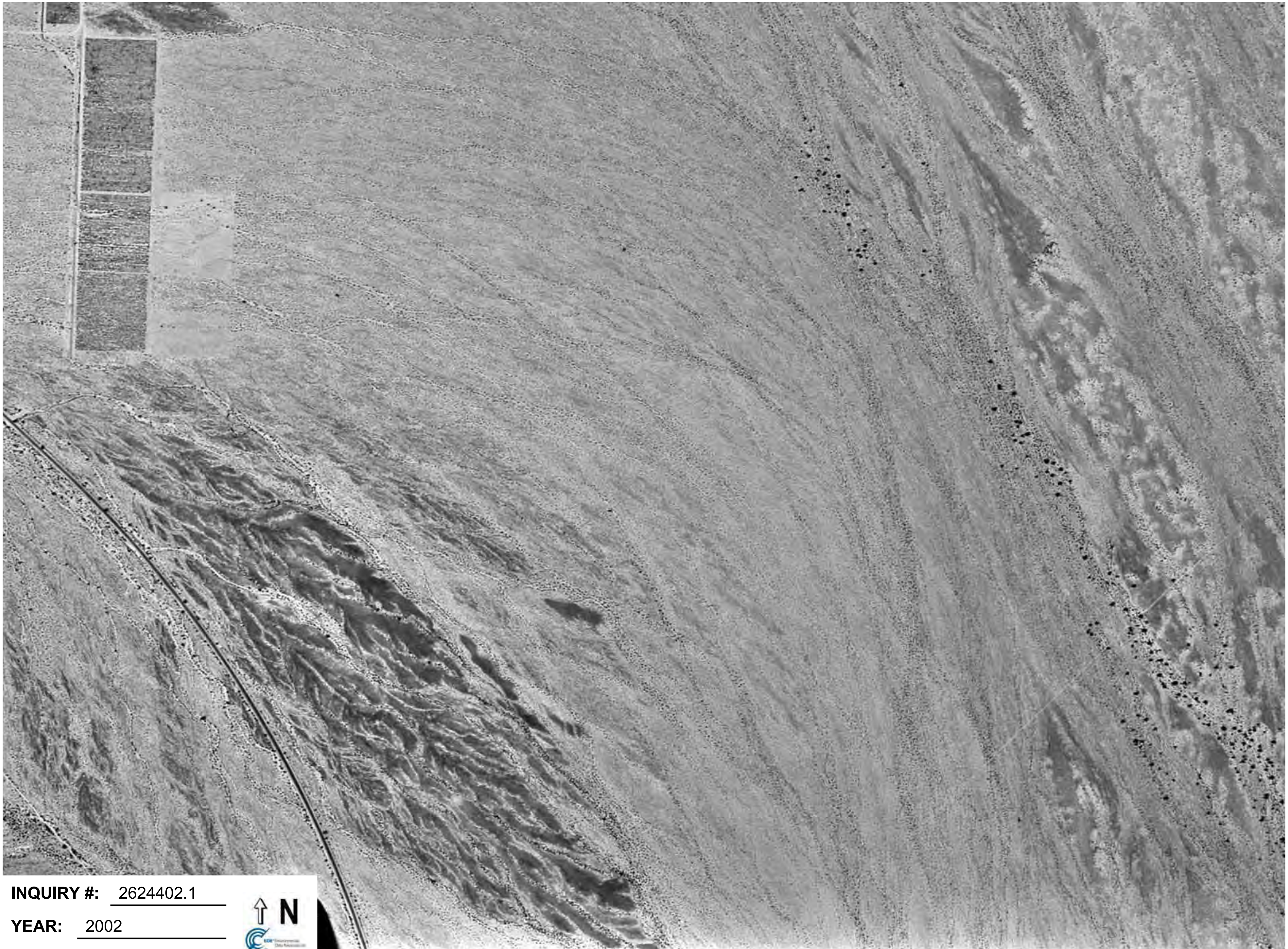

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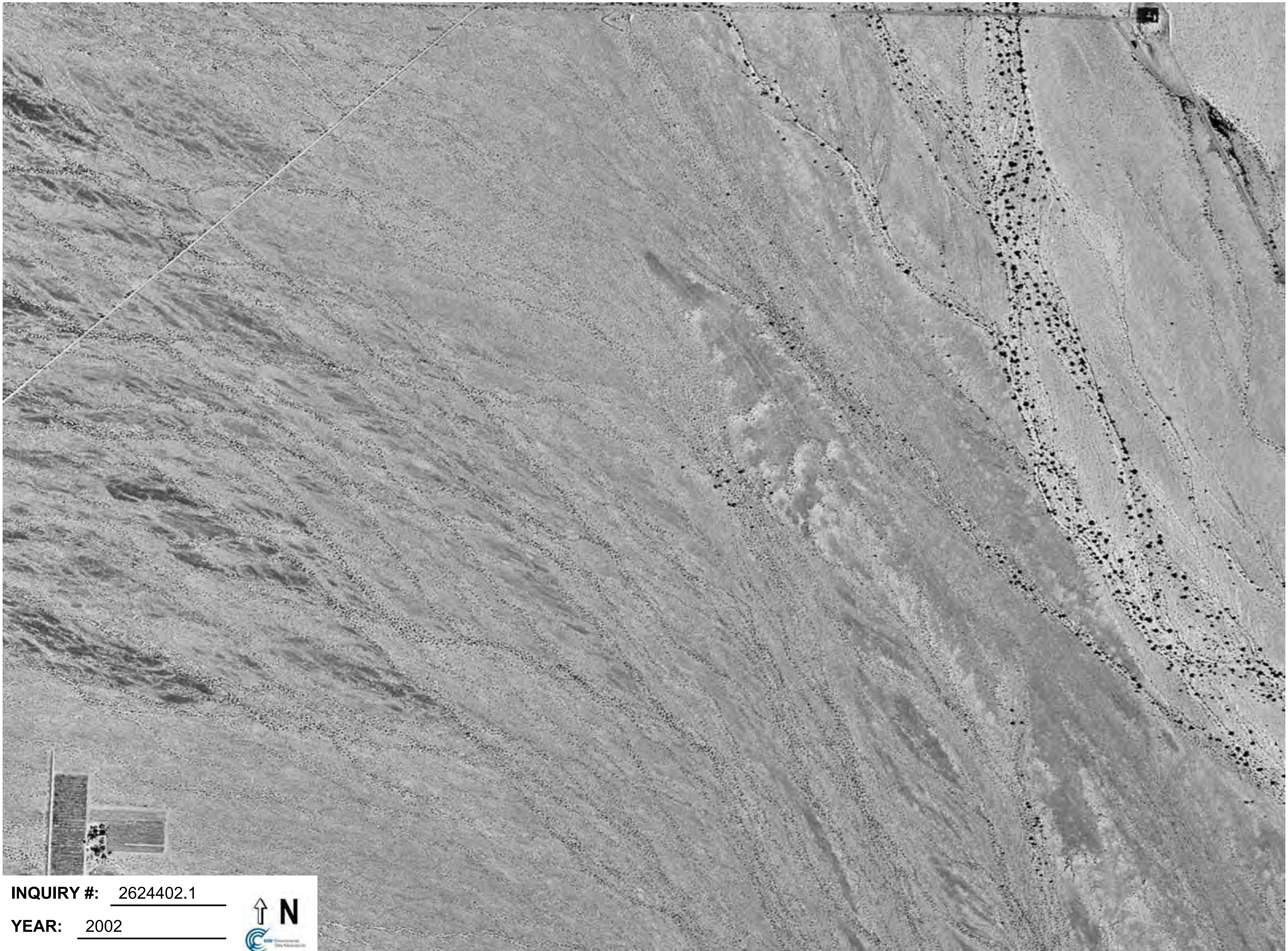

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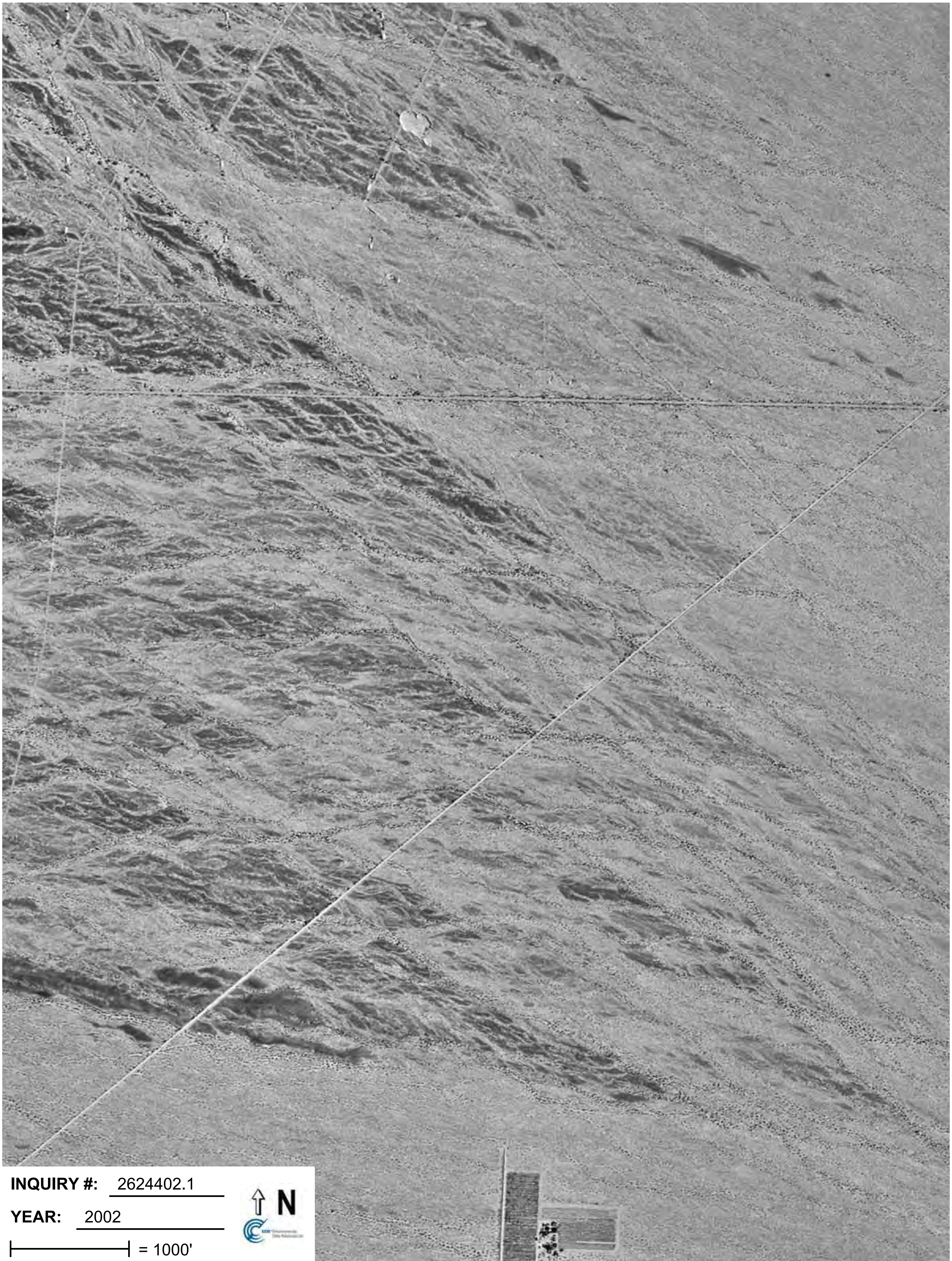
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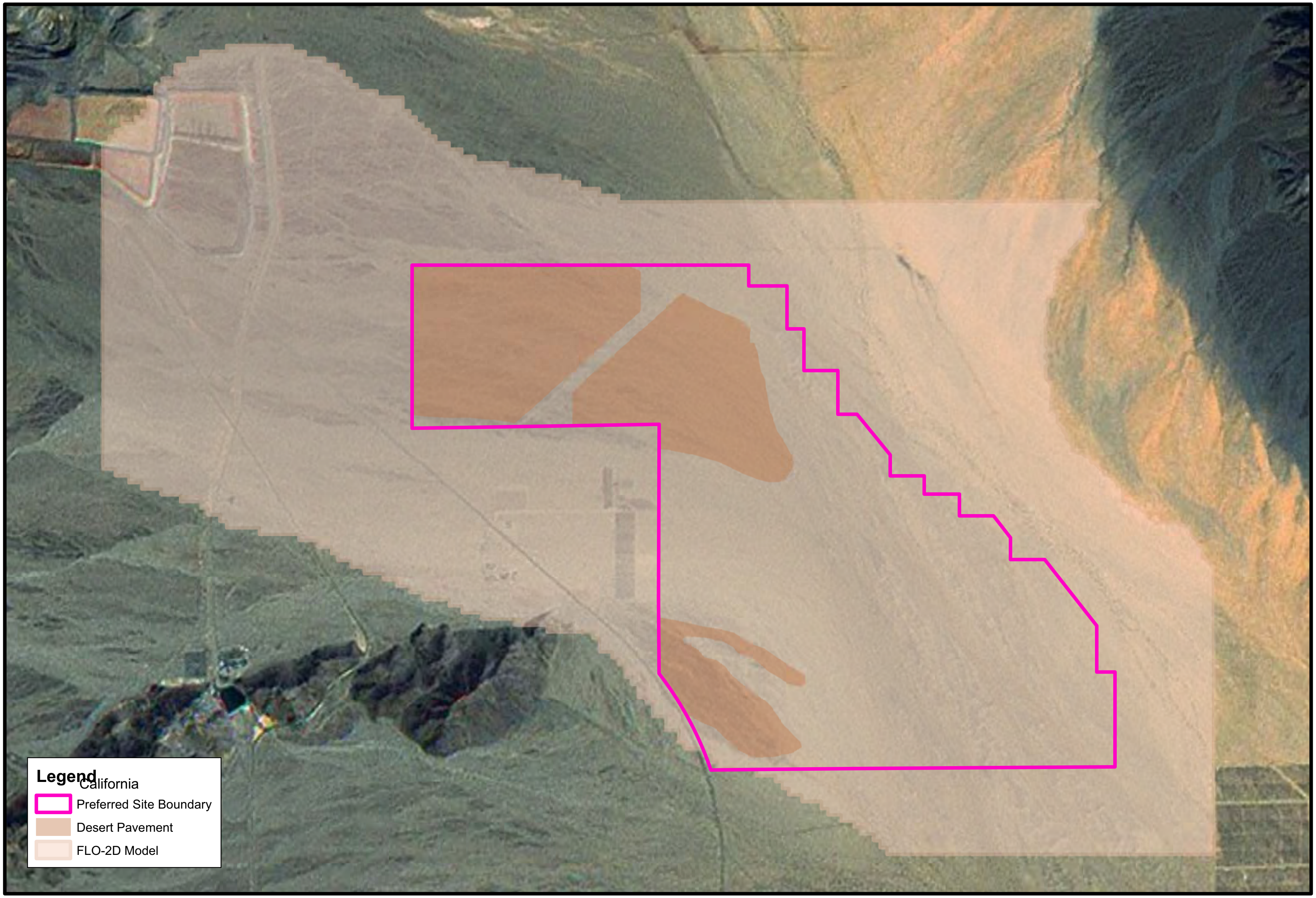
## Appendix E: EUC Delineated Desert Pavement Areas

The following figure shows the locations where the infiltration capacity of desert pavement was applied to the hydraulic model.




AECOM

Appendix E
EUC Delineated Desert Pavement Areas

# Storm Water Hydrology Report for Solar Farm Layout B

# Desert Sunlight Solar Farm – Alternative B

## Storm Water Hydrology Report: Hydrologic, Hydraulic, Sediment Transport and Scour Analyses

**Project Site:**
Desert Sunlight Solar Farm
Riverside County, California

**Prepared for:**
First Solar, Inc.
1111 Broadway, 4th Floor
Oakland, California 94607


**Prepared by:**
AECOM
South Portland, Maine/Camarillo, California

April 9, 2010

AECOM Project No. 60131167 (114785)

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## APPENDICES

# 1 EXECUTIVE SUMMARY

AECOM has conducted hydrologic, hydraulic, sediment transport and scour analyses of storm water for Solar Farm Site – Alternative B of the First Solar, Inc. Desert Sunlight Solar Farm (DSSF or Project). The objectives of this Storm Water Hydrology Report (Report) are:

1. Establish design basis for the DSSF solar farm (Alternative B) improvements and infrastructure from a conservative (100-year) storm water event.
2. Verify that a low impact development measure (decompaction) with an additional measure will mitigate the hydrological impact to the upstream and downstream properties from the DSSF solar farm (Alternative B) improvements and infrastructure for a 10-year storm water event;

The significant results of this report are:

1. Results of the hydrologic analysis for the DSSF development indicated that implementing decompaction of the areas between the panels will reduce the post development hydraulic conditions to within +/-5% of the pre-development hydraulic conditions. An additional on-site mitigation measure such as basins with rip-rap protection, check dams or strip detention basins can be implemented to retain the remaining excess total off-site storm water volume increase. Please note that the accuracy of the model is approximately +/- 5% and so the differences (i.e. within 5%) calculated by the model are within this range.
2. Results of the hydrologic analysis for the post-development DSSF grading design without the addition of mitigation measures indicated that, in general, storm water off-site peak flow rates and volumes increased for the 10-year storm event. The storm water off-site peak flow rate and volume increased 4.7% and 5.9%, respectively for the 10-year storm event. The peak flow depth and velocity did not change on-site for the 10-year event.
3. Results of the hydrologic analysis for post-development design that only includes a decompaction mitigation measure indicated that the storm water off-site peak flow rate and volume increased 1.1% and 2.8% for the 10-year storm, respectively. Flow depth and velocity remain the same on-site, as compared to the existing conditions for the 10-year storm event. The additional storm water peak volume is reduced by decompaction of soils, which is the most significant measure to mitigate post-development conditions to within +/- 5% of the pre-development conditions.
4. The addition of mitigation measures such as basins with rip-rap protection, check dams, or strip detention basins to the DSSF development in addition to decompaction, will address excess post-development hydraulic impacts that are not addressed by decompaction. These additional measures are based on implementing storm water best management practices and have not been rigorously modeled, however they would be designed to retain excess total off-site storm water volume. The intent of an additional mitigation measure is to reduce overall flow depths, velocities and outflow volume by detaining run-on storm water volume. The additional measures would also be successful at reducing potential increases in sediment transport and would be designed to retain the excess total volume capacity which is on the order of 55 ac-ft for the 10-year storm event.
5. Results of the sediment particle size based transport model for post-development determined that the average degradation for the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions. The average degradation depth is 0.01 feet for the 10-year storm (i.e., general scour).
6. Results of the total scour analysis for post-development found that the average on-site scour depth would be 0.7 to 1.2 feet at the base of the PV supports for the 100-year storm, depending on the angle of flow to the supports. Placement of riprap will provide a less significant benefit to mitigate for additional runoff. However, riprap placed at the base of each support structure will help reduce the effects of local scour and lower storm water runoff velocities.

7. Results of the qualitative fluvial geomorphologic analysis indicates existing areas of relatively inactive sediments characterized by desert pavement and more active areas consisting of finer sand and gravel. The changes to the site resulting from Project development will create an area that has consistent compaction, soil type and grading compared to existing conditions. It is anticipated that these changes will create a geologic environment conducive to the formation of shallow channels up to two feet or less in depth (i.e. long-term scour). This long term scour can be mitigated by periodic monitoring to identify changes to the site grading and maintenance activities as/if needed to restore design conditions.
8. Along with the mitigation measures, a Monitoring and Response Plan will be prepared and submitted to the BLM. The Monitoring and Response Plan will indicate the procedures that will be followed to mitigate potential impacts to the site structures, storm water infrastructure or site grading that can occur from local scour, sediment transport and long term degradation (i.e. fluvial geomorphology) during the operation of the DSSF.

# 2 INTRODUCTION

AECOM has conducted a hydrologic, hydraulic, sediment transport and scour analyses of storm water conditions within and around Solar Farm Site – Alternative B of the Desert Sunlight Solar Farm (DSSF or Project) for First Solar, Inc. The DSSF is a future 550 MW solar photovoltaic (PV) electric generating facility. The Project is located in Riverside County on public lands under the jurisdiction of the Bureau of Land Management (BLM). This report provides a site description which includes an overview of the Project and its environment (climate, geology, land-use/soil-type, drainage areas), and a specific section on fluvial geomorphology. A quantitative hydrologic, hydraulic and sediment transport analysis was conducted using several computer models. In addition, scour evaluation was performed to assess scour potential around the PV support structures.

The objectives of the Report are:

1. Establish design basis for the DSSF solar farm (Alternative B) improvements and infrastructure from a conservative (100-year) storm water event.
2. Verify that a low impact development measure (decompaction) with an additional measure will mitigate the hydrological impact to the upstream and downstream properties from the DSSF solar farm (Alternative B) improvements and infrastructure for a 10-year storm water event;

The 100-year storm was used to focus on the storm water impacts on the development, and 10-year storm was used to evaluate impacts of the development on the storm water and sediment transport characteristics of the site. During a100-year storm event, the magnitude of the run-off is significant resulting in highest potential of structural impact; however, the difference in run-off between pre and post-development is higher during the 10-year storm, which is more probable to occur during the design life of the project. During the 10-year storm event, the percent difference is not overwhelmed by the shear amount of run-off volume associated with 100-year event, which quickly saturates the ground and effect of infiltration capacity diminishes. Therefore, using the 100-year event to evaluate storm water impacts on the development and the 10-year storm event to evaluate post-development stormwater and sediment transport characteristics represents a conservative approach to understanding the potential for stormwater impacts both on the Project and to the upstream and downstream properties.

The storm water analysis was based on the Riverside County Flood Control and Water Conservation District Hydrology Manual, which uses a 100-year storm event under antecedent moisture conditions (AMC) II criteria for the design basis criteria. A 10-year storm event was analyzed in addition to the 100-year storm event in order to evaluate the more probable event that will be experienced in the Project's lifespan.

The Report presents the results of a detailed hydrologic analysis and hydraulic/sediment-transport model of the DSSF for the existing (i.e., pre-development) conditions. It also includes the results of a watershed analysis that encompasses areas immediately upstream and downstream of the DSSF to determine and evaluate the Project's potential on-site and off-site peak flows during design storm events. The detailed analysis calculated off-site peak flow rate, off-site peak flow volume, maximum and average on-site peak flow depth, and on-site peak and average flow velocity. The off-site peak flow rate and volume are determined at the downstream boundary of the model, which is approximately1/4 mile south of the southern boundary

This report includes the results of the initial hydraulic analysis that modeled the pre-development conditions and compared them to the post-development conditions based on the Project's grading design submitted as part of the Project Description on March 19, 2010. The primary concepts relating to storm water characteristics that were incorporated into this DSSF grading design were contour grading. The intent of the contour grading concept is to smooth the existing surface into consistent graded slopes. Existing slopes on-site will be maintained such that the average cut/fill over the entire site is approximately 5-inches. The results of this comparison are discussed in Section 4.

The hydraulic analysis models the post-development conditions based on the Project's grading design that incorporates a decompaction mitigation measure. The intent of the de-compaction concept is to restore the soil infiltration capacity to the pre-development state. De-compaction will be applied to the areas between the rows of PV panels that were compacted during PV support structure and panel installation. The results of this comparison are discussed in Section 5.

Section 5.4 also includes discussions of other mitigation measures that are proposed to be in addition to the decompaction mitigation measure. These additional mitigation measures are recognized to have beneficial effects to the Project storm water characteristics, but are not as effective as the decompaction mitigation measure. Therefore these additional mitigation measures are discussed in qualitative terms.

Section 5.5 discusses the effect of the Project development on the storm water flows in Pinto Wash.

Sediment Transport characteristics comparing the pre-development conditions and post-development conditions based on the Project's grading design is presented in Section 6.

Fluvial geomorphology for the post-development conditions based on the Project's grading design is discussed in Section 7.

Local scour at the base of the PV solar panel supports for the post-development conditions based on the Project's grading design is discussed in Section 8.

# 3 PROJECT SITE DESCRIPTION

The DSSF is located on a vacant, largely undeveloped, and relatively flat tract of land in the Chuckwalla Valley area of the Sonoran Desert in eastern Riverside County, approximately four miles north of the rural community of Tamarisk Park and six miles north of the I-10 freeway and the rural community of Desert Center. The inactive Eagle Mountain Mine and the boundary of Joshua Tree National Park are located approximately 1.5 miles west and 1.4 miles east of the DSSF, respectively. The future DSSF location is shown on Figure 1.

Eagle Mountain Road, Kaiser Road, a paved road, and Eagle Mountain Railroad run from the Eagle Mountain Mine along the southwest portion of the DSSF before continuing south. Because the mine is no longer in operation, the various local roadways are lightly traveled.

Three existing transmission lines pass through the DSSF site. An existing 230-kV transmission line and a 33-kV distribution line, both owned by the Metropolitan Water District of Southern California (MWD), run along Power Line Road and traverse the DSSF.

## 3.1 Proposed Development

The DSSF, as proposed by First Solar, will be a solar photovoltaic (PV) energy generating facility producing 550 Megawatt AC (MWAC). The solar farm will occupy approximately 4,245 acres and includes the solar arrays, an on-site substation, access roads, a monitoring and maintenance facility, and other support facilities.

The First Solar PV modules, of which there will be a total of approximately 8.4 million on-site, are mounted on module framing assemblies made of steel, each holding 16 modules and measuring approximately eight (8) feet wide by 16 feet long. PV module assemblies are attached at an angle to vertical steel piles that are spaced eight (8) feet center-to-center and are driven into the ground to a depth of four (4) to seven (7) feet below grade. Each steel pile is a single W6x9 "I" beam. Once mounted, the front of each PV module assembly will be approximately 1.5 feet above grade, while the rear will be approximately five (5) to six (6) feet above grade. Each row of modules is spaced approximately seventeen (17) feet center-to-center from the adjacent row.

The PV modules are electrically connected by wiring harnesses running along the bottom of each assembly to combiner boxes that collect power from several rows of modules. The combiner boxes feed DC power from the modules to the Power Conversion Station (PCS) via underground cables. The inverters in the PCS convert the DC electric input into AC electric output and the isolation transformer steps the current up for on-site transmission of the AC power to the PV combining switchgear (PVCS). The PVCS collects the power for transmission to the Substation.

## 3.2 Climate

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14, which was used to estimate precipitation frequency for the hydrologic model, defines southwestern California as a semi-arid region. The Riverside County Hydrology Manual describes the inland valley and desert areas as extremely hot and dry during the summer months and moderate during the winter. The mean seasonal precipitation is three inches in the eastern desert regions and 35 to 40 inches in the San Bernardino and San Jacinto Mountains. There are three types of storms within the region: (1) general winter storms, (2) general summer storms and (3) high intensity thunderstorms. General winter storms originate as tropical cyclones (warm Pacific air masses) that occur in the late fall or winter months. High rates of precipitation occur over the interior mountain ranges but precipitation decreases rapidly over the desert areas. General summer storms can result in heavy precipitation and have durations of several days. These typically occur between the months of July and September as a result of tropical air masses from either the Gulf of Mexico or the South Pacific Ocean. Thunderstorms that generate extremely high precipitation rates for short durations can occur at any time of year.

### 3.3 Geology

Regional and site surficial geology are discussed in the 2007 "Phase 1 Geologic Reconnaissance Report" prepared for the Project by Eberhart/United Consultants (EUC). The site is located within the southwestern portion of the Mojave Desert Geomorphic Province of southern California. The San Andreas Fault defines the southwestern boundary of the Geomorphic Province while the Garlock Fault forms the boundary to the north. The Mojave is a broad interior region of isolated mountain ranges separated by expanses of desert plains. It has an interior enclosed drainage and many playas. The proposed DSSF site is located in the Chuckwalla Valley, which is formed from multiple alluvial fans disseminating from the Eagle Mountains in the west and the Coxcomb Mountains in the east. The Pinto Wash bisects the valley and forms the eastern boundary of the solar farm site.

### 3.4 Land Use and Soil Type

Available data indicates that land use activities at the DSSF site have remained relatively consistent over the past 30 to 40 years. Several small agricultural plots have been established in the vicinity of the site with the use of irrigation. The site itself has remained as largely undeveloped desert with sparse vegetation.

Field reconnaissance by EUC in 2007 investigated the surficial sediments at the site. Two distinct sediment types were present, one associated with areas of desert pavement and the other with more active wash sediments. EUC collected samples with a hand auger at three locations within the proposed DSSF site. Table 1 below summarizes the sediment characteristics.

**Table 1. Surficial Sediment Summary**

| Sample ID | Location | Depth (ft) | $D_{50}$ (mm) | Description |
|---|---|---|---|---|
| A | Southwest | - | - | Well graded gravel (desert pavement) grading into well sorted sand with gravel |
| C | Northwest | 0 to 0.5 | 9.5 | Well graded gravel (desert pavement) grading into well sorted sand with gravel |
| C | Northwest | 0.5 to 1.5 | 0.8 | Well sorted sand with gravel |
| J | South | 2.0 to 4.5 | 1.5 | Well graded sand with gravel |

### 3.5 Drainage Areas and Extent of the Modeling

The major drainage in the vicinity of the DSSF is the Pinto Wash. The Pinto Wash is located along the eastern boundary of the DSSF, continues southeast across undeveloped land, and drains into Palen Dry Lake to the east of the DSSF. Figure 2 shows a map of the model extents for both the hydrologic and hydraulic models. The basin delineation and model extents were developed utilizing automatic basin delineation tools available in the U.S. Environmental Protection Agency's (EPA) BASINS software. Elevations from the United States Geological Survey's (USGS) National Elevation Dataset were used for development of the model hydrology, which is discussed further in the following section.

# 4 HYDROLOGIC ANALYSIS

A two-dimensional (2D) model was constructed to simulate flow patterns and sediment transport within the DSSF. The hydrologic component of the 2D model was developed in HEC-HMS, a product of the Hydrologic Engineering Center (HEC) within the U.S. Army Corps of Engineers. The hydrologic analysis was performed using AMC II conditions utilizing guidelines outlined in the Riverside County Flood Control and Water Conservation District Hydrology Manual. The hydrologic analysis was repeated for the 10-year storm event incorporating various mitigation measures.

## 4.1 Hydrologic Analysis

The Riverside County Manual refers to the NOAA Atlas 2 for rainfall data. However, NOAA has superseded this source with Atlas 14 in the Project area. The website associated with NOAA Atlas 14 can provide rainfall intensity-duration-frequency (IDF) curves for any location based on latitude and longitude. The approximate coordinates of the DSSF site were entered into the website to develop rainfall totals for the 100- and 10-year storm events. A rainfall distribution was not specified by Riverside County; therefore, the balanced distribution recommended by the San Bernardino County Hydrology Manual (August 1986) was used for the analysis.

The Soil Conservation Service (SCS) curve number methodology was used to estimate flows to the hydraulic model. Curve numbers ranging from 79 in upstream areas to 63 in downstream areas were used for delineated basins. These curve numbers reflect AMC II, or normal moisture, conditions as specified by the Riverside County Manual. An initial abstraction of 0.15 was used. Lag times were calculated using the curve number method.

Hydrologic information was entered into HEC-HMS, which was then used to generate flows to the hydraulic model. Figure 3 presents the rainfall hyetograph at the Project site and Figure 4 shows the estimated total storm water peak flow running onto the entire project site over time during the 100-year and 10-year storm events. A summary of the hydrologic analysis is contained below in Table 2.

**Table 2. Hydrologic Analysis Summary**

| Parameter | Value | Value |
|---|---|---|
| Design Storm Frequency | 100-year | 10-year |
| Peak Rainfall Depth | 0.72 inches in 5 minutes | 0.31 inches in 5 minutes |
| Total Rainfall Depth | 3.58 inches | 1.96 inches |

# 5 HYDRAULIC ANALYSIS

Flow and sediment transport within the study area were simulated using FLO-2D. FLO-2D is a two-dimensional model designed to simulate unconfined overland flows. The extents of the FLO-2D model are shown in Figure 2 and include Solar Farm Site – Alternative Bas well as the Pinto Wash area immediately to the east. The northern and southern boundaries of the model were determined based on the path of water flow as per the USGS National Elevation Dataset. The upstream boundary extends approximately two miles upstream of the DSSF to establish flow patterns and sediment loads flow entering the site. The downstream boundary condition was set over half a mile downstream so that the downstream boundary condition would not affect flows on the Project site. FLO-2D model grid cells were set to dimensions of 200-feet by 200-feet.

Three configurations were analyzed: (1) existing conditions (2) proposed or future (post-development) conditions and (3) proposed or future conditions with soil decompaction. Future conditions were modeled without stormwater mitigation measures and with the inclusion of a storm water mitigation measure in the form of soil decompaction.

## 5.1 Inputs and Assumptions

Light Detection and Ranging (LIDAR) topographic survey data was collected within the DSSF. The LIDAR data was combined with USGS elevation data to populate the 2D model grid with elevations. These elevations represent the existing conditions of the site. For this analysis the same topographic data was used for both existing and proposed or future (post-development) conditions. Using the LIDAR data for both existing and future conditions will show the hydraulic changes at the project site as a result of grading and compaction by changing only the Manning's roughness and infiltration parameters. The grading plan would not greatly affect the model elevations that are averaged within the 200 foot by 200 foot grid elements created in FLO-2D.

The FLO-2D model uses the Green-Ampt method to simulate ground infiltration. The parameters for the Green-Ampt method were calibrated using information from the hydrologic HEC-HMS model. HEC-HMS uses the Curve Number infiltration method. The volume of flow that should runoff the site was estimated in HEC-HMS. The hydraulic conductivity in FLO-2D was adjusted so that the correct volume of flow was generated in the FLO-2D model. A curve number of 63 (i.e. barren land) was used for the majority of the existing conditions. The areas classified as "barren land" represent areas containing existing wash. The areas of desert pavement that occur within the project site were assumed to have similar infiltration capacity as the dirt roads introduced for the future conditions (i.e. curve number 72). Earth Systems Southwest (ESSW) provided an estimate that suggests approximately 20-30 percent of the total project area is covered in moderate to strong desert pavement. Delineation of the desert pavement areas were done by EUC (EUC, 2007). AECOM reviewed EUC's delineation against recent aerial images to confirm accuracy. This delineation is shown in Appendix E; the mapped desert pavement area is approximately 30 percent of the project site. The properties of desert pavement are discussed further in Section 7.1, Fluvial Geomorphologic Assessment Methodology. A curve number of 72 (i.e. dirt roads) was used for future conditions to account for compaction and loss of vegetation within the DSSF site. Outside the project site the existing conditions assignment of 63 representing barren land was retained.

A Manning's "n" value of 0.043 was used for existing conditions and was based on guidelines established by the USGS for developing Manning's roughness coefficients in floodplains (USGS Water-supply Paper 2339). For the post-development conditions, the Manning's "n" is reduced to 0.034, reflecting both the reduction in roughness due to smoothing the grade and removing existing vegetation and takes into account the increase in roughness due to the presence of the piles supporting the solar panels. See Appendix B for a detailed review of the Manning's value assignments.

### 5.2 Results: Future Conditions

The results presented in this section show the future hydraulic conditions without stormwater mitigation measures. The FLO-2D model was simulated for a 48-hour period for the 100- and 10-year design storm events. Plots of peak storm water depth and velocity for both future and existing conditions were produced with the FLO-2D model results. To be conservative in terms of peak velocities, sediment transport was not taken into account during these simulations. In reality, when sediment transport (scour) takes place flow depth will increase and the peak velocities will therefore decrease. Sediment transport models were developed separately, the results of the sediment transport analysis can be found in Section 6.

The 100-year future conditions model indicates that the storm water peak flow depth would be less than 2.3 feet in the center of the DSSF and towards the east due to the Pinto Wash. In general, the modeling results demonstrate that there would be very little change (less than one tenth (1/10) foot of difference) in flow depth as a result of Project-related changes to the site. The modeling results also demonstrate that there would be no increase in maximum storm water peak flow velocities as a result of the changes to the Project site.

A summary of the hydraulic analysis for the 100-year storm is contained in Table 3 below. In this table, “on-site location” essentially indicates the changes within the Project site and “off-site location” indicates the impacts to the areas immediately downstream of the DSSF site.

**Table 3. Hydraulic Analysis Summary: 100-year**

| Parameter | Location | Existing Conditions | Future Conditions | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 23,952 cfs | 24,263 cfs | 311 cfs 1.3% |
| Total Outflow Volume | Off-site | 6,645 acre-ft | 6,813 acre-ft | 168 acre-ft 2.5% |
| Maximum Peak Flow Depth | On-site | 2.2 ft | 2.3 ft | 0.1 ft 4.5% |
| Average Peak Flow Depth | On-site | 0.8 ft | 0.8 ft | 0.0 ft 0.0% |
| Peak Velocity | On-site | 5.0 ft/s | 5.0 ft/s | 0.0 ft/s 0.0% |
| Average Velocity | On-site | 1.9 ft/s | 1.9 ft/s | 0.0 ft/s 0.0% |

The hydraulic model results of the 10-year storm can be found in Table 4, below. There was no change in peak flow depth from existing to proposed conditions and the average flow depth remained the same. Peak flow velocity and average velocities will not increase as a result of development for the 10-year storm.

**Table 4. Hydraulic Analysis Summary: 10-year**

| Parameter | Location | Existing Conditions | Future Conditions | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 5,461 cfs | 5,717 cfs | 256 cfs 4.7% |
| Total Outflow Volume | Off-site | 1,958 acre-ft | 2,073 acre-ft | 115 acre-ft 5.9% |
| Maximum Peak Flow Depth | On-site | 1.5 ft | 1.5 ft | 0.0 ft 0.0% |
| Average Peak Flow Depth | On-site | 0.4 ft | 0.4 ft | 0.0 ft 0.0% |
| Peak Velocity | On-site | 3.5 ft/s | 3.5 ft/s | 0.0 ft 0.0% |
| Average Velocity | On-site | 1.1 ft/s | 1.1 ft/s | 0.0 ft 0.0% |

Table 3 and Table 4 do not reflect storm water mitigation measures that will be incorporated into the final design of the DSSF. See Section 5.3 below for the model results with incorporated LID design mechanisms.

### 5.3 Results: Future Conditions with Decompaction

The results presented in this section show the future hydraulic conditions with decompaction as stormwater mitigation. The FLO-2D model was simulated for a 48-hour period for the 100- and 10-year design storm events. Infiltration rates were adjusted to represent decompaction of the soil between the rows of the arrays. Plots of peak storm water depth and velocity for both future and existing conditions were produced with the FLO-2D model results. To be conservative in terms of peak velocities, sediment transport was not taken into account during these simulations. Sediment transport models were developed separately, the results of the sediment transport analysis can be found in Section 6.

The goal of the design is to minimize the change of hydraulics and sediment transport. The grading design incorporating the soil decompaction storm water mitigation measure was modeled to determine the impact caused by development of the DSSF site. Soil decompaction will be implemented between the rows of tables within each of the arrays. The decompaction operation will restore the infiltration to the pre-development original state. The intent of the decompaction mitigation measure is to increase the post-development soil infiltration that results in a lower total storm water outflow volume.

For the project areas located on existing desert pavement, the decompaction measure is not anticipated to restore the pre-development conditions. Project areas that are currently covered with desert pavement already have a low infiltration capacity. Although the decompaction measure is intended to increase post-development soil infiltration, the decompaction measure is not anticipated to significantly change the infiltration capacity as compared to pre-development conditions for desert pavement areas.

The values presented in Table 5 are the results from simulating decompaction of 37.3% of the total project site. This percentage was calculated based on the current array configuration and site layout that allows for approximately 9.4 feet of the area between rows to be decompacted with an allowance to minimize damage to the panels. Figure 9 shows the maximum peak flow depths, Figure 10 shows the change in maximum peak flow depth, Figure 11 shows the maximum peak velocity and Figure 12 shows the change in peak velocity. The change in total outflow volume is 81 acre-feet or a 1.2% increase from existing conditions when decompaction was considered.

**Table 5. Hydraulic Analysis Summary: 100-year with Decompaction**

| Parameter | Location | Existing Conditions | Future Conditions with Decompaction Measure | Change |
|---|---|---|---|---|
| **Peak Outflow** | Off-site | 23,952 cfs | 24,068 cfs | 116 cfs 0.5% |
| **Total Outflow Volume** | Off-site | 6,645 acre-ft | 6,726 acre-ft | 81 acre-ft 1.2% |
| **Maximum Peak Flow Depth** | On-site | 2.2 ft | 2.2 ft | 0 ft (0%) |
| **Average Peak Flow Depth** | On-site | 0.8 ft | 0.8 ft | 0 ft (0%) |
| **Peak Velocity** | On-site | 5.0 ft/s | 5.0 ft/s | 0 ft/s (0%) |
| **Average Velocity** | On-site | 1.9 ft/s | 1.9 ft/s | 0 ft/s (0%) |

The 10-year decompaction simulation resulted in a change in total outflow volume of 55 acre-feet or a 2.8% increase from existing conditions. Figure 13 shows the maximum peak flow depths, Figure 14 shows the change in maximum peak flow depth, Figure 15 shows the maximum peak velocity and Figure 16 shows the change in peak velocity.

**Table 6. Hydraulic Analysis Summary: 10-year with Decompaction**

| Parameter | Location | Existing Conditions | Future Conditions with Decompaction Measure | Change |
|---|---|---|---|---|
| Peak Outflow | Off-site | 5,461 cfs | 5,519 cfs | 58 cfs 1.1% |
| Total Outflow Volume | Off-site | 1,958 acre-ft | 2,013 acre-ft | 55 acre-ft 2.8% |
| Maximum Peak Flow Depth | On-site | 1.5 ft | 1.5 ft | 0 ft (0%) |
| Average Peak Flow Depth | On-site | 0.4 ft | 0.4 ft | 0 ft (0%) |
| Peak Velocity | On-site | 3.5 ft/s | 3.5 ft/s | 0 ft/s (0%) |
| Average Velocity | On-site | 1.1 ft/s | 1.1 ft/s | 0 ft/s (0%) |

The results presented in Table 5 and Table 6 do not include sediment transport functions.

The decompaction measure will mitigate the impact from pre to post development conditions to less than 5% change at the boundary of the model.

### *5.3.1 Discussion of Additional Mitigation Measures*

Decompaction of soils is the most significant measure to mitigate post-development impact, by reducing added runoff. Decompacting the soil provides additional infiltration capacity which reduces runoff volume, peak flow rate, flow velocities and sediment transport. Placement of riprap can also be considered as an additional mitigation measure. Riprap increases surface roughness slowing down the velocities, decreasing sediment transport, and increasing flow depth. Riprap would be used in conjunction with decompaction, as riprap will not mitigate flow or volume.

An additional mitigation measure such as retention basins can be implemented to address specific post-development hydraulic characteristics that remain after implementation of the decompaction measure. These retention basins could be located along the upstream western boundary of the project site to intercept run on storm water flows. The intent of this measure is to reduce overall flow depths, velocities and outflow volume by retaining run-on storm water volume. They will also reduce sediment transport within the project site. Due to the size of the grid elements in FLO-2D (200 foot by 200 foot) an accurate representation of the basins cannot be distinguished in the model. However, it can be assumed that the basins can be designed to retain the excess total storm water volume. Once the basins are designed, their retention capacity volume can be subtracted from the total outflow volume of any of the simulations. Retentions basins would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 55 ac-ft for the 10-year storm event.

An additional mitigation measure such as check dams can be implemented to address specific post-development hydraulic characteristics that remain after implementation of the decompaction measure. These check dams could be located near the downstream southern boundary of the project site to intercept run off storm water flows. The intent of this measure is to reduce outflow volume by retaining run-off storm water volume. Check dams would have an effect on the storm water upstream of each dam because the storm water would back up behind each dam. Check dams would also reduce flow velocities and sediment transport leaving the project site. Check dams would change the Manning's roughness ("n") values used in the model at their immediate vicinity. It can be assumed that the check dams can be designed to retain the excess total storm water volume. Once the check dams are designed, their retention capacity volume can be subtracted from the total outflow volume of any of the simulations. Check dams would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 55 ac-ft for the 10-year storm event.

An additional mitigation measure such as strip detention basins can be implemented to address specific post-development hydraulic characteristics that remain after implementation of the decompaction measure. The strip detention basins would be approximately 6-inches deep and 70 feet wide. The strip detention basins would be designed to follow the contours, so the lengths would be dependent on the locations of the basins on the site. These detention basins could be located near the downstream southern boundary of the project site to intercept run off storm water flows. The intent of this measure is to reduce outflow volume by detaining run-off storm water volume, similar to the check dam measures. Strip detention basins would not have an effect on the storm water upstream of each basin but would reduce flow velocities and sediment transport leaving the project site. Strip basins would not appreciably change the Manning's roughness ("n") values used in the model for the project. The strip detention basins would not be as effective a measure as the check dams. Check dams can be designed to hold more volume than the strip detention basins when placed on flatter slopes and also check dams will act as a bigger obstacle than strip detention basins attenuating storm water flow. It can be assumed that the strip detention basins can be designed to retain the excess total storm water volume and would have a retention volume capacity equivalent to that for the check dams. Strip detention basins would be designed to retain the excess total volume capacity which for the current modeling results is on the order of 55 ac-ft for the 10-year storm event. Once the strip detention basins are designed, their detention capacity volume can be subtracted from the total outflow volume of any of the simulations.

#### *5.3.2 Discussion of Effect on the Pinto Wash*

As shown on the pre-development and post-development figures, the development will not significantly affect the storm water flow in the Pinto Wash. For the most part, the storm water flow in the Pinto Wash will encroach onto the DSSF for 10-year and 100-year storm events. The figures show that the flow on the DSSF does not enter the Pinto Wash along the DSSF boundary (or within the boundaries of the model), rather the storm water outflow from the site will enter the Pinto Wash in an area several miles downstream of the DSSF. The volume of storm water in the Pinto Wash is on the order of 4,072 ac-ft for the 100-year storm event and 1,545 ac-ft for the 10-year storm event. The DSSF does not increase Pinto

Wash flows at the downstream end of the project; however, an additional 81 ac-ft for the 100-year event from the DSSF would eventually make its way into Pinto Wash at which point the increase is expected to be less than 1%. Velocities and depths within the pinto wash will not change as a result of development. The DSSF development would not have a significant impact to a storm water flow in the Pinto Wash.

# 6 SEDIMENT TRANSPORT ANALYSIS

This section describes sediment transport for the project as predicted by FLO-2D. The sediment transport analysis is conservative because degradation depths presented do not reflect sediment deposition which may occur within the same model cell. The model does not account for local scour at the supports for the solar panels. Local scour is evaluated later in this report; see Section 8 LOCAL SCOUR ANALYSIS.

## 6.1 Methodology

The existing and proposed model configurations discussed in the Hydraulics Section were modified to account for sediment transport. FLO-2D has the capability of simulating sediment transport and offers several different methodologies. The Zeller and Fullerton methodology was selected for sediment transport analysis of the DSSF since this methodology is appropriate for alluvial floodplain conditions (FLO-2D User's Manual, 2007). Sediment profile information was obtained from the geotechnical study (EUC, 2007).

## 6.2 Results

The existing and future conditions with decompaction were modeled under AMC II conditions to determine the loss in depth of the sediment (degradation or scour) during the 100- and 10-year storm events. Maps presenting the results of the existing conditions 100-year and 10-year peak degradation are shown in Figure 18 and 20, respectively. Maps presenting the results of the 100-year and 10-year peak degradation are shown in Figure 18 and Figure 21 respectively. Graphs showing change in sediment transport depth can be found in Figure 19 and Figure 22. Table 7 presents average degradation depths for the 100-year storm event within the DSSF for the simulations. The modeling results determined that the average degradation for the 100-year storm event within the project site does not change (the difference is 0.0%) for the future conditions with decompaction.

**Table 7. Sediment Transport Summary: 100-year storm**

| Simulation | Average Degradation Depth | Change |
|---|---|---|
| Existing Conditions | 0.03 ft | NA |
| Future Conditions with Decompaction | 0.03 ft | 0.00 ft (0.0%) |

The 10-year simulation results are presented below in Table 8. The modeling results determined that the average degradation for the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions.

**Table 8. Sediment Transport Summary: 10-year storm**

| Parameter | Average Degradation Depth | Change |
|---|---|---|
| Existing Conditions | 0.01 ft | NA |
| Future Conditions with Decompaction | 0.01 ft | 0.00 ft (0.0%) |

Sediment transport, based on the sediment particle size, showed that the proposed installation did not have any impact on degradation; the average degradation depth is 0.03 feet for the 100-year storm and 0.01 feet for the 10-year storm over most of the DSSF for both pre- and post-development conditions. The results show that the average degradation within the project site remains the same for existing conditions and all development options.

Although the modeling results indicate that the average degradation depth is not significant for both pre- and post-development conditions, sediment transport may occur as a result of either a large storm event or a series of smaller storm events. This issue can be mitigated by periodic monitoring and maintenance of the site. For example, monitoring conducted after storm events would indicate sediment depth at that time and maintenance activities would be conducted as/if needed to add/remove material to restore design conditions. A Monitoring and Response Plan will be incorporated into the final design of the DSSF to ensure that the storm water infrastructure is in good working order on an ongoing basis during Project operation.

# 7 FLUVIAL GEOMORPHOLOGIC ASSESSMENT

## 7.1 Methodology

AECOM reviewed existing data including geologic literature, site reports, aerial mapping and topographical survey to qualitatively determine the fluvial geomorphology of the DSSF. Aerial photographs from the years 1978, 1996 and 2002 were analyzed to determine changes in land use and stream channel configurations.

As noted earlier, the DSSF is located in the Chuckwalla Valley, which is bounded by a series of alluvial fans that slope gently to moderately toward the southwest and southeast. The Pinto Wash runs through the center of the valley. The DSSF facilities are to be located to the west of the Pinto Wash. Vegetation at the site generally consists of sage and other scrub-type brush that is typical for the arid regions of southern California (EUC, 2007).

The geomorphology of alluvial fans is described by John Field and Philip Pearthree in their article "Geomorphologic Flood-Hazard Assessment of Alluvial Fans and Piedmonts" published in the Journal of Geoscience Education, Vol. 45, 1997:

> "Alluvial fans are generally cone-shaped depositional landforms with distributary drainage patterns that emanate from a discrete source and increase in width downslope. Older, inactive, alluvial fans commonly are isolated from active depositional processes and dendritic drainage patterns are developed on them."
>
> "Surfaces that are subject to flooding are undissected, display well preserved bar-and-swale topography, and lack desert pavement and varnish. In contrast, surfaces that have not been flooded for hundreds of thousands of years are moderately to deeply dissected, have well developed desert pavements and abundant shattered cobbles on the surface; their soils include substantial accumulations of clay and calcium carbonate (caliche)."
>
> "Several criteria can be used to distinguish between a permanent and temporary trench. Fanhead trenches dissecting inactive surfaces with well developed soils, desert pavement, and rock varnish are permanent features, since it is the incision of the trench itself that is largely responsible for the isolation of the adjacent old surfaces. A trench dissecting a young surface, on the other hand, is potentially only a transient feature. The depth of incision alone should not be used to determine whether a trench is permanent. Trenches as deep as 8 m can be filled and/or cut during a single debris flow event. …Regardless of the absolute depth of the incision, a fanhead trench is not a permanent feature if floodwaters can overtop or backfill the channel under the prevailing hydrologic conditions."

Review of recent aerial imagery and site photographs indicates that there are two significant geologic environments occurring at the DSSF. The first geologic environment is characterized as older alluvial sediments with developed desert pavement. This environment occurs in the northwest portion of the site in the vicinity of Power Line Road. It also occurs in the southwest corner of the site adjacent to Kaiser Road (Co Route R2). Based on LIDAR topographic survey data, alluvial stream channel depths near Power Line Road approach four feet at the northwest end of the project while the channels near Kaiser Road are generally two (feet or less.

The second significant geologic setting at the DSSF site consists of an area of active younger sediments with no evidence of desert pavement. Topography in these areas tends to be very consistent with channels depths generally less than one foot deep.

The EUC "Phase 1 Geologic Reconnaissance Report" corroborates the two significant conditions encountered at the site. EUC describes the established alluvial sediments as follows:

> "Older alluvial fan deposits consisting of Pleistocene non-marine sediments extend outward into the valley from both the Eagle Mountains on the west and the Coxcomb Mountains on the east. Desert pavement type deposits (manganese and iron oxidized coatings on cobbles and sand) blanket the top three (3) to six (6) inches of the older alluvial fan material."

EUC describes the area near Power Line Road and Kaiser Road as the “Northwest fan – includes sediments derived from the Eagle Mountain Quartz Monzonite, Pleistocene volcanic rocks, and Pre-Cretaceous metamorphosed sediments.” In contrast, they describe the younger active sediments as “of Holocene age. These soils consist of fine to coarse sand, interbedded with clay, silt and gravel.”

Lateral migration of stream channels is typically evaluated based on the analysis of historical aerial photographs. AECOM reviewed aerial photographs from the years 1978, 1996 and 2002 at the proposed site. Based on the data available, stream channels at the site have been relatively stable over the period evaluated. It is more difficult to determine the stability of smaller channels located in the more active portions of the site due to their scale. Based on knowledge of similar environments, it would be expected that alluvial stream channels in the older alluvial regions remain relatively stable. It is anticipated that the shallow channels that exist within the younger sediment would exhibit frequent channel avulsion and lateral migration during flood flows.

### 7.2 Results

Changes to the vertical profile of the stream channels are difficult to quantify without detailed survey data of Project site topography over time. However, existing conditions at the site indicate channel depths of two to four feet in the older alluvial sediments and less than two feet in the younger sediments.

The grading design of the DSSF includes grading of the entire site with varying levels of compaction depending on proposed land use (primary road, secondary road, etc.). Existing slopes on the site vary from zero to two percent in the active alluvial areas to two to four percent in the regions of less active older alluvial sediments. Planned slopes will be zero to two percent across the entire site.

The proposed changes to the site will have an impact on future geomorphic conditions. Instead of relatively inactive areas characterized by desert pavement in combination with more active areas, the geologic conditions at the site will change to a more consistent geological condition. Changes to existing site grades will also have an impact on flood flows. It is anticipated that these changes will create a geologic environment conducive to rapidly migrating shallow channels, approximately two feet deep or less. Channel formation from fluvial geomorphology occurs as a result of multiple storm events over time. This long term scour or channel formation can be mitigated by periodic monitoring to identify changes to the site grading, followed by maintenance measures to address these changes as/if needed. Development of a Monitoring and Response plan would address monitoring of the drainage control devices after storm events and development of appropriate maintenance responses so that the drainage control devices are operational for subsequent storm events. Flatter slopes may also contribute to areas of sediment deposition during storm events.

If further evaluation of existing and post-development conditions at the site is needed, a detailed quantitative fluvial geomorphologic assessment will be conducted. The quantitative evaluation would include a detailed analysis of stream migration based on historical aerial images, additional historical information including interviews with local inhabitants, and site reconnaissance to determine channel characteristic, extent of desert pavement and soil properties.

**Photo 1. Stream channel in older alluvial sediments (desert pavement)**

**Photo 2. View of desert pavement material**

# 8 LOCAL SCOUR ANALYSIS

The total predicted scour depth is the sum of the following components: general scour, long term scour and local scour. General scour is discussed in the Sediment Transport Analysis Section 6 of this report. Long term scour depth is estimated in the previous Fluvial Geomorphologic Assessment Section 7. It is assumed that the long term scour can be mitigated by periodic monitoring to identify changes to the site grading and followed by maintenance measures to address these changes as/if needed. Therefore, the total scour depth presented in this section is assumed to be the local scour and general scour that the site structures could experience. The local scour is discussed herein for the future conditions 100-year storm event. Local scour is measured at an instantaneous point in time as a result of turbulent flow at the pylons. Sediment is suspended at the base of these structures within the turbulent flow. As the sediment moves away from the turbulent zone the flow can no longer support the sediment load and it is typically deposited a short distance downstream. Local scour occurs at the base of a structure as a result of the change in direction and velocity of storm water as the water flows around the structure. The effect of the local scour is limited to the area immediately adjacent to the base of the PV solar panel support structures.

## 8.1 Methodology

For the purpose of this study, local scour was analyzed at the base of the PV solar panel support structures. Scour depths were calculated using a local pier scour equation from the Federal Highway Administration's Hydraulic Engineering Circular No. 18 (HEC-18), "Evaluating Scour at Bridges" ($4^{th}$ Edition).

Scour depths were calculated for each element in the 2D model within the DSSF. Velocity and depth outputs from the model were used to determine scour at each element. The dimensions of a model element are 200-feet by 200-feet and velocities and depths predicted by the model are averaged across the element area. Therefore, the velocities may not be conservative because high concentrations at portions of the element are lost and larger scour depths than predicted may occur.

The local scour equation and the various parameters and assumptions are as follows:

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 K_4 \left(\frac{y}{a}\right)^{0.35} Fr^{0.43}$$ **(Equation 1)**

Where:

$y_s$ = Local scour depth (ft);
$K_1$ = Correction factor for pier nose shape;
$K_2$ = Correction factor for angle of attack of flow;
$K_3$ = Correction factor for bed condition;
$K_4$ = Correction factor for armoring;
a = Pier width (ft);
y = Flow depth (ft);
Fr = Froude number:

$$Fr = \frac{V}{\sqrt{gy}}$$ **(Equation 2)**

Where:

V = Average velocity (ft/s);
g = Acceleration due to gravity (ft/$s^2$).

### 8.2 Approach

Two (2) different scour depth analyses were performed to encompass the best and worst case scour depths by varying the pile geometry. The only parameters of the scour equation that change in each case are the pier width (a) and the correction factor for angle of attack ($K_2$). All other values (velocity, depth, etc.) remain the same for a given element within the modeled domain. A plane bed was assumed for the bed condition, resulting in a $K_3$ factor of 1.1. The grain size analyses collected during the EUC Phase 1 Geologic Reconnaissance Report all contained a median particle diameter of less than two (2) millimeters, resulting in a $K_4$ factor of 1.0.

### 8.3 Inputs and Assumptions

The proposed pile configuration consists of steel wide flange I-beams (W6X9). The shape correction factor was assumed to be square for both cases, resulting in a $K_1$ factor of 1.1. The worst case analysis assumed the pier width was the largest flange dimension (5.9 inches) and the angle of attack was assumed to be 90 degrees. A 90 degree angle of attack produces the largest $K_2$ value (1.3). The equation for determining $K_2$ is shown below (HEC-18):

$$K_2 = \left( Cos\theta + \frac{L}{a} Sin\theta \right)^{0.65}$$ **(Equation 3)**

Where:

L = Length of pile (ft);
Θ = Angle of attack of flow (degrees).

The worst case angle of attack assumptions mentioned above produce the most conservative scour depth results. The best case scour analysis assumed the pier width was the smallest flange dimension (3.94 inches) and the angle of attack was assumed to be zero degrees. A zero degree angle of attack produces the smallest $K_2$ value (1.0). The best case angle of attack assumptions produce less conservative scour depths and are not presented herein. A visual representation of the 100-year worst case scenario is shown on Figure 23.

### 8.4 Results

The maximum local scour depth (i.e. when the flow is aligned with the widest part of the support structure) for the DSSF using the worst case assumptions described above for the 100-year storm was 2.1 feet. The maximum total scour within the project site was 2.6 feet. This was the combination of local scour and general scour within the same model cell. This scour depth occurred for both the future conditions and future conditions including the decompaction mitigation measure. The areas of maximum scour potential are along the northwest portion of the site. The average scour depth was found to be 1.2 feet. Table 9 shows the frequency of occurrence for the more-erosive scour depths within the project site. Figure 23 shows the distribution of maximum local scour depths using worst case assumptions within the Project area for the future conditions 100-year storm.

Formation of local areas of scour can occur as a result of a large storm event or a series of smaller storm events. Local scour can be mitigated by periodic monitoring and maintenance of the site. A Monitoring and Response Plan will be utilized during operations of the DSSF to ensure that PV supports remain in stable operational condition and are not compromised by local scour impacts.

**Table 9. Local Scour Summary: 100-year Worst Case Frequency of Occurrence within the Project Site for Decompaction**

| Depth of Scour | Local Scour | Total Scour |
|---|---|---|
| 0.0 to 0.5 feet | 0.1% | 0.1% |
| 0.5 to 1.0 foot | 24.9% | 24.4% |
| 1.0 to 1.5 feet | 68.2% | 63.8% |
| 1.5 to 2.0 feet | 6.7% | 11.2% |
| 2.0 to 2.5 feet | 0.1% | 0.4% |
| 2.5 to 3.0 feet | 0.0% | 0.0% |
| Average Scour Depth | 1.2 ft | 1.2 ft |
| Maximum Scour Depth | 2.1 ft | 2.6 ft |

The less erosive-case (i.e. when flow direction is aligned with the narrow side of the support structure) maximum local scour depth was 1.2 feet and total scour was 1.9 feet. Frequency of occurrence can be found in Table 10 for the less-erosive case.

**Table 10. Local Scour Summary: 100-year Best Case Frequency of Occurrence within the Project Site for Decompaction**

| Depth of Scour | Local Scour | Total Scour |
|---|---|---|
| 0.0 to 0.5 feet | 14.9% | 14.3% |
| 0.5 to 1.0 foot | 84.7% | 81.2% |
| 1.0 to 1.5 feet | 0.4% | 4.3% |
| 1.5 to 2.0 feet | 0.0% | 0.2% |
| Average Scour Depth | 0.7 ft | 0.7 ft |
| Maximum Scour Depth | 1.2 ft | 1.9 ft |

# 9 CONCLUSIONS

The results of the storm water modeling are:

1 Results of the hydrologic analysis for the DSSF development indicated that implementing decompaction of the areas between the panels will reduce the post development hydraulic conditions to within +/-5% of the pre-development hydraulic conditions. An additional on-site mitigation measure such as basins with rip-rap protection, check dams or strip detention basins can be implemented to retain the remaining excess total off-site storm water volume increase. Please note that the accuracy of the model is approximately +/- 5% and so the differences (i.e. within 5%) calculated by the model are within this range.

2 Results of the hydrologic analysis for the post-development DSSF grading design without the addition of a mitigation measure indicated that, in general, storm water off-site peak flow rates and volumes increased for both the 100-year and 10-year storm events. The storm water off-site peak flow rate and volume increased 1.3% and 2.5% respectively for the 100-year storm event and 4.7% and 5.9%, respectively for the 10-year storm event. The maximum on-site peak flow depth for the 100-year event increased 4.5% and there was no change for the 10-year event. The on-site peak flow depth and velocity did not change for 100-year and 10-year events.

3 Results of the hydrologic analysis for post-development design that only includes a decompaction mitigation measure indicated that the storm water off-site peak flow rate and volume increased 0.5% and 1.2% respectively for the 100-year storm event and 1.1% and 2.8% respectively for the 10-year storm event. Flow depths and velocities remain the same on-site, as compared to the existing conditions for both the 100-year and 10-year storm events. The additional storm water peak volume is reduced by decompaction of soils, which is the most significant measure to mitigate post-development conditions to within +/- 5% of the pre-development conditions

4 The addition of mitigation measures such as basins with rip-rap protection, check dams, or strip detention basins to the DSSF development in addition to decompaction, will address excess post-development hydraulic impacts that are not addressed by decompaction. These additional measures are based on implementing storm water best management practices and have not been rigorously modeled, however they would be designed to retain excess total off-site storm water volume. The intent of an additional mitigation measure is to reduce overall flow depths, velocities and outflow volume by detaining run-on storm water volume. The additional measures would also be successful at reducing potential increases in sediment transport and would be designed to retain the excess total volume capacity which is on the order of 55 ac-ft for the 10-year storm event.

5 Results of the sediment tra nsport analysis for post-development determined that the average degradation for the 100-year and the 10-year storm event within the project site does not change (the difference is 0.0%) for future conditions. The average degradation depth for the 100-year storm would be 0.03 feet, and 0.01 feet for the 10-year storm (i.e., general scour);

6 Results of the total scour analysis for post-development found that the average on-site scour depth would be 0.7 to 1.2 feet at the base of the PV supports for the 100-year storm, depending on the angle of flow to the supports. Placement of riprap will provide a less significant benefit to mitigate for additional runoff. However, riprap placed at the base of each support structure will help reduce the effects of local scour and lower storm water runoff velocities.

7 Results of the qualitative fluvial geomorphologi c analysis indicates existing areas of relatively inactive sediments characterized by desert pavement and more active areas consisting of finer sand and gravel. The changes to the site resulting from Project development will create an area that has consistent compaction, soil type and grading compared to existing conditions. It is anticipated that these changes will create a geologic environment conducive to the formation of shallow channels up to two feet or less in depth (i.e., long-term scour). This long term scour can be mitigated by periodic monitoring to identify changes to the site grading and maintenance activities as/if needed to restore design conditions.

The results of the modeling indicate that the DSSF development would have a small impact on off-site peak flow rate and a negligible increase in maximum degradation depth comparing pre-development conditions to post-development conditions. These impacts are relatively small. However, the implementation of storm water mitigation measures will minimize impacts of the DSSF development on sedimentation and erosion characteristics in downstream areas with the result that post-development downstream conditions are essentially the same as pre-development existing conditions.

Along with the mitigation measures, a Monitoring and Response Plan will be prepared and submitted to the BLM. The Monitoring and Response Plan will indicate the procedures that will be followed to mitigate potential impacts to the site structures, storm water infrastructure or site grading that can occur from local scour, sediment transport and long term degradation (i.e. fluvial geomorphology) during the operation of the DSSF. This plan will address monitoring of the mitigation measures after storm events and development of appropriate maintenance responses so that the mitigation measures are in good working order and continue to be effective for subsequent storm events. Because the differences are so small (i.e. within +/- 5%) and there are a number of unknowns associated with real life conditions (i.e. compared to computer simulation), it is recommended that after each significant event (e.g. a 1-year storm or larger) hydrologic, hydraulic and sediment transport characteristics to be monitored. If acute or chronic problems are detected then modifications can be made as necessary.

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12. U.S. Department of Transportation, Federal Highway Administration, “Hydraulic Engineering Circular No. 18, Evaluating Scour at Bridges,” Fourth Edition. Publication No. FHWA NHI 01-001, May 2001.
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N

0 4 8 Miles

Figure 1
Desert Sunlight Solar Farm
Locus Map

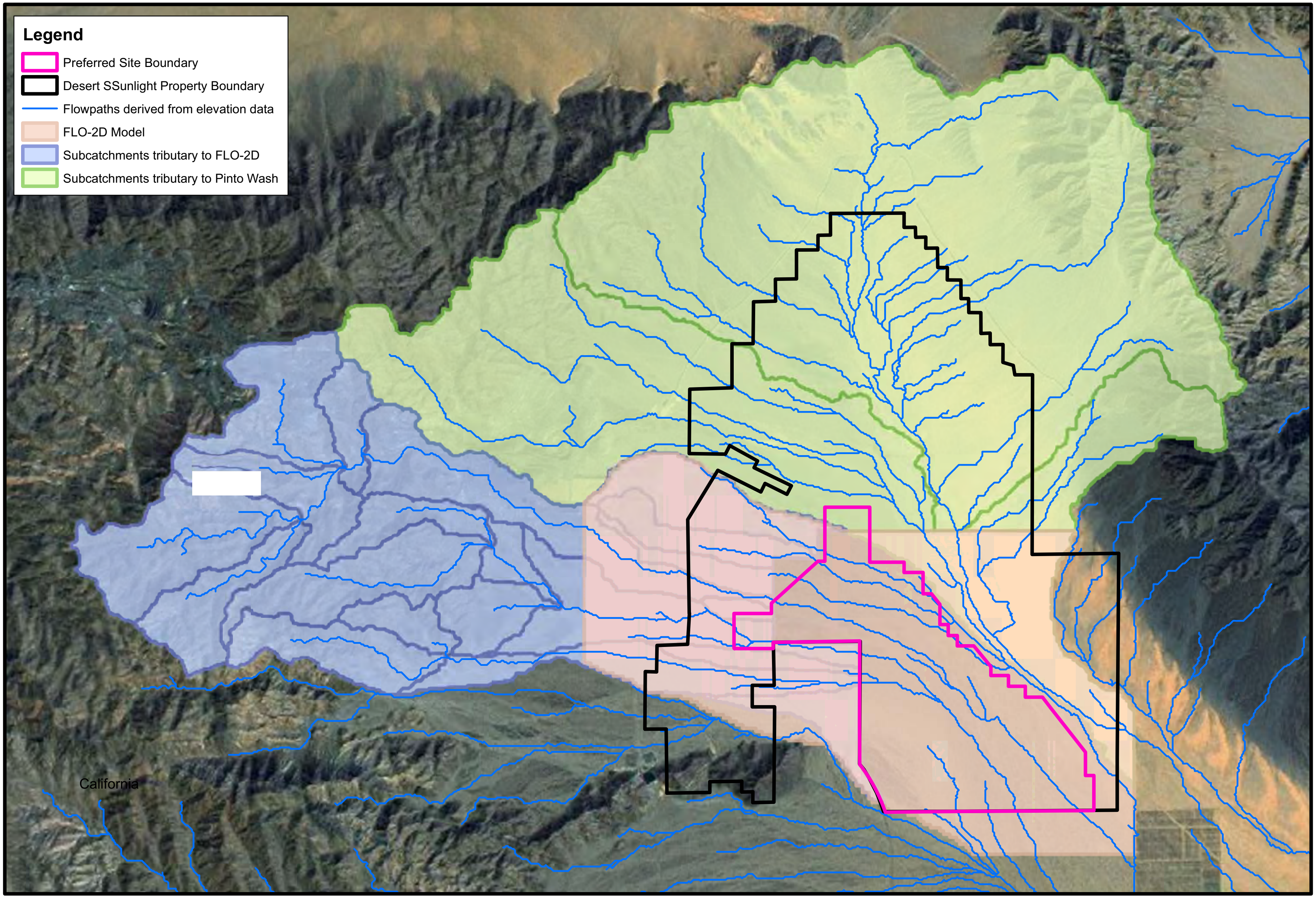


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Figure 2
Map of FLO-2D and HEC-HMS
Model Extents

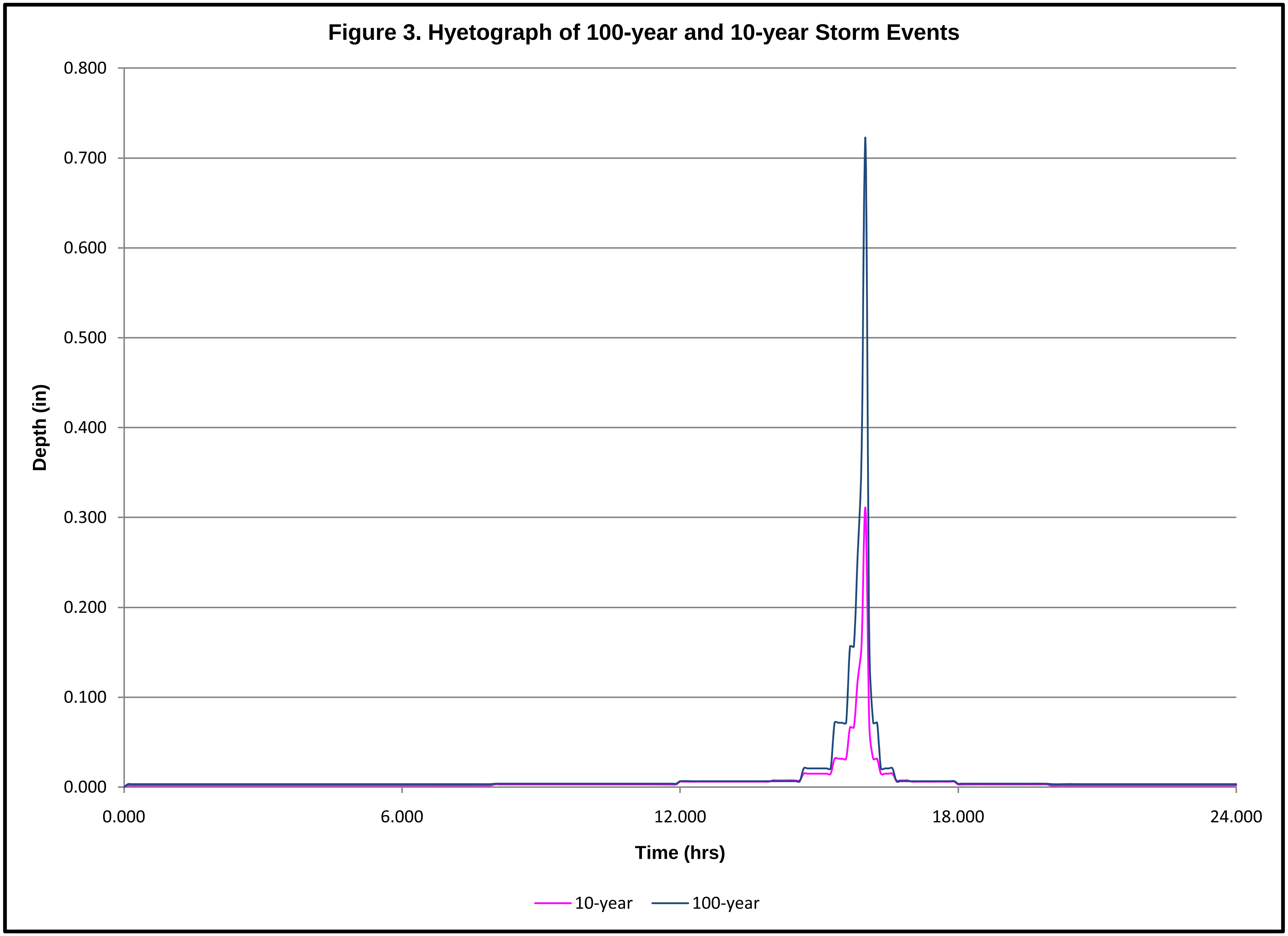
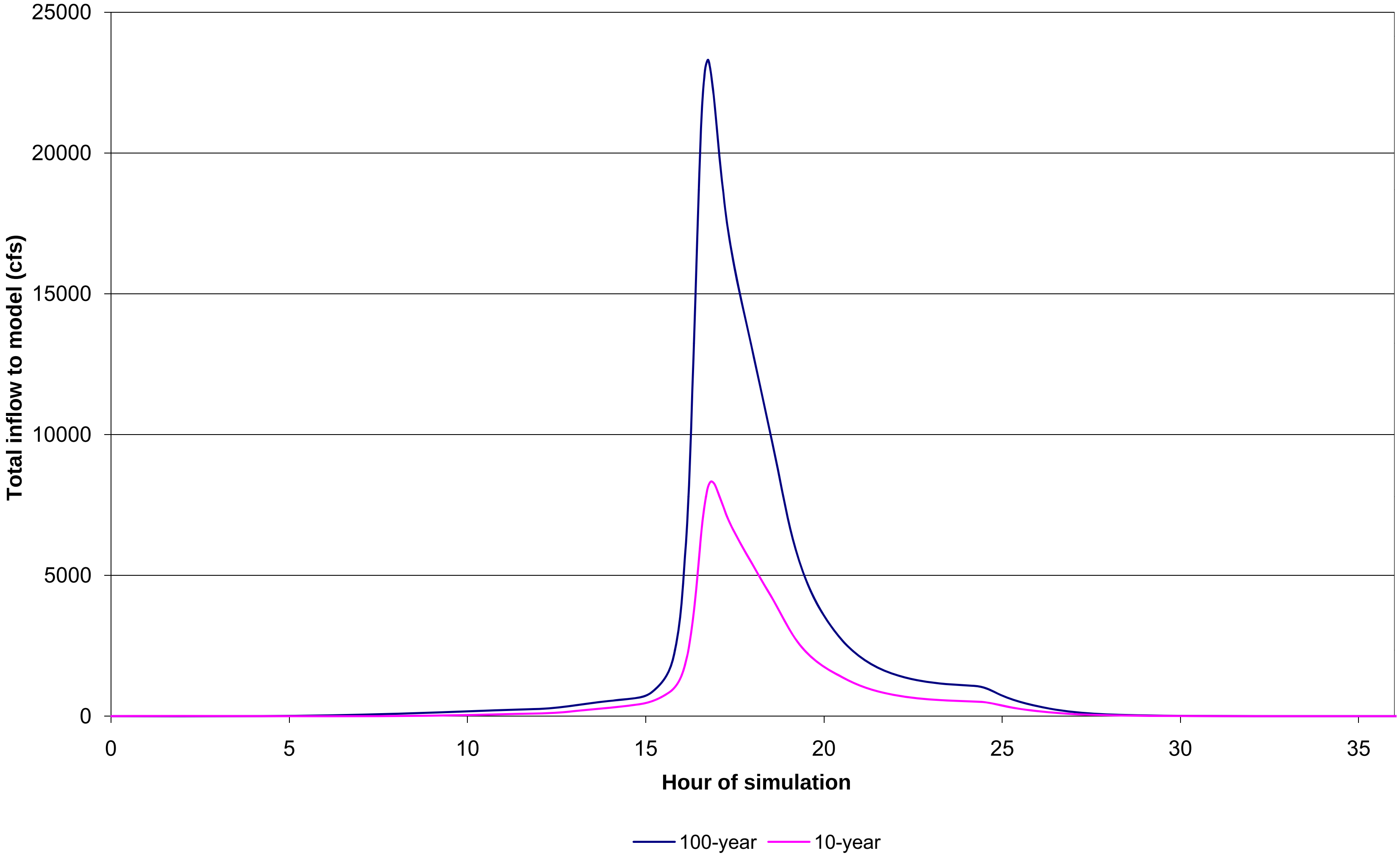
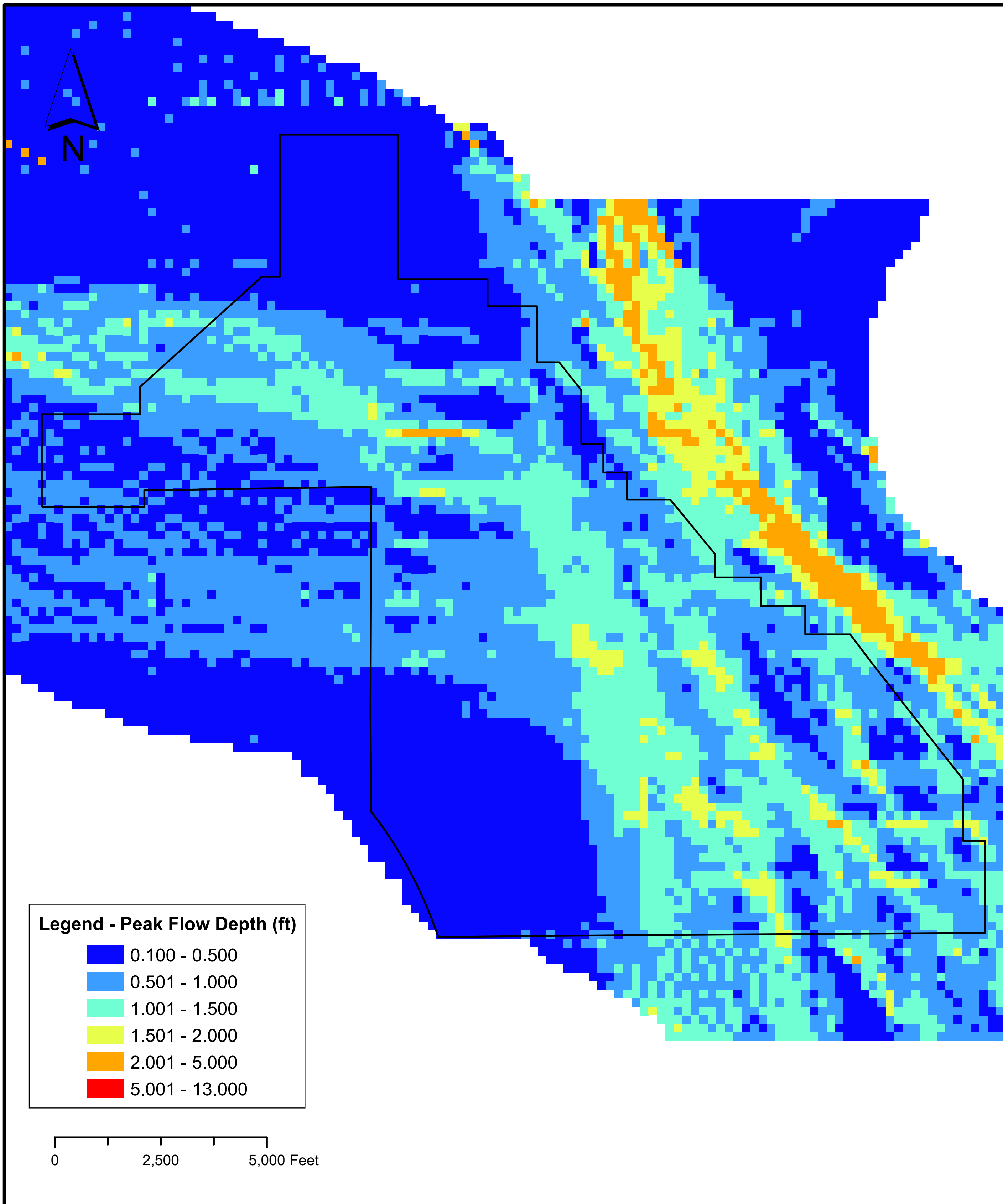


Figure 3. Hyetograph of 100-year and 10-year Storm Events
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Depth (in)
0.000
6.000
12.000
18.000
24.000
Time (hrs)
10-year
100-year

## Figure 4. Estimated Inflow to Model



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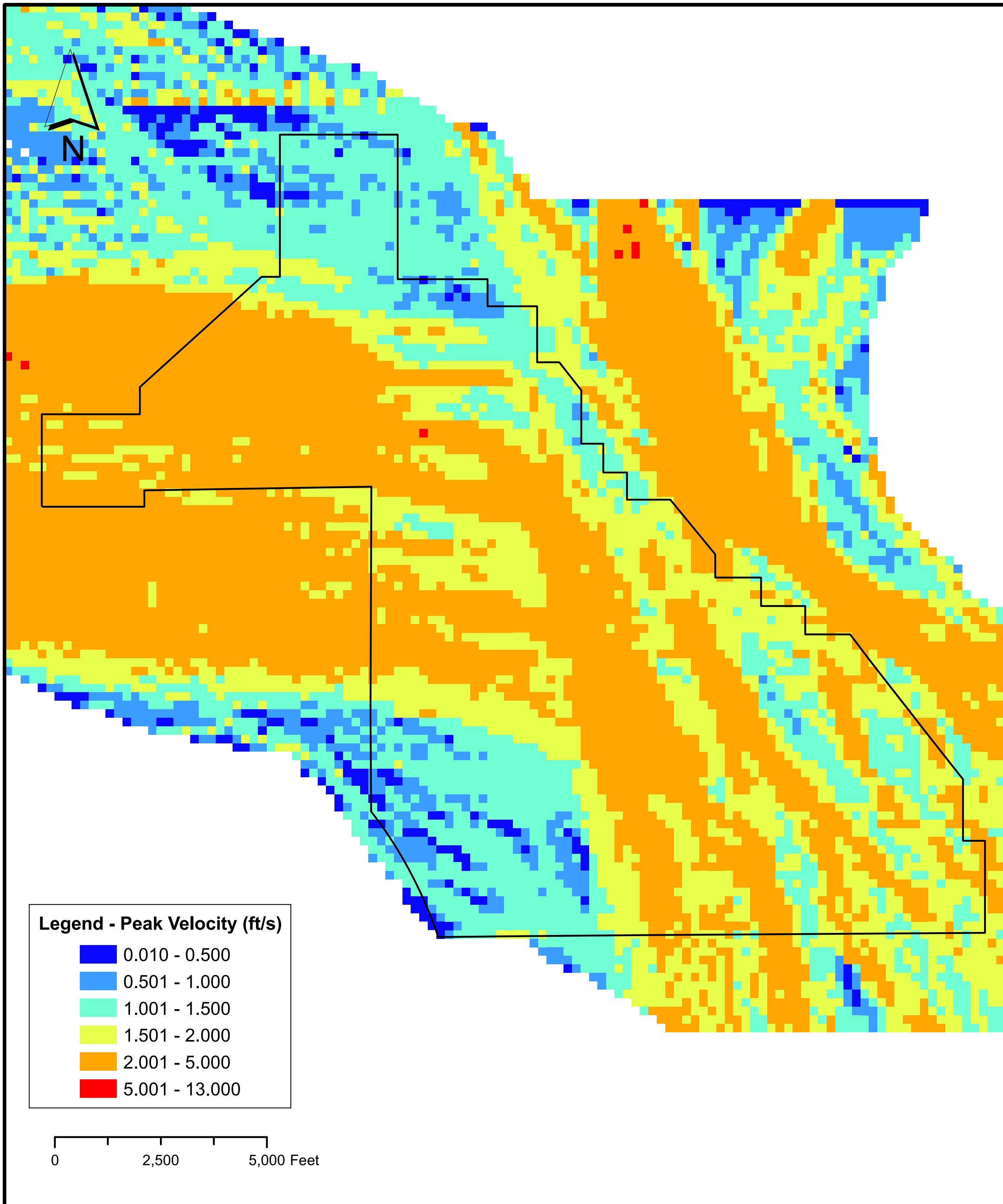
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 5 |
|---|---|---|---|

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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Existing Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 6 |
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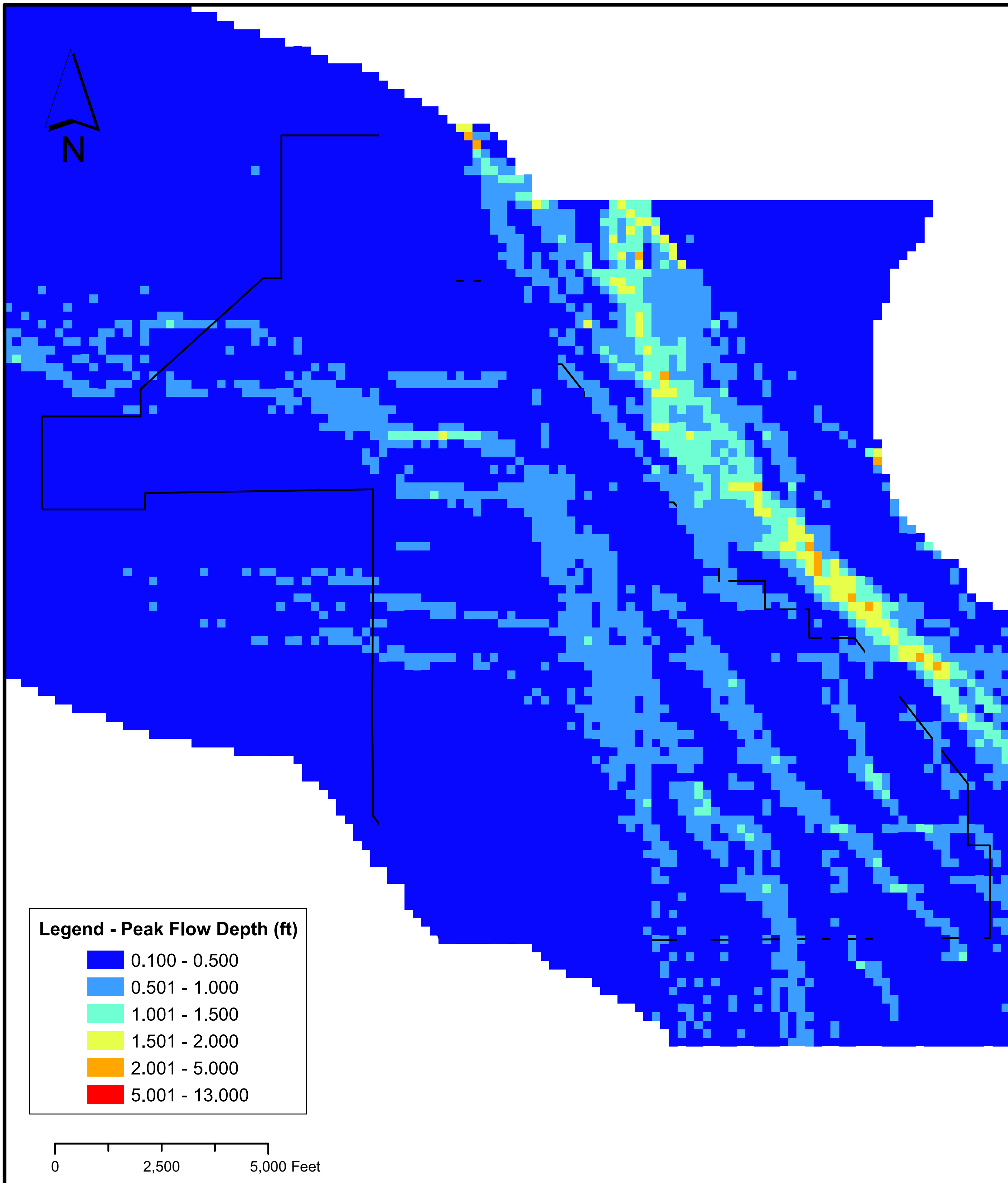


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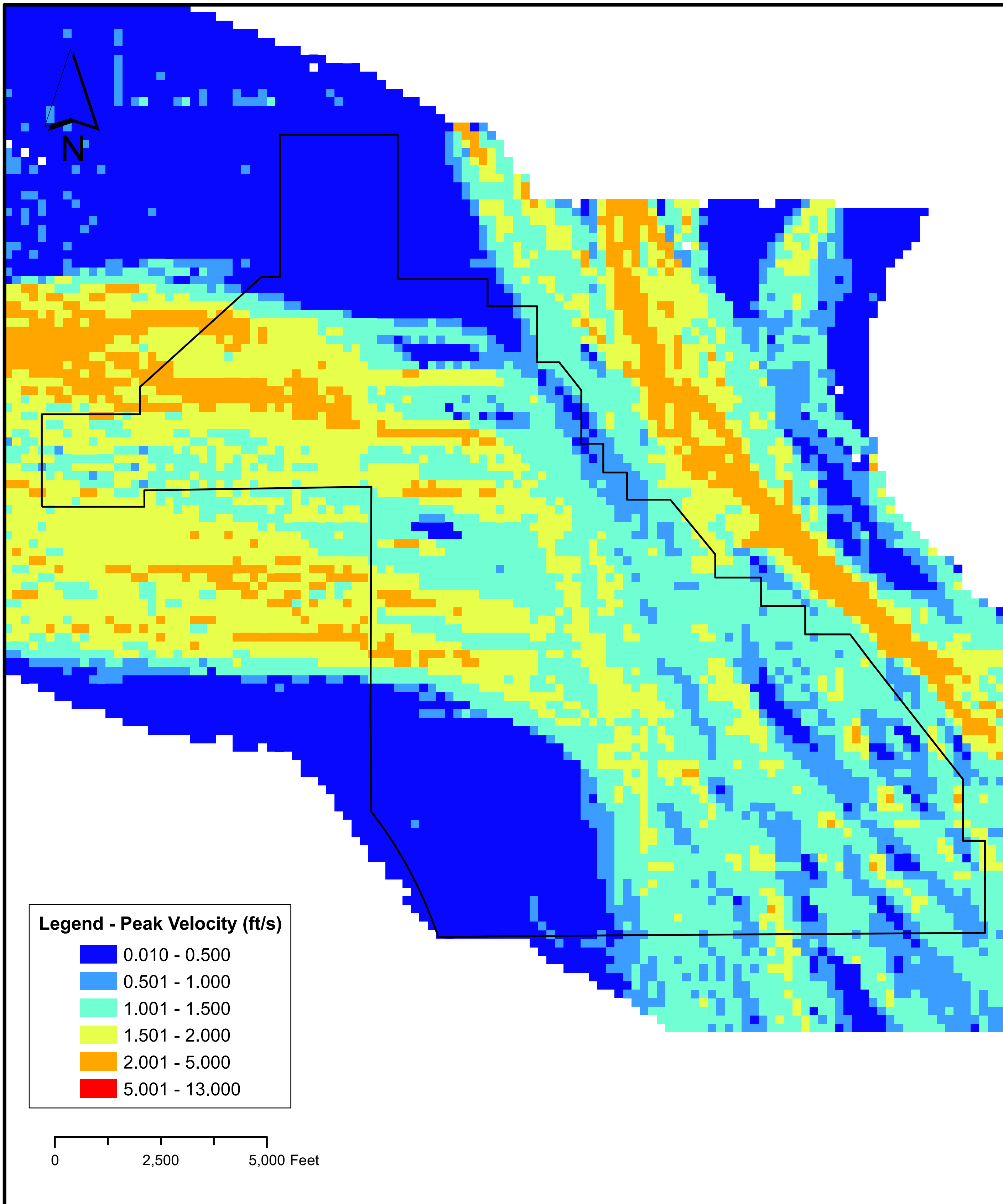
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Existing Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 7 |
| --- | --- | --- | --- |

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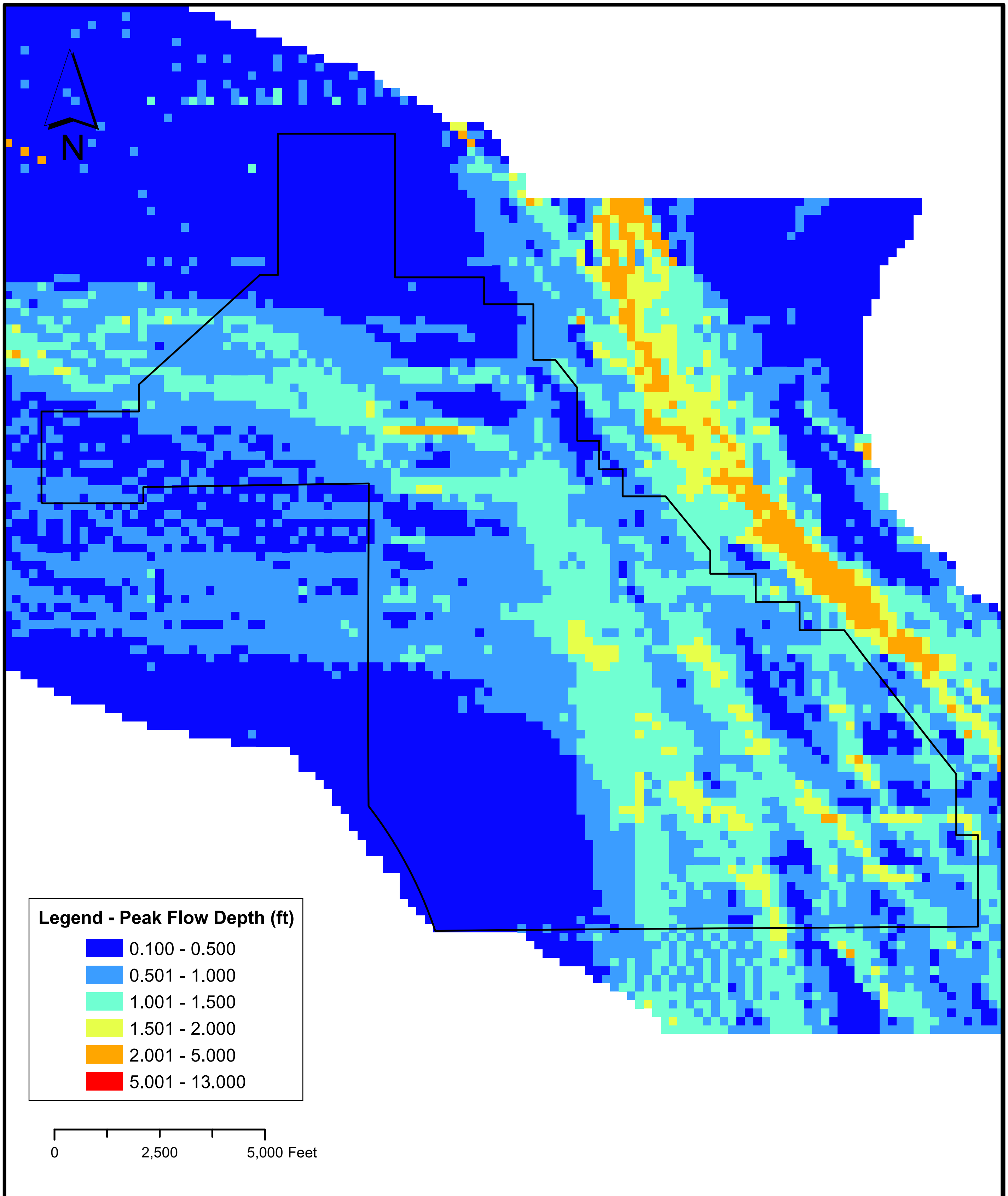
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Existing Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 8 |
| --- | --- | --- | --- |

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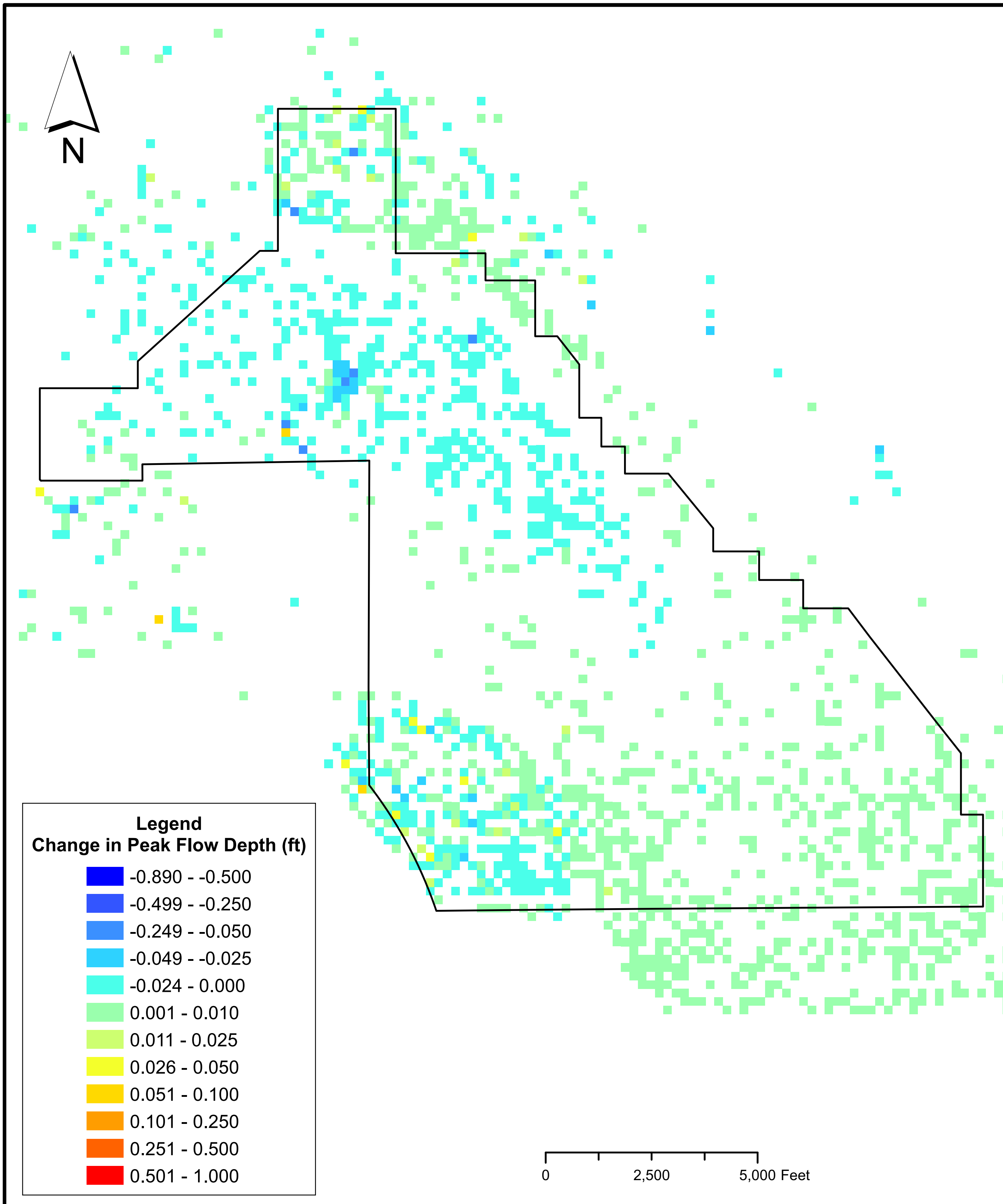
DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Peak Flow Depth

GIS FILE:

SCALE: AS NOTED

DATE: 03/12/2010

Figure 9

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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Flow Depth (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 02/17/2010 | Figure 10 |
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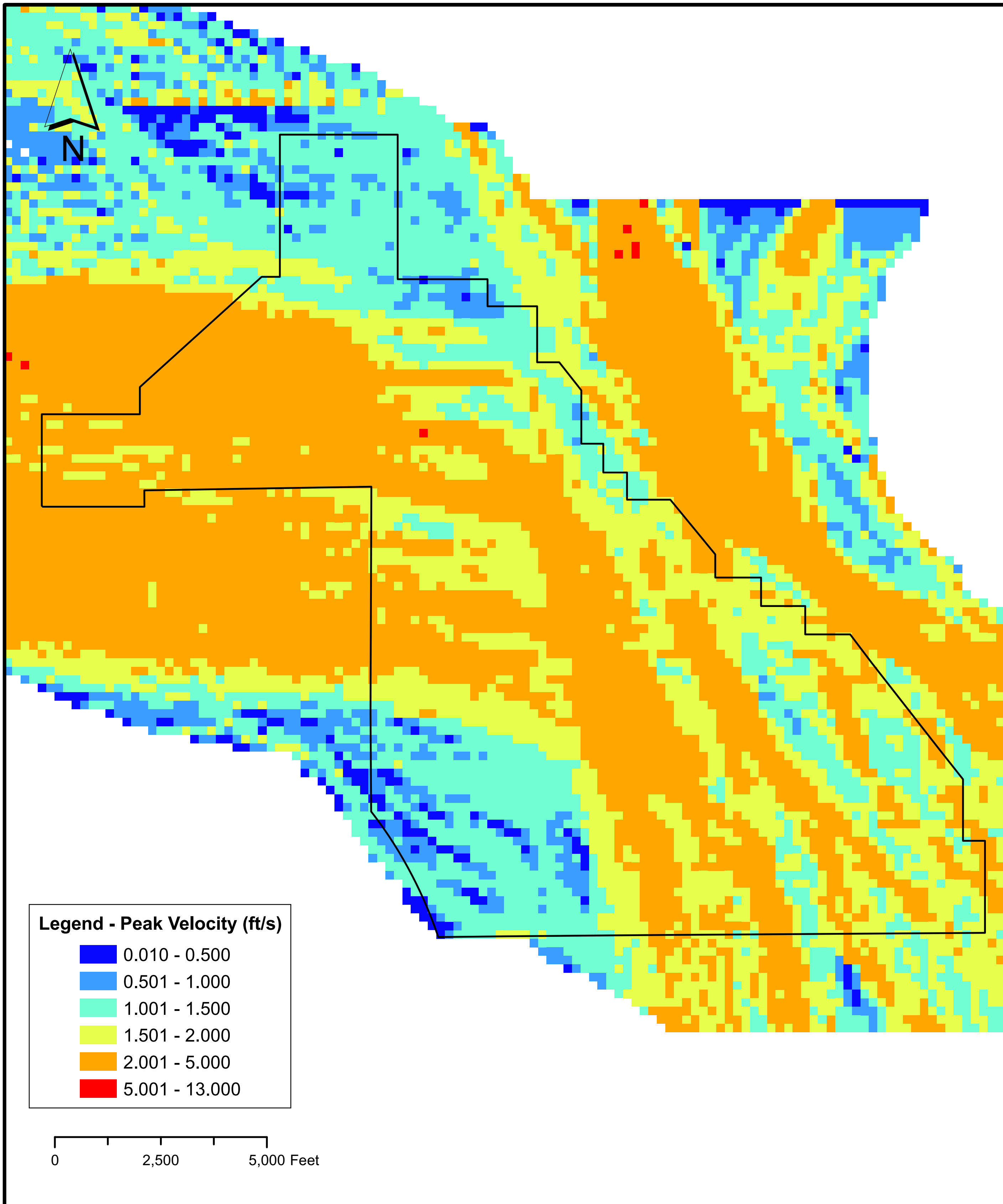


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 11 |
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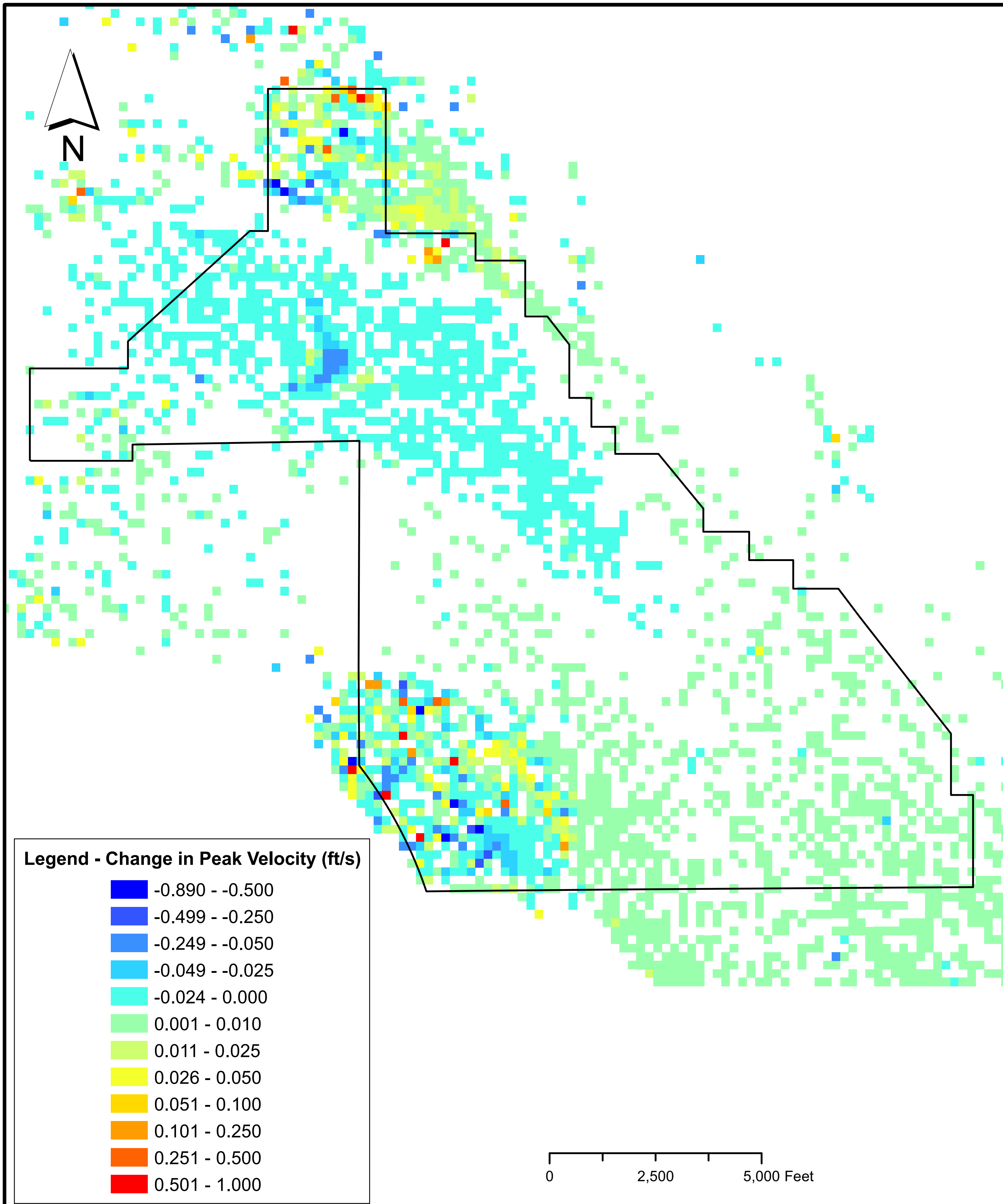


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Change in Peak Velocity (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 12 |
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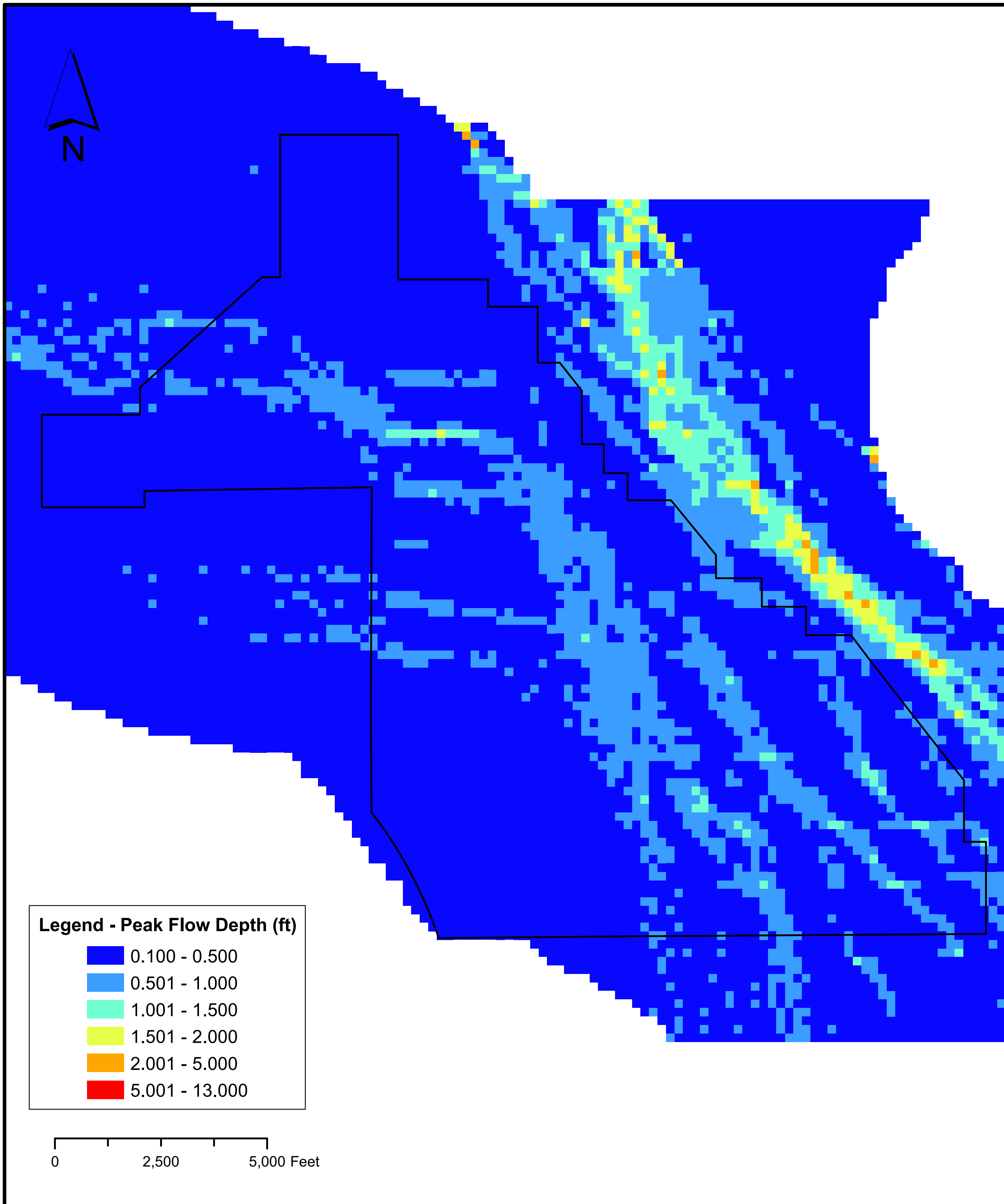


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Peak Flow Depth

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 13 |
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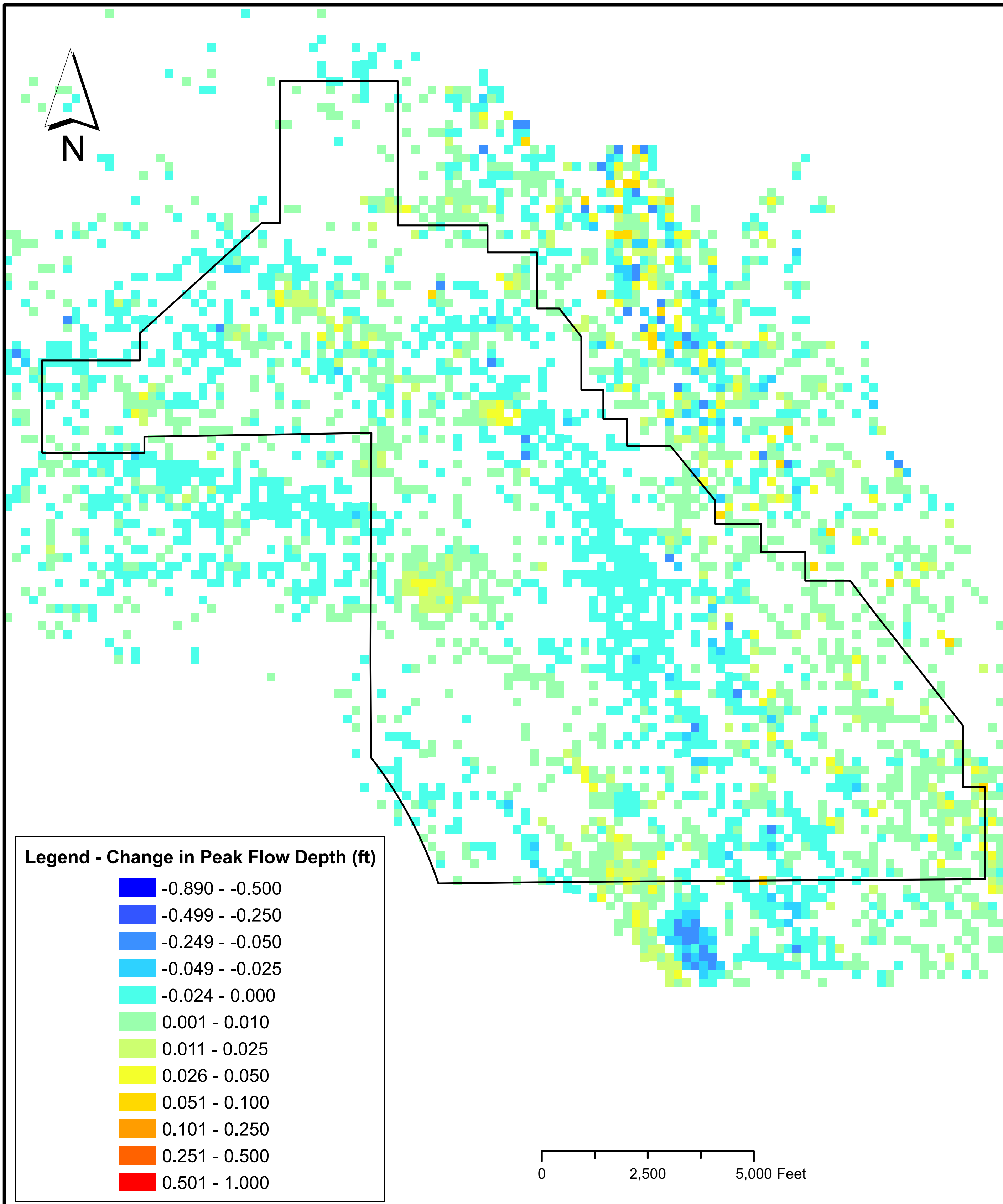


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Flow Depth (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 14 |
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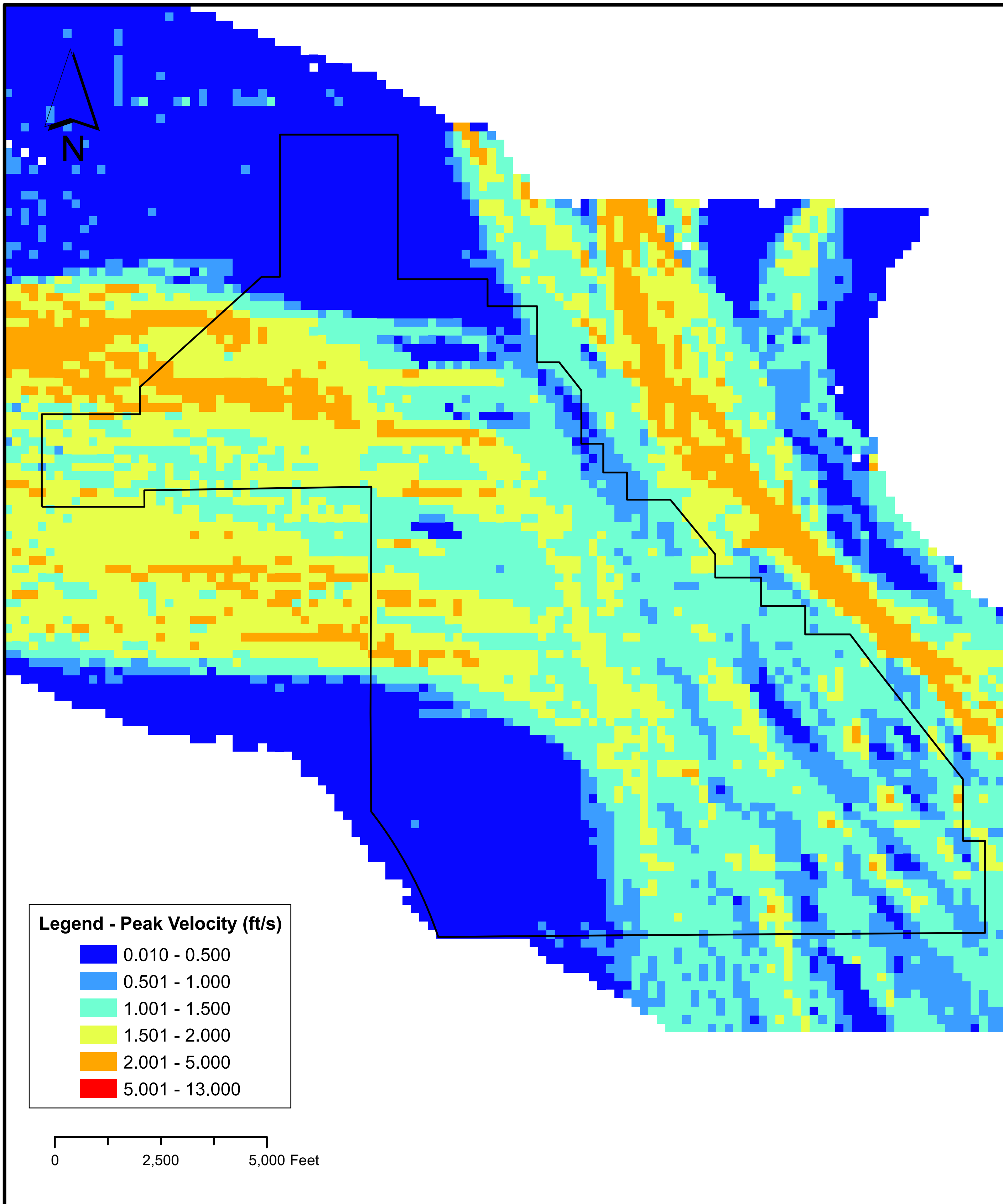


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Peak Velocity

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 15 |
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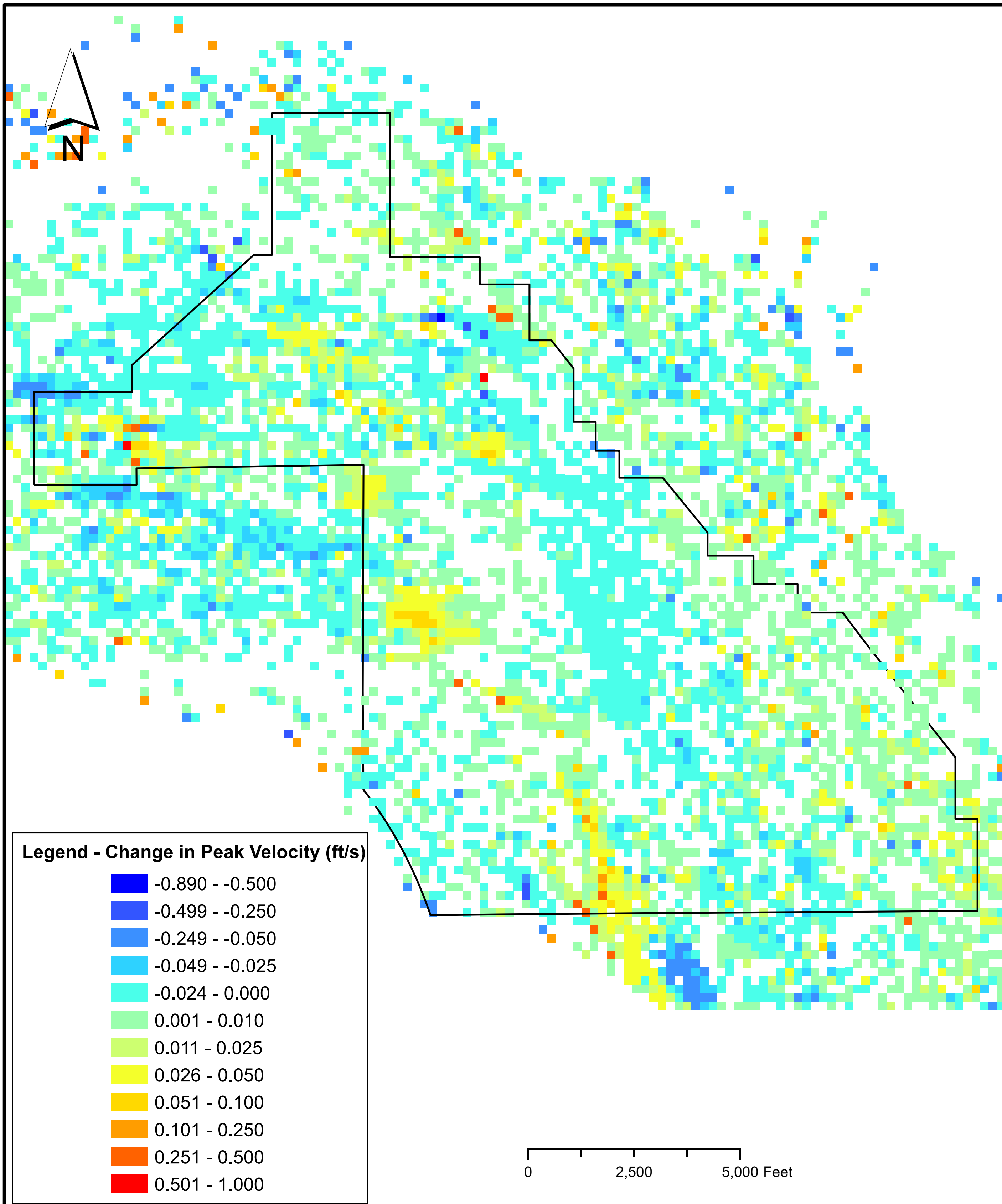


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Change in Peak Velocity (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 16 |
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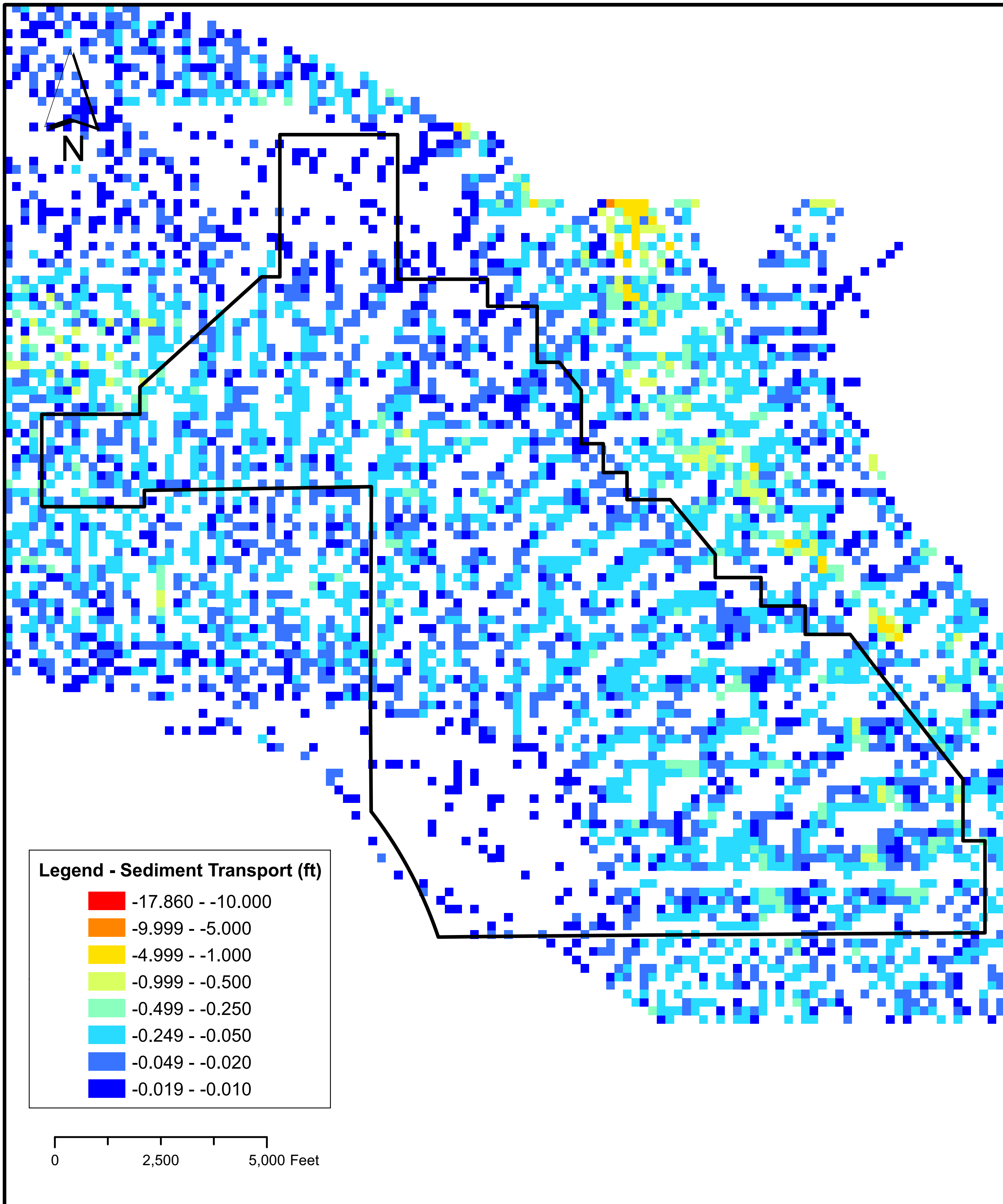


| AECOM | DSSF - Storm Water Hydrology Report<br>Hydrologic, Hydraulic, Sediment Transport and Scour Analyses<br>100 Year - Exisitng Conditions Maximum Sediment Transport | | |
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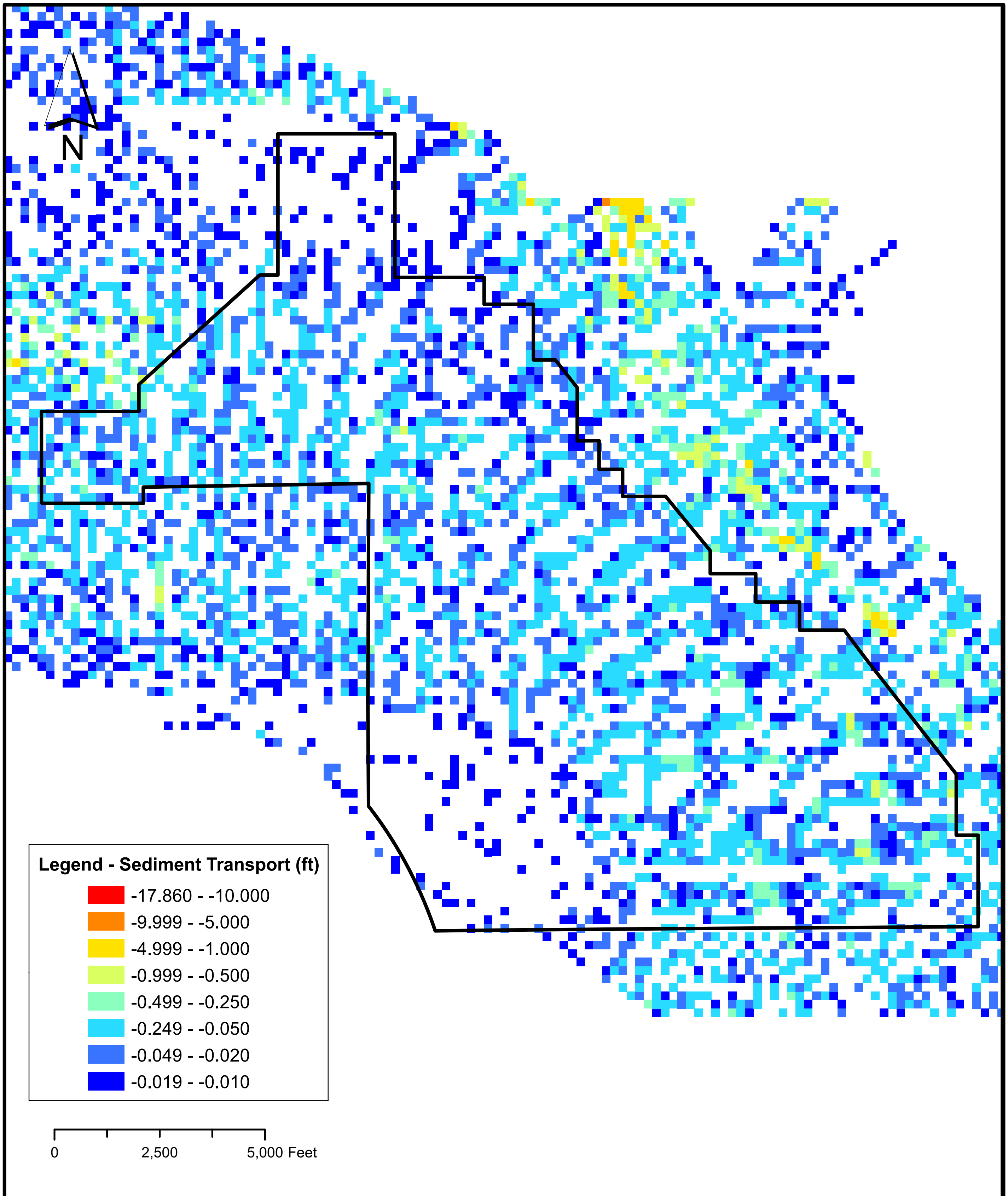
| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 17 |

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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Future Conditions Maximum Sediment Transport

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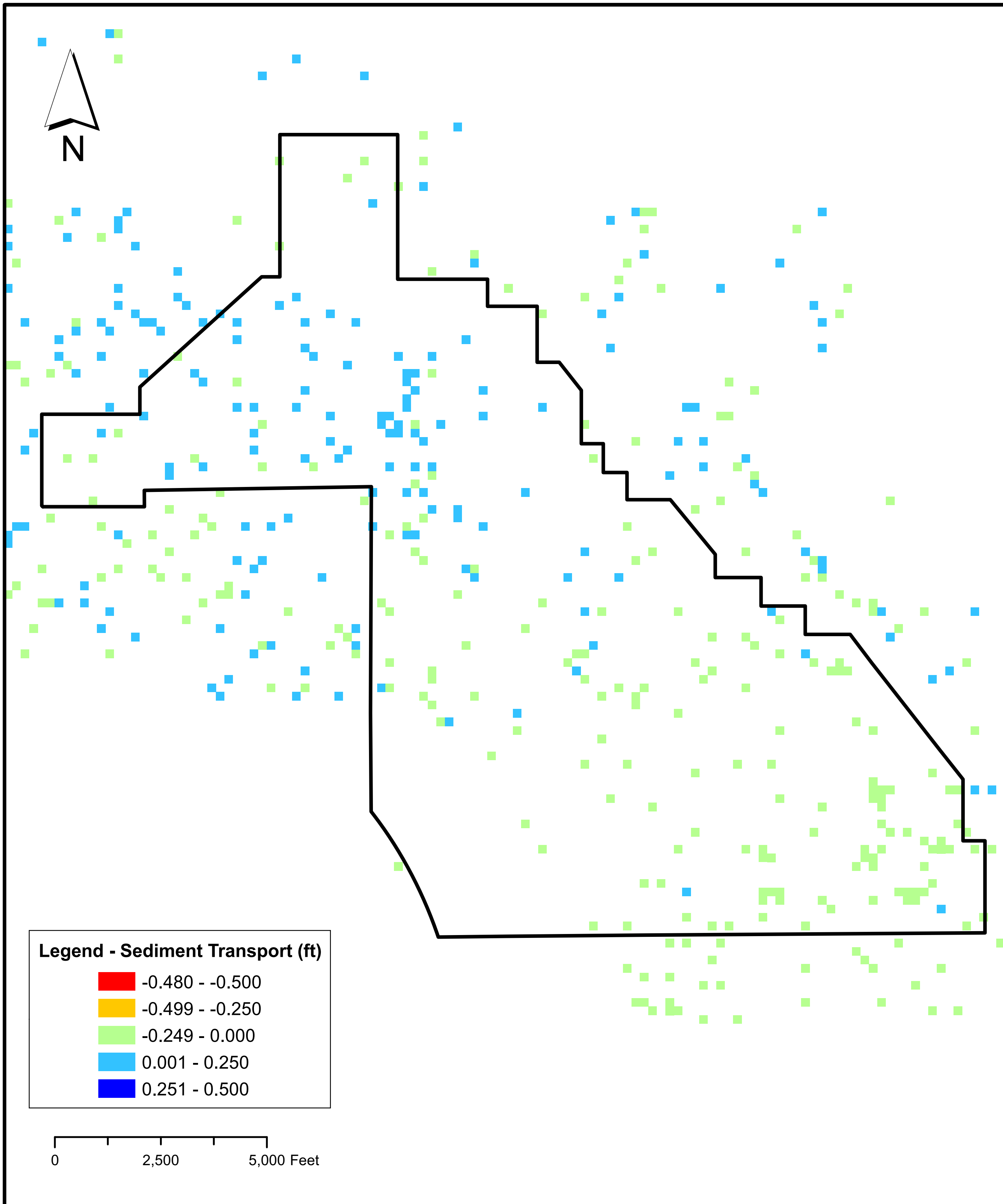


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Max Sediment Transport Change (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 19 |
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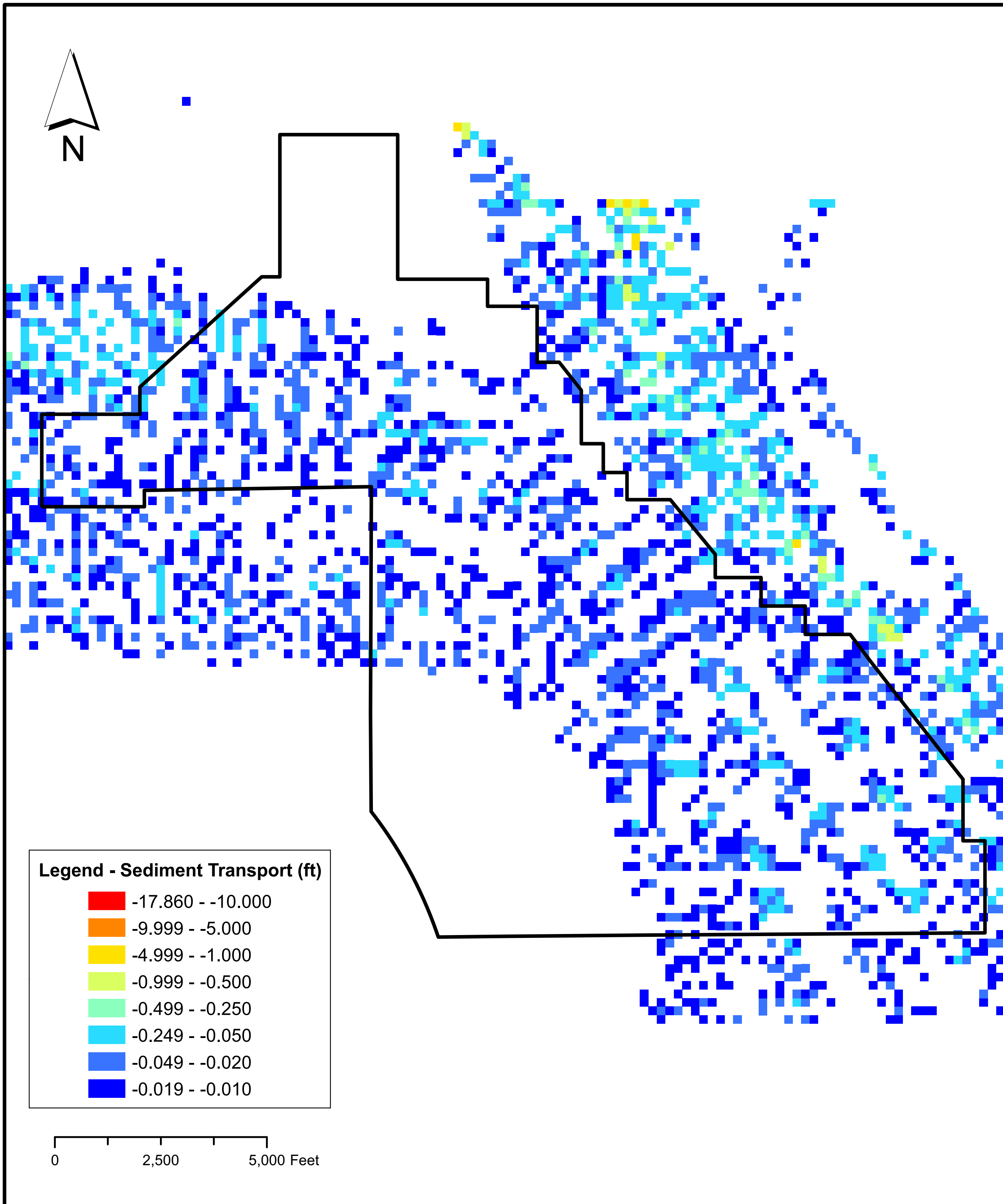


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Existing Conditions Maximum Sediment Transport

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 20 |
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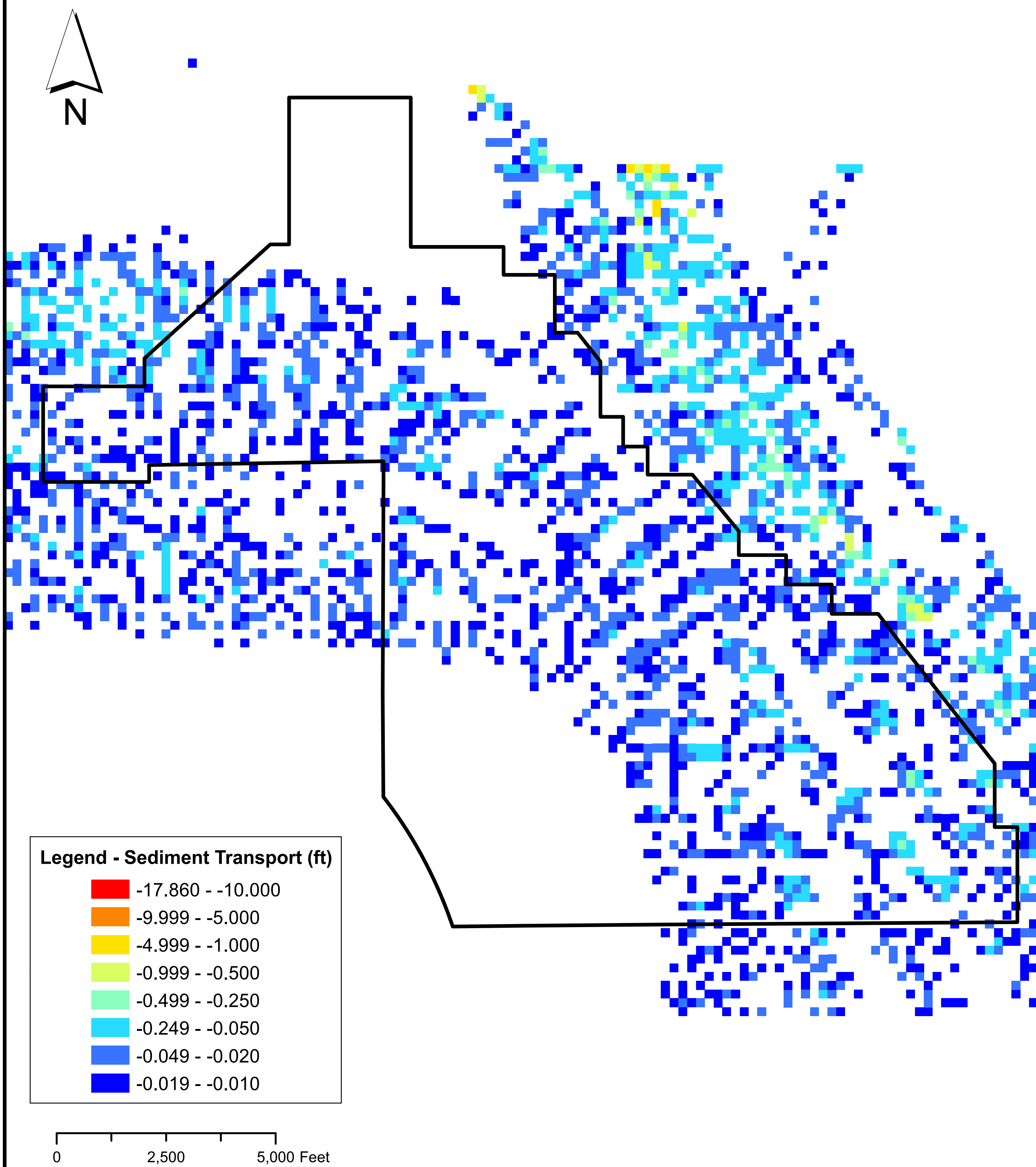


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Future Conditions Maximum Sediment Transport

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 21 |
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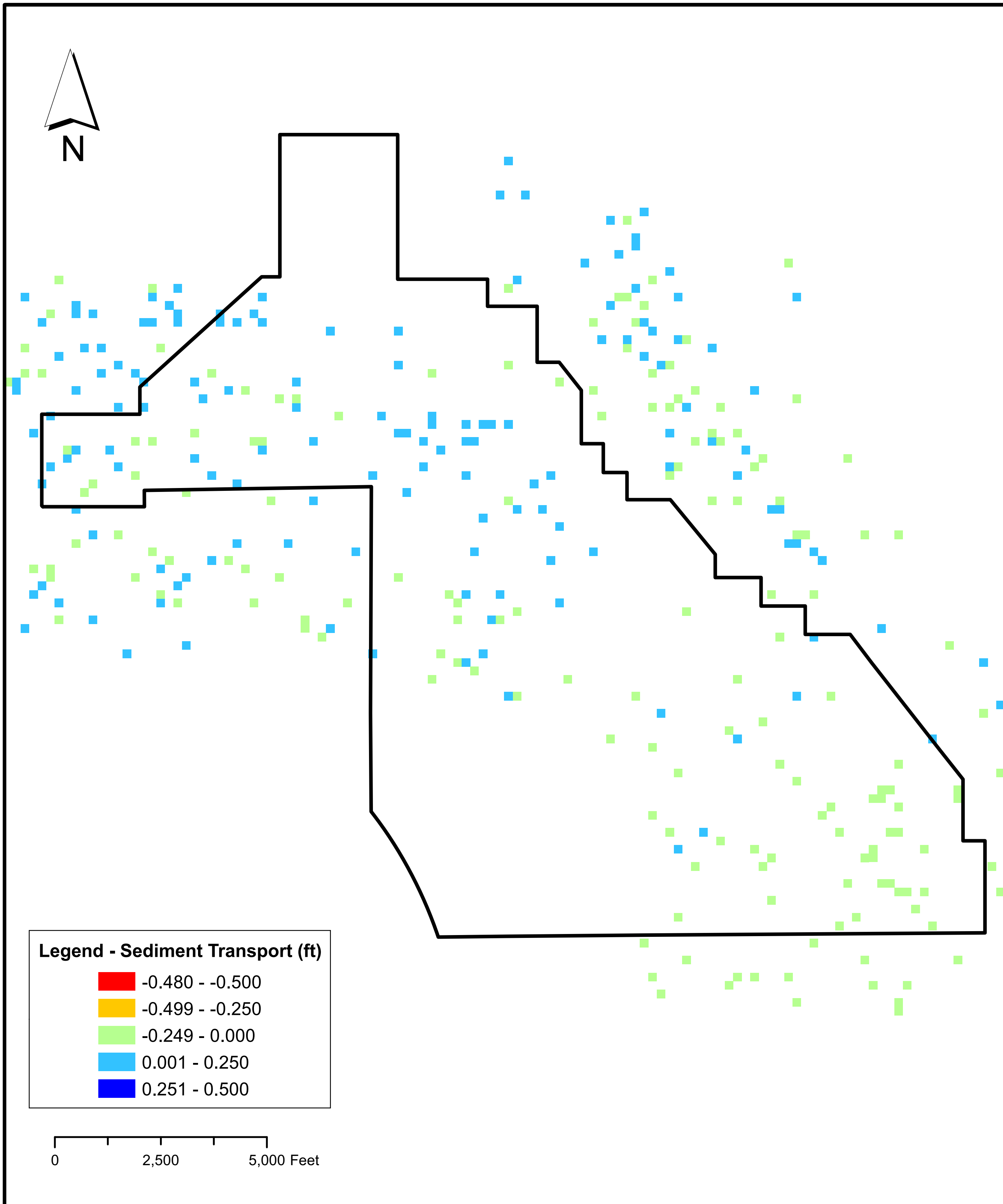


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
10 Year - Max Sediment Transport Change (Future - Existing)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/12/2010 | Figure 22 |
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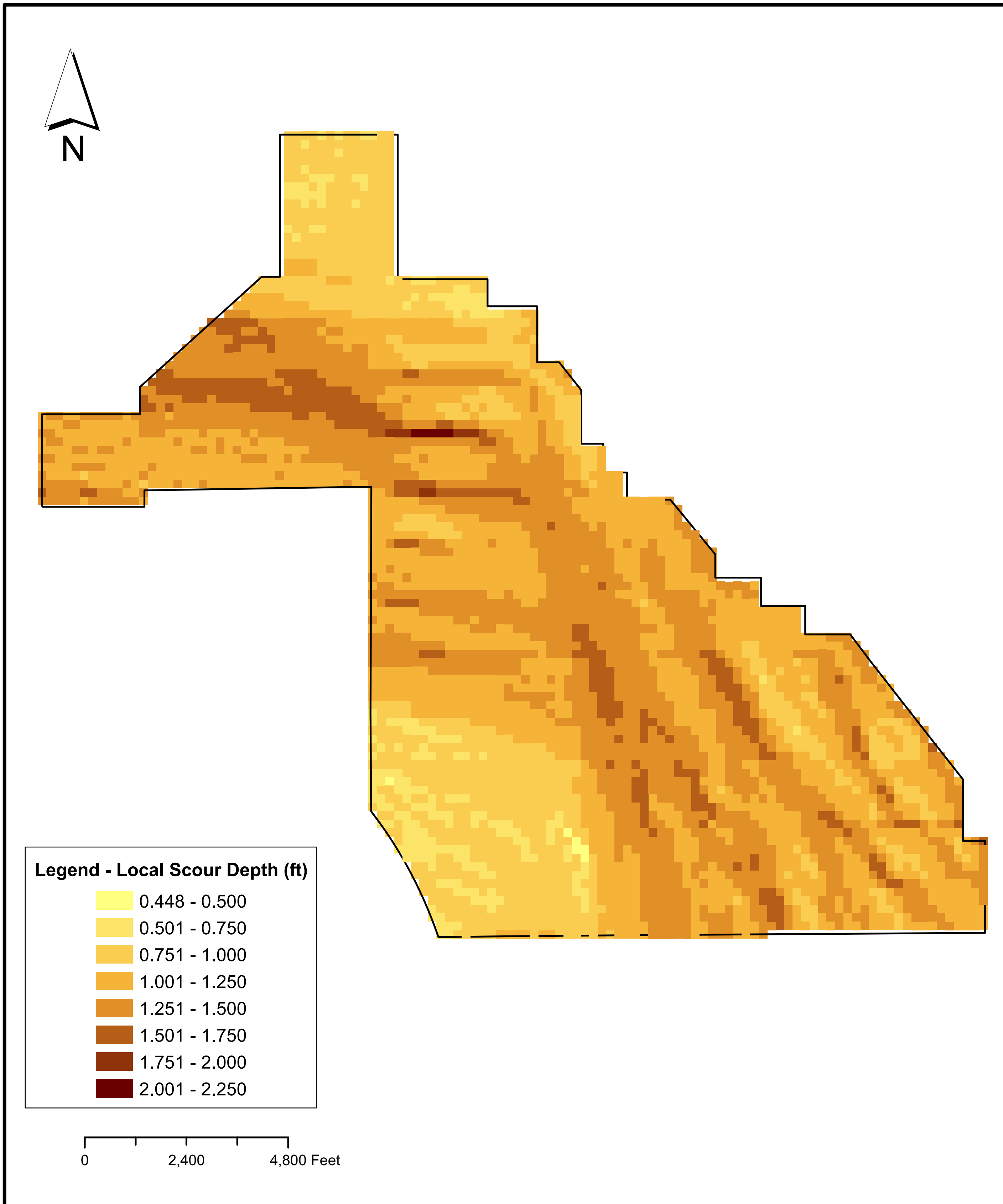


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DSSF - Storm Water Hydrology Report
Hydrologic, Hydraulic, Sediment Transport and Scour Analyses
100 Year - Local Scour Depth (Worst Case Scour)

| GIS FILE: | SCALE: AS NOTED | DATE: 03/18/2010 | Figure 23 |
| --- | --- | --- | --- |

**Appendix A: Hydrologic Analysis Supporting Data**

U.S. Department of Agriculture, Natural Resources Conservation Service, Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) dated June 1986 was used to estimate runoff/infiltration characteristics. Following is the table from TR-55 that contains the curve numbers used in this analysis.

**Table 2-2a** Runoff curve numbers for urban areas [1]

| Cover description | | Curve numbers for hydrologic soil group | | | |
|---|---|---|---|---|---|
| Cover type and hydrologic condition | Average percent impervious area [2] | A | B | C | D |
| *Fully developed urban areas (vegetation established)* | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.) [3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only) [4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| *Developing urban areas* | | | | | |
| Newly graded areas (pervious areas only, no vegetation) [5] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

**Appendix B: Hydraulic Analysis Supporting Data**

Manning's n value was used to describe surface roughness. The roughness was calculated as shown below:

Estimate for existing conditions n

| | |
|---|---|
| Coarse Sand Floodplain | 0.03 |
| Minor irregularities | 0.003 |
| Small-Medium Vegetation | 0.01 |
| Total | **0.043** |

Estimate for future conditions n

| | |
|---|---|
| Coarse Sand Floodplain | 0.03 |
| Add Poles/Obstructions | 0.004 |
| Total | **0.034** |

The addition of poles and other obstructions was assumed to be negligible to minor; occupying between 5% and 15% of the cross-sectional area.

Estimate for six (6)-inch rip-rap n

| | |
|---|---|
| Cobble | 0.039 |
| Add Poles/Obstructions | 0.004 |
| Total | **0.043** |

In order to achieve a roughness of 0.039 for the 100-year future conditions approximately 54% of the project site would need to be covered in six (6) inch diameter rip-rap. The roughness value of 0.057 for the 10-year storm event cannot be obtained with six (6) inch rip-rap

The methodology is based on the following USGS methodology:

Arcement, Jr., G.J., Schneider, V.R., "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains," United States Geological Survey Water-Supply Paper 2339.

**Appendix C: Sediment Transport Analysis Supporting Data**

Zeller and Fullerton equation was used in sediment transport modeling within the Flo2D modeling software framework. Flo2D model user manual states the following:

*"Zeller-Fullerton Equation. Zeller-Fullerton is a multiple regression sediment transport equation for a range of channel bed and alluvial floodplain conditions. This empirical equation is a computer generated solution of the Meyer-Peter, Muller bed-load equation combined with Einstein's suspended load to generate a bed material load (Zeller and Fullerton, 1983). The bed material discharge qs is calculated in cfs per unit width as follows:*

$$qs = 0.0064\ n1.77\ V4.32\ G0.45\ d\text{-}0.30\ D50\text{-}0.61$$

*where n is Manning's roughness coefficient, V is the mean velocity, G is the gradation coefficient, d is the hydraulic depth and D50 is the median sediment diameter. All units in this equation are in the ft-lb-sec system except D50, which is in millimeters. For a range of bed material from 0.1 mm to 5.0 mm and a gradation coefficient from 1.0 to 4.0, Julien (1995) reported that this equation should be accurate with 10% of the combined Meyer-Peter Muller and Einstein equations. The Zeller-Fullerton equation assumes that all sediment sizes are available for transport (no armoring). The original Einstein method is assumed to work best when the bedload constitutes a significant portion of the total load (Yang, 1996)."*

Also the Flo2D model user manual recommends the following:

*"Summary. Yang (1996) made several recommendations for the application of total load sediment transport formulas in the absence of measured data. These recommendations have been expanded to all the equations in the FLO-2D and are slightly edited:*

- *Use Zeller and Fullerton equation when the bedload is a significant portion of the total load.*
- *Use Toffaleti's method for large sand-bed rivers.*
- *Use Yang's equation for sand and gravel transport in natural rivers.*
- *Use Ackers-White or Engelund-Hansen equations for subcritical flow in lower sediment transport regime.*
- *Use Lausen's formula for shallow rivers with silt and fine sand.*
- *Use MPM-Woo's relationship for steep slope, arroyo sand bed channels and alluvial fans. "*

**Appendix D: Fluvial Geomorphology Analysis Supporting Data**

The following historical aerial photos were used in studying fluvial geomorphology of the Project site.

**Desert Solar Farm Site**
Riverside County
Desert Center, CA 92239

Inquiry Number: 2624402.1
October 30, 2009

# The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

# EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDRs professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

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***Thank you for your business.***
Please contact EDR at 1-800-352-0050
with any questions or comments.

## Date EDR Searched Historical Sources:

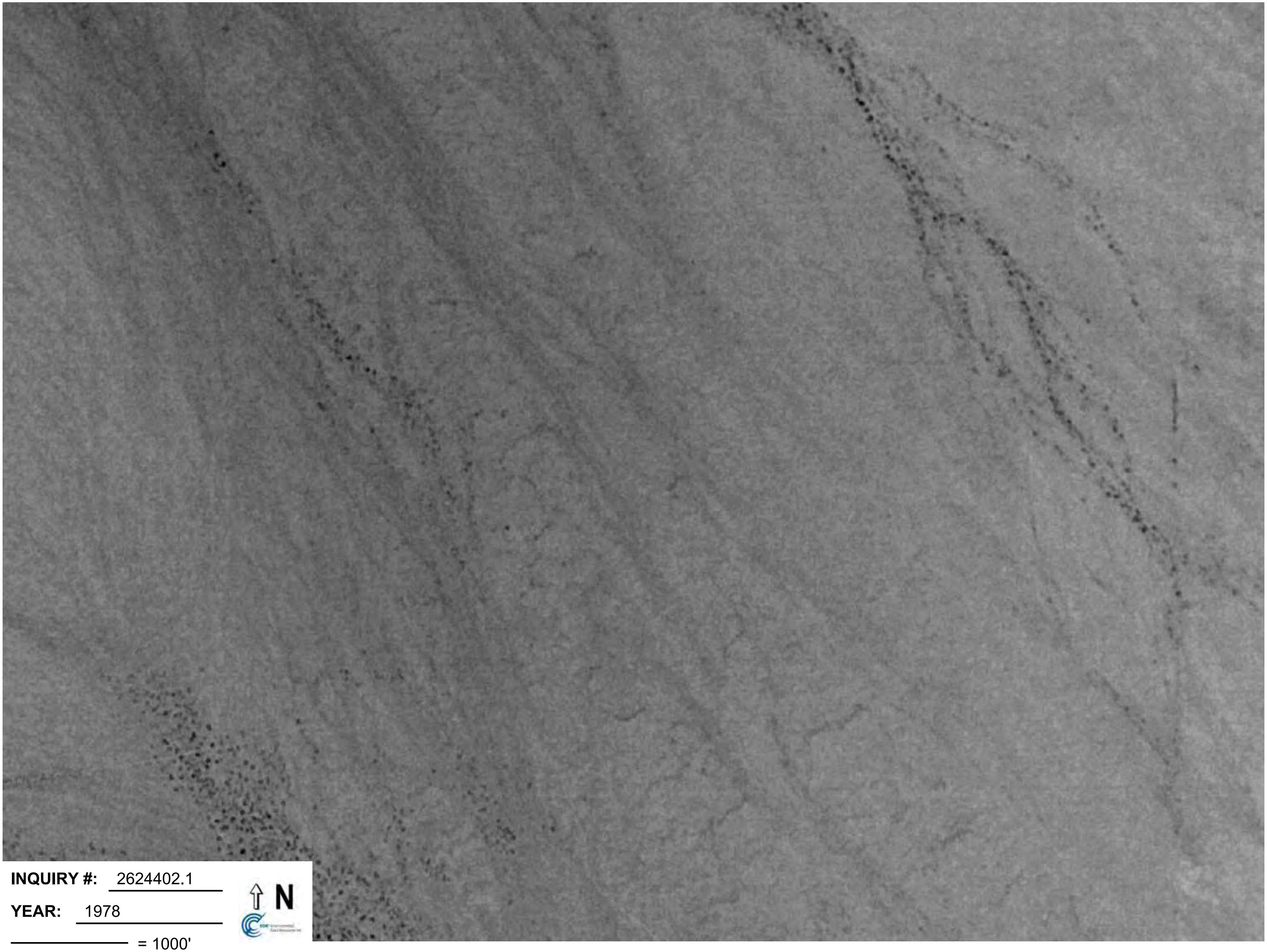
Aerial Photography October 30, 2009

## Target Property:

Riverside County

Desert Center, CA 92239

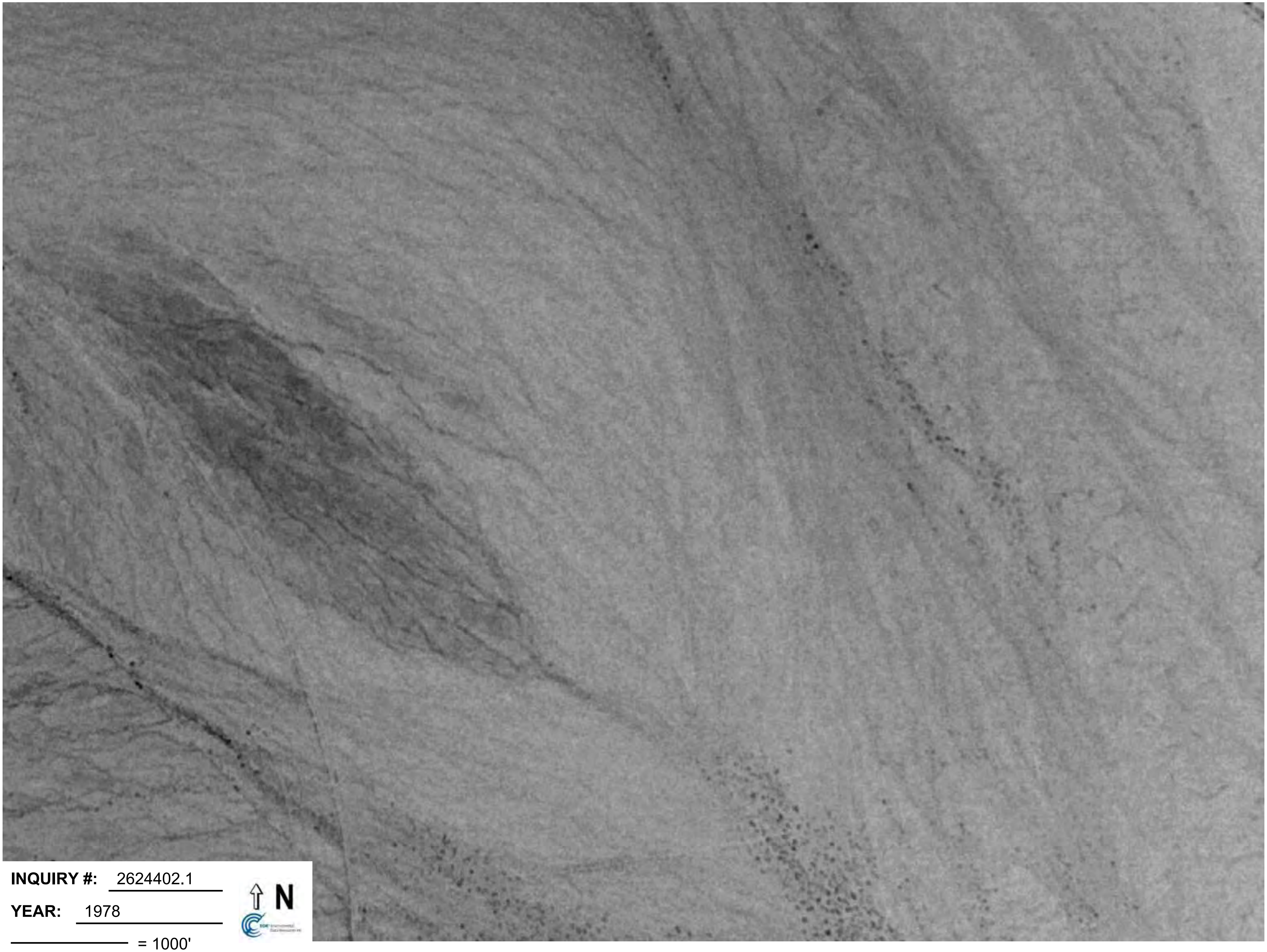
| ***Year*** | ***Scale*** | ***Details*** | ***Source*** |
|---|---|---|---|
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1978 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1978 | Nasa |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 1996 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 1996 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |
| 2002 | Aerial Photograph. Scale: 1"=1000' | Flight Year: 2002 | USGS |



INQUIRY #: 2624402.1

YEAR: 1978

= 1000'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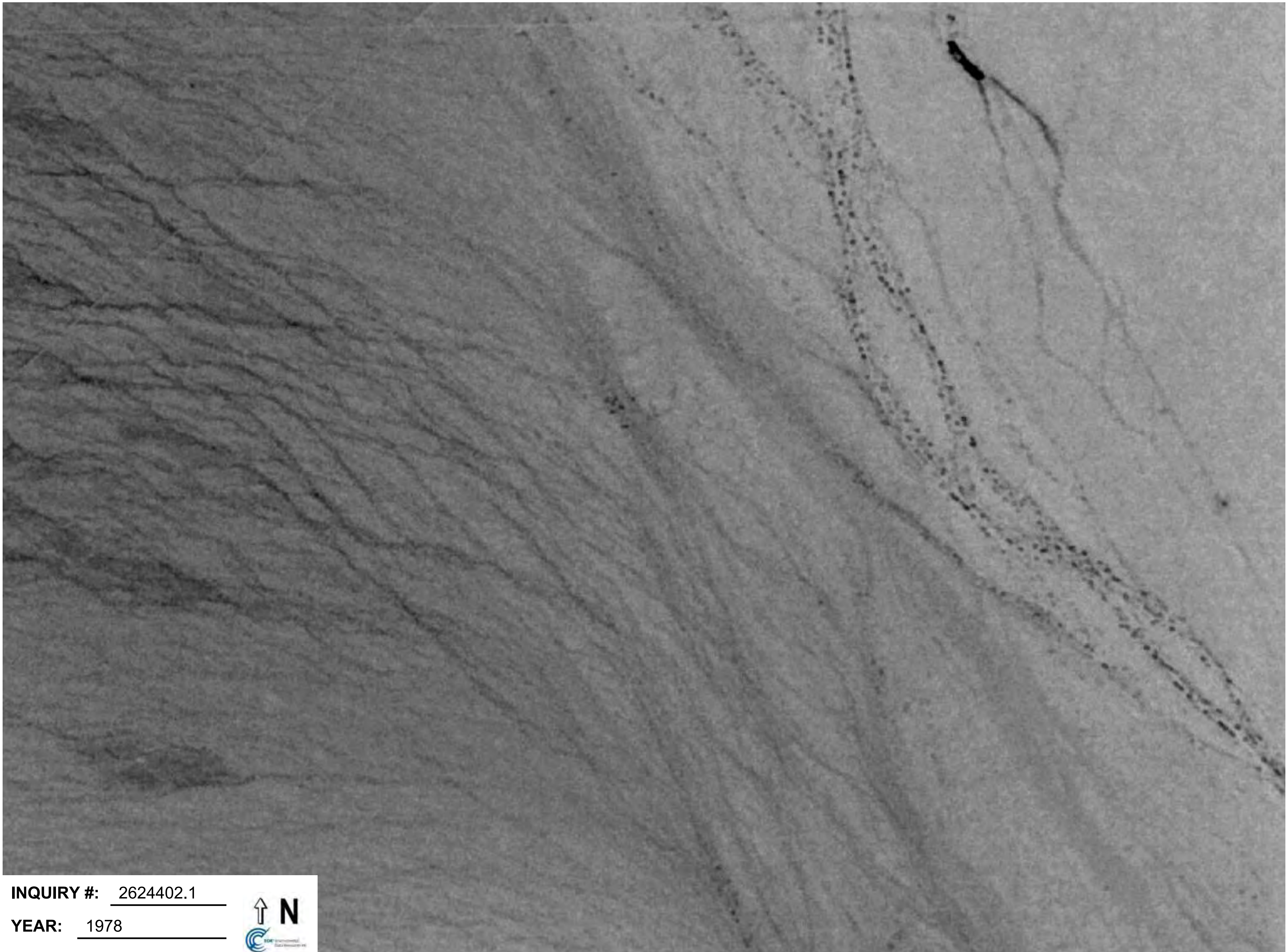

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**YEAR:** 1978

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**YEAR:** 1996

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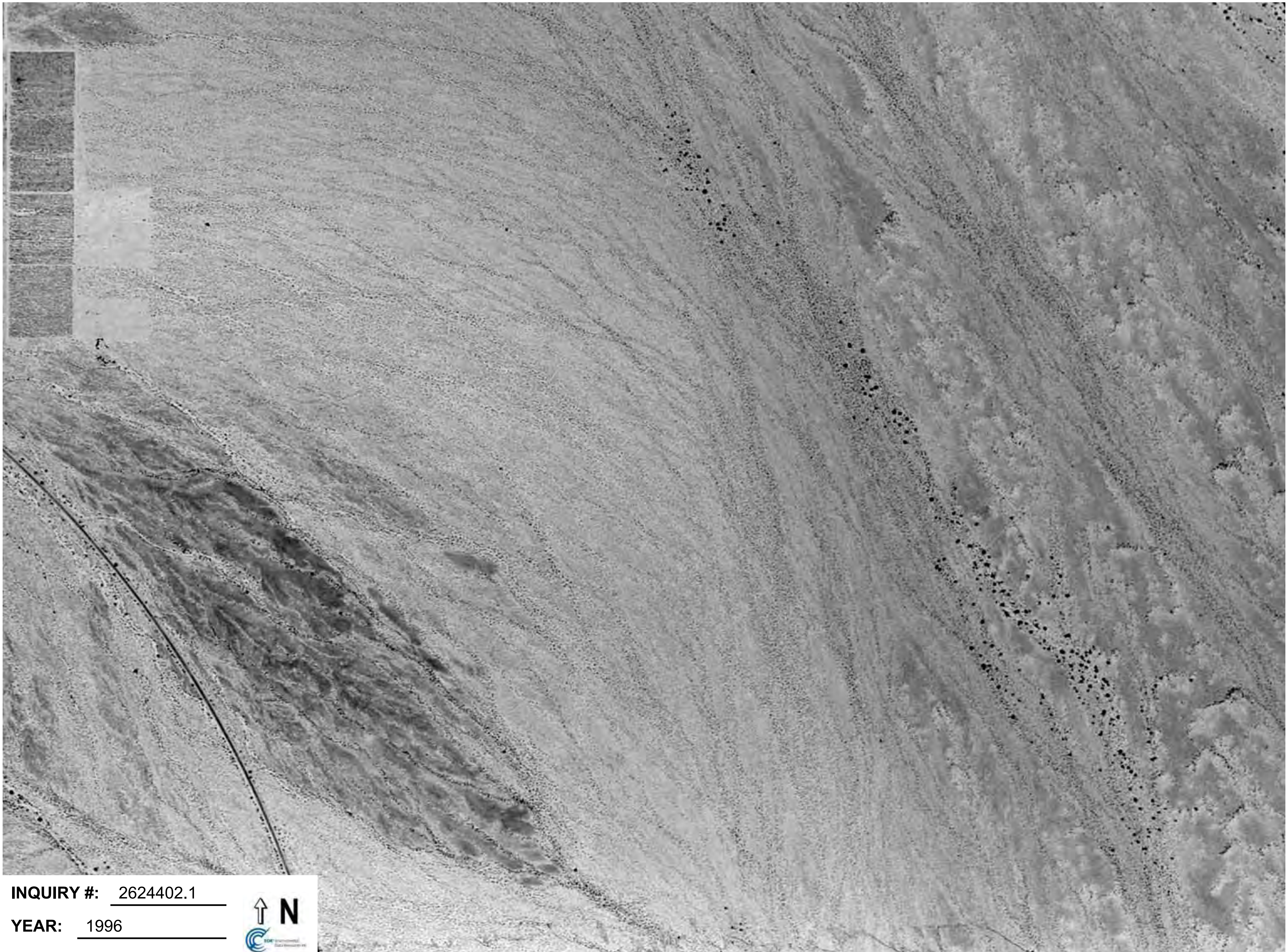
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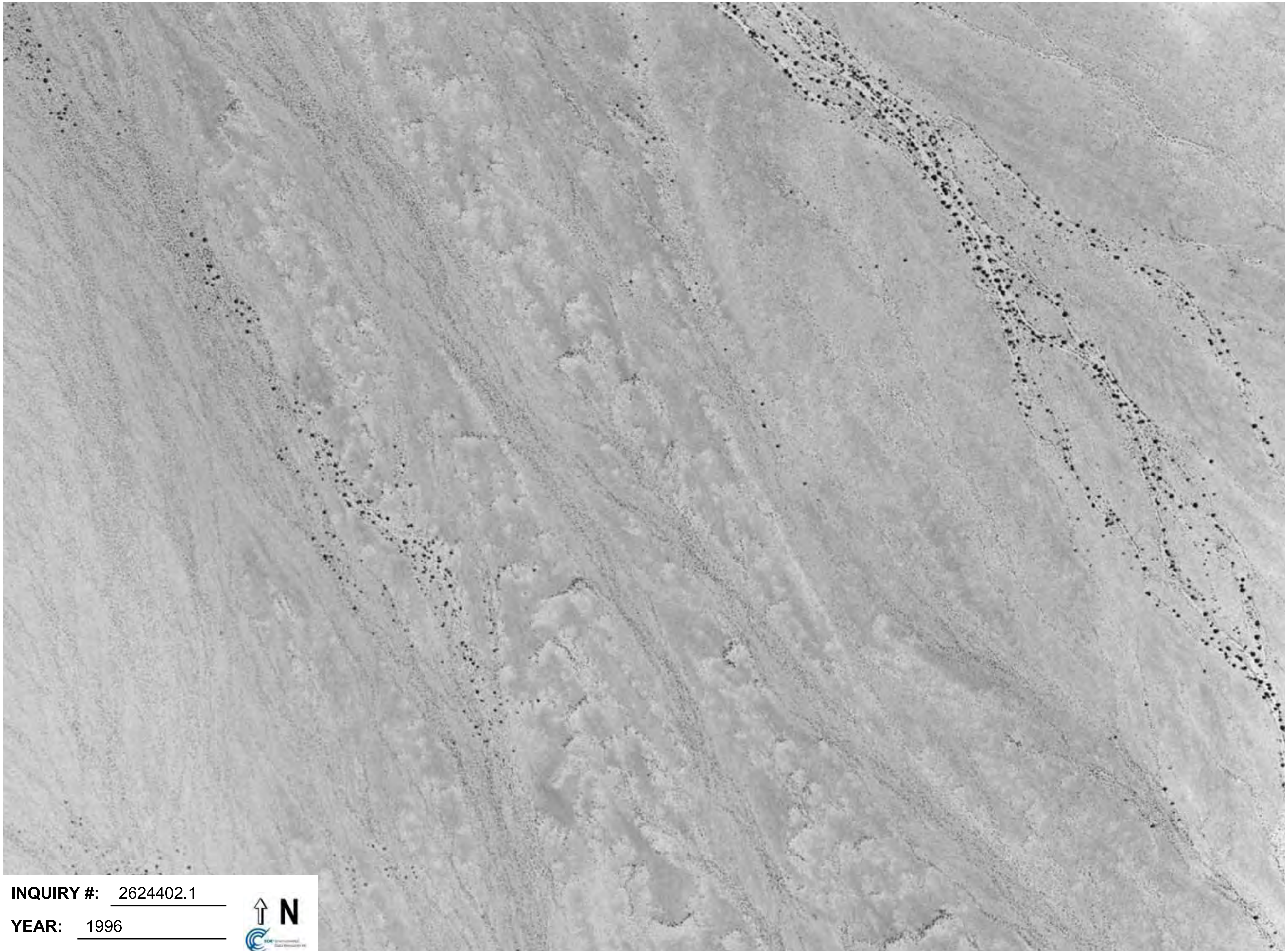

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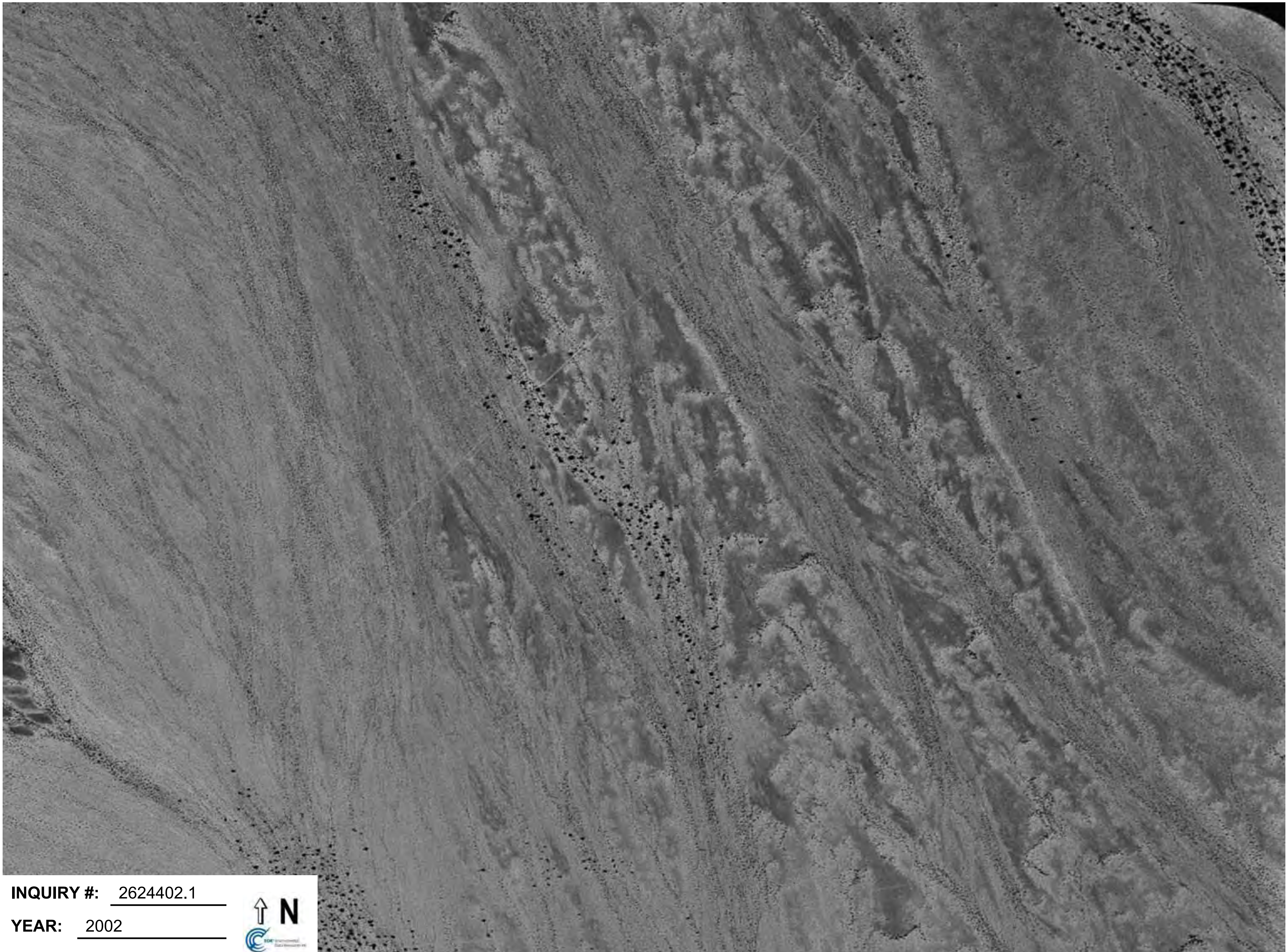

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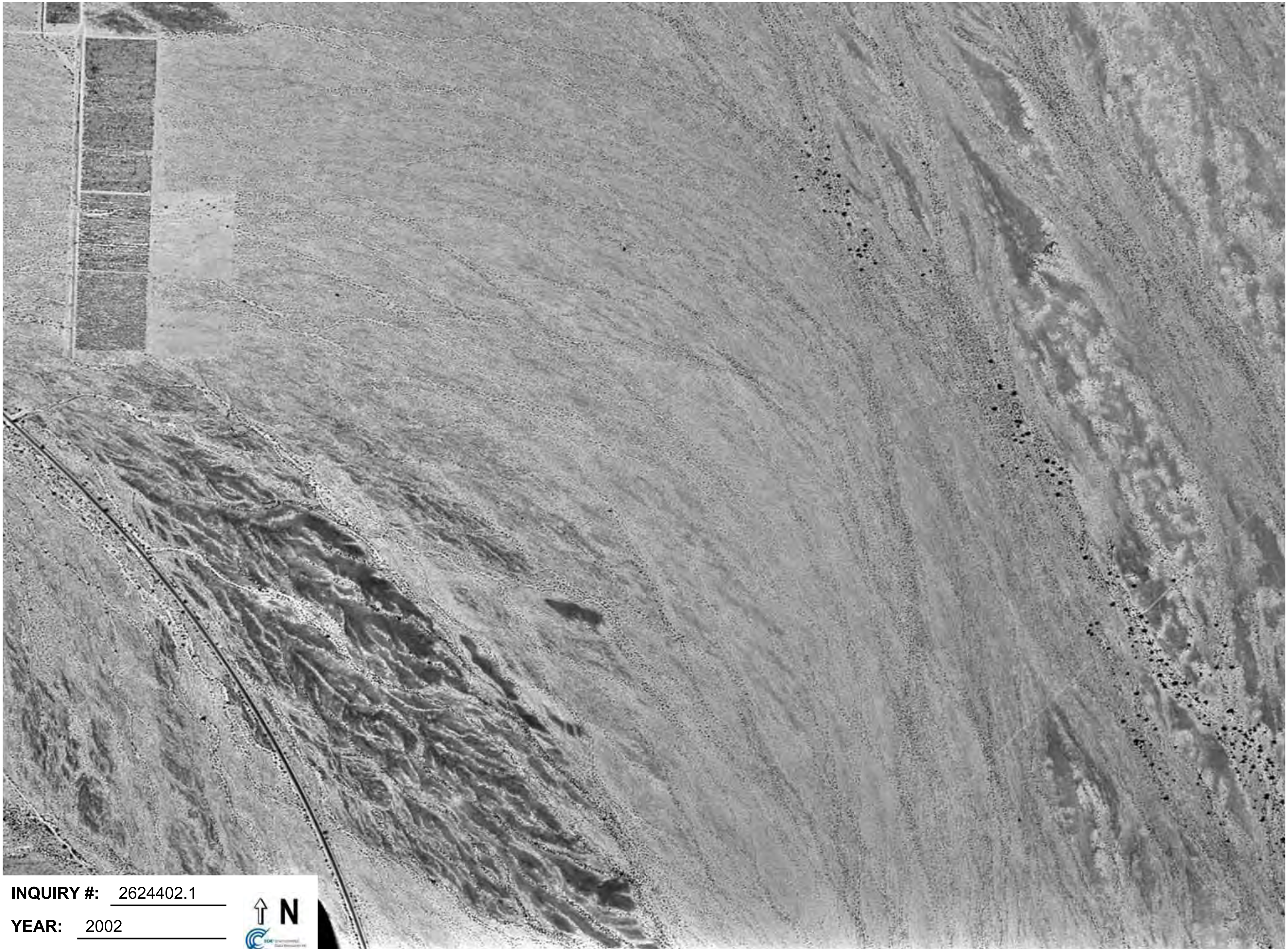

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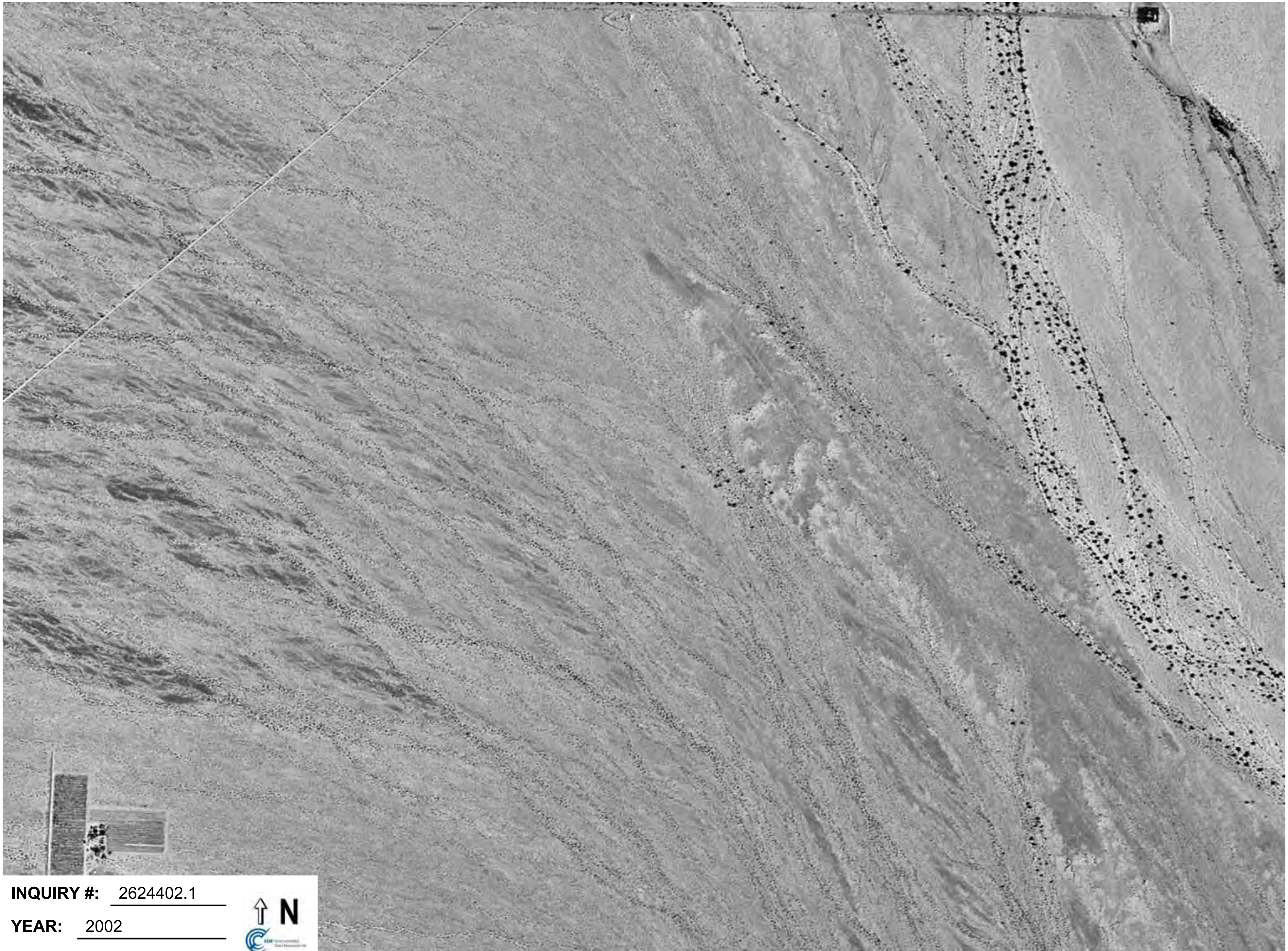

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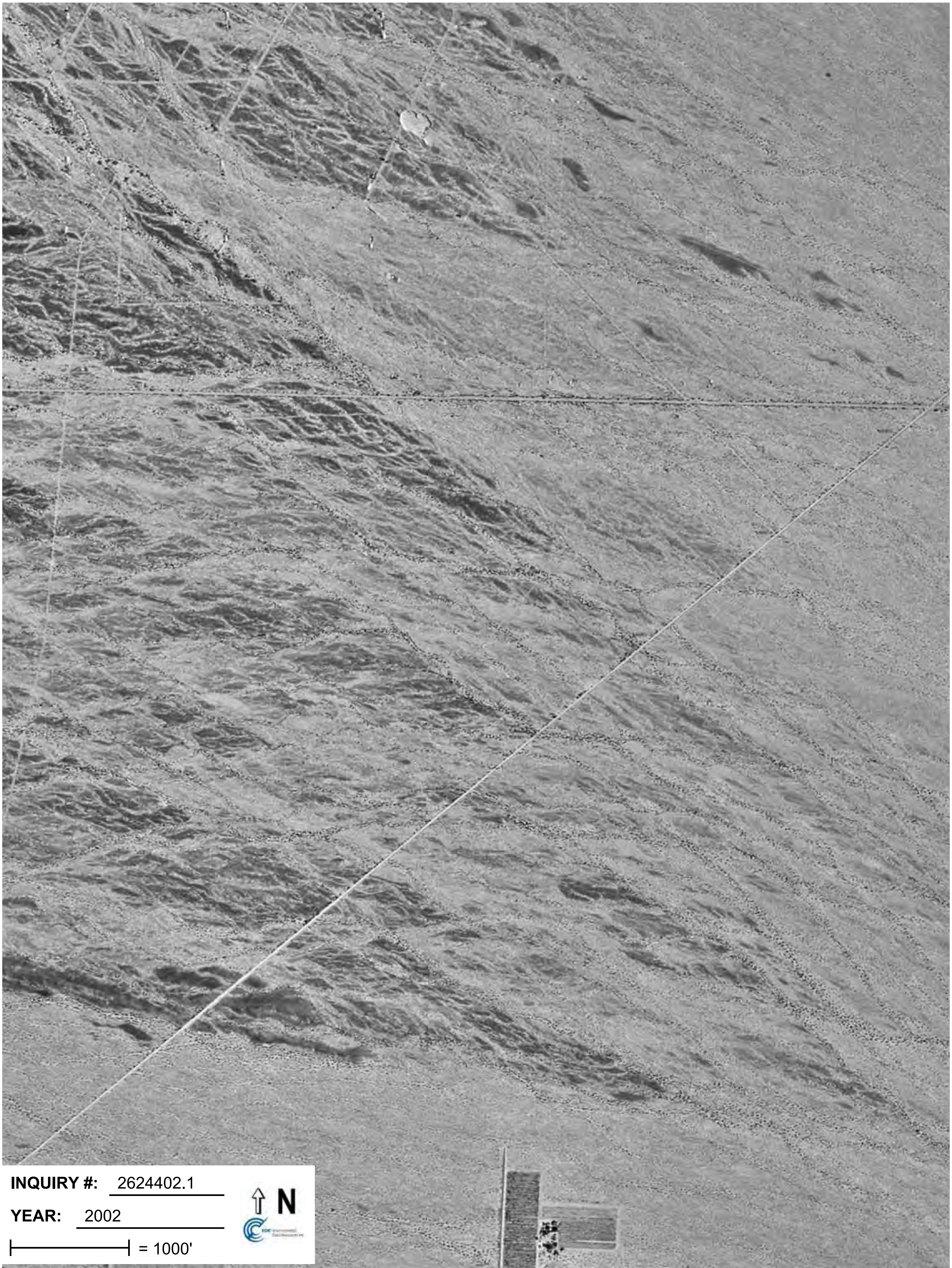
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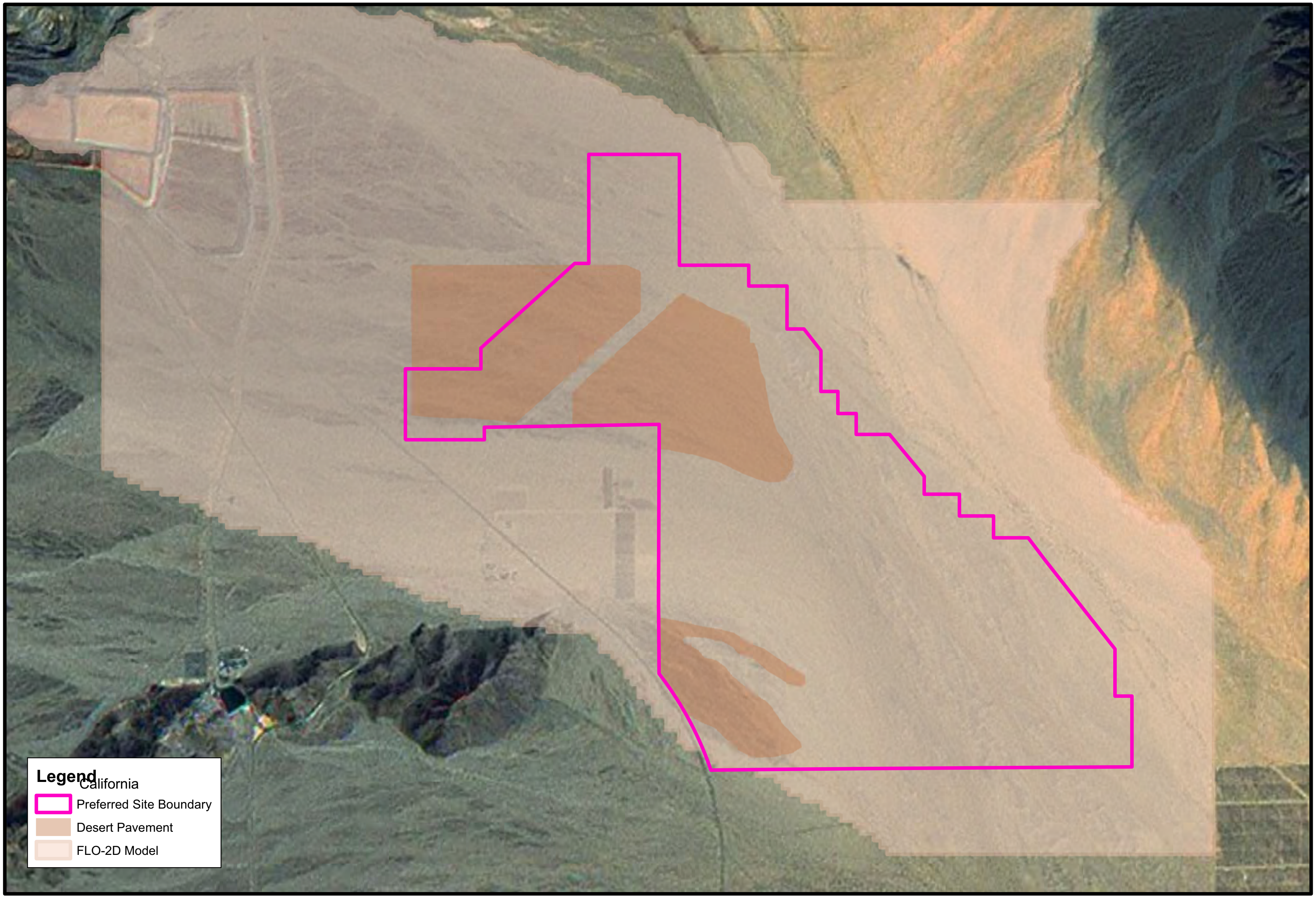
## Appendix E: EUC Delineated Desert Pavement Areas

The following figure shows the locations where the infiltration capacity of desert pavement was applied to the hydraulic model.




AECOM

N

0 1 2 Miles

Appendix E
EUC Delineated Desert Pavement Areas

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# Numerical Groundwater Model

Environment

Prepared for:
Desert Sunlight Holdings LLC
Riverside, CA

Prepared by:
AECOM
Camarillo, CA
60139386
June 2010

# NUMERICAL GROUNDWATER MODEL EVALUATION OF PROPOSED PROJECT GROUNDWATER PUMPING

## Desert Sunlight Solar Farm
## Chuckwalla Valley, Riverside, CA

AECOM Environment

Prepared for:
Desert Sunlight Holdings LLC
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60139386
June 2010

# NUMERICAL GROUNDWATER MODEL EVOLUTION OF PROPOSED PROJECT GROUNDWATER PUMPING

## Desert Sunlight Solar Farm
## Chuckwalla Valley, Riverside, CA


David Li
Project Hydrogeologist, PH

Michael Flack
RC&E Group Manager, PG, CEG

Arrie Bachrach
Program Manager

# Contents



# List of Tables



# List of Figures

# List of Abbreviations

| | |
|---|---|
| af | acre-feet |
| afy | acre-feet per year |
| Basin | Chuckwalla Valley Groundwater Basin |
| bgs | below ground surface |
| DWR | Department of Water Resources |
| ft/d | feet per day |
| $ft^2/d$ | square feet per day |
| Project | Desert Sunlight Solar Farm Project |
| USBR | United States Bureau of Reclamation |
| USGS | United States Geological Survey |

# 1.0 Introduction

The Desert Sunlight Solar Farm Project (Project) is a proposed 550-megawatt solar photovoltaic generating facility that will be constructed in the westernmost portion of the Chuckwalla Valley, in Riverside County, California (Figure 1). Project water use during operation will be minimal (0.2 acre-feet per year [afy]) over a 30-year Project life for a total of only 6 acre-feet (af). Project water use during construction of the Project is expected to total between 1,300 and 1,400 af over a 26-month construction period. The Project will obtain its water supply from groundwater. This document provides an assessment of potential impacts on adjacent water supply wells from the proposed groundwater pumping for Project construction and operation.

Two new water supply wells, one each for construction and operational water supply, are proposed for the Project (Figure 2). There are four existing water supply wells within a 2-mile radius of each of the proposed water supply wells. A review of available data and an online database search of the United State Geological Survey (USGS) National Water Information System show that wells in the vicinity of the proposed construction water supply well have been or are used for supply to the Kaiser Eagle Mountain Mine, located northwest of the Project site, and for domestic and agricultural supply and are completed (i.e., well screen interval) to depths between about 200 and 1300 feet below the ground surface (bgs). A review of available information shows that there is limited information on the well construction details in the vicinity of the proposed operational supply well.

The goal of the impact assessment provided herein is to use a previously published USGS numerical groundwater model to assess if the proposed pumping of groundwater for Project construction would impact the water supply wells adjacent to the proposed construction supply well, and how the pumping might affect groundwater basin storage. Though the proposed operational supply is insignificant (roughly 0.12 gallons per minute assuming the well would operate continuously all year long), the proposed operational pumping was evaluated to provide a comprehensive assessment of the Project water supply impacts.

# 2.0 Hydrogeology

The Project is located in the alluvial-filled basin of the Chuckwalla Valley. Regionally, this valley formed as a structural depression or a pull-apart basin and is composed of two broad geologic units, consolidated rocks and unconsolidated alluvium. The consolidated rocks consist of pre-Tertiary age igneous and metamorphic rocks, which form the basement complex. Water-bearing units include the Quaternary- to Pliocene-age continental deposits that are divided into the Quaternary alluvium, Pinto and Bouse Formations (DWR 2004). The Quaternary alluvium is reported to be the most important aquifer in the area (DWR 1979). In the area of the Project site, coarse-grain sand and gravel deposits are reported to overlay fine-grained lacustrine sediments, and geophysical surveys show that the depth to bedrock is over 1,000 feet bgs in the area of the Project site (GEI 2009, Figure E2-6, Cross Section C-C'). Estimates show that the coarse-grain sediments above the lacustrine deposits in the Upper Chuckwalla Valley(and in the Project site vicinity), are about 300 feet in thickness; based on available water level measurements, about 150 feet of the coarse-grained sediments are saturated above the lacustrine deposits. The coarse-grain sediments thicken dramatically to the south of the Project site, and in the area of Desert Center the saturated thickness is estimated to be over 600 feet. The saturated alluvial sediments increase in thickness eastward to over 1,000 feet in the area of Ford Dry Lake (GEI 2009, WorleyParsons 2009). The Department of Water Resources (DWR) (2004) estimates recoverable storage in the Basin at between 9,100,000 and 15,000,000 af.

Groundwater within the Basin generally flows from the west to east through the gap in the McCoy and Mule Mountains. Below the Project site, groundwater flow is generally north to south from the gap separating Pinto Valley from the Chuckwalla Valley, then southeasterly below the Project site toward Palen Dry Lake. This flow pattern is a result of a groundwater recharge mechanism from the Pinto Valley and Orocopia Valley Groundwater Basins as groundwater flows into the Basin from the west and then exits to the Palo Verde Mesa Groundwater Basin through the gap in the McCoy and Mule Mountains. Groundwater in the Basin is reportedly contained under generally unconfined conditions in the western portion of the Basin, and semi-confined and confined conditions in the central and eastern portion of the Basin, as there are near-surface lacustrine sediments that form a confining layer in these areas (AECOM 2009, WorleyParsons 2009).

Properties used to define aquifer characteristics include hydraulic conductivity, transmissivity, and storage coefficient. Hydraulic conductivity is the property of the aquifer material to transmit water, and is expressed in units of feet per day (ft/d). Transmissivity is the hydraulic conductivity multiplied by the thickness of the sediments capable of transmitting water, and is expressed in units of gallons per day per foot or feet squared per day ($ft^2/d$). Storage coefficient refers to the percentage of water that can be released from the aquifer material pore space. A higher storage coefficient indicates a slower progression of the cone of depression in the aquifer resulting from groundwater extraction, and a lower storage coefficient indicates a much faster progression of the cone of depression.

In general, there is limited reliable information on the aquifer characteristics within the Basin. The available data are variable and appear related to the heterogeneity of the water-bearing materials throughout the Basin, and possibly the variability in the approach to aquifer testing and analysis between investigators. In the area of Desert Center and in the Upper Chuckwalla Valley, hydraulic conductivity has been reported at between about 2 to 30 ft/d (CH2M-Hill 1996) and up to 125 ft/d (GEI 2009). This range of values is typical for a complex alluvial aquifer system that is characterized by discontinuous layers of sandy alluvial channels inter-bedded with low-permeability fine-grained silt and clay. The aquifer storage coefficient has been reported between 0.05 and 1.03 (GEI 2009).

# 3.0 Numerical Groundwater Model

A previously constructed numerical groundwater model developed by the USGS was selected to evaluate the impacts of the proposed Project groundwater pumping. This regional model was developed by the USGS in cooperation with the United States Bureau of Reclamation (USBR) to evaluate the potential for depletion of the Colorado River from groundwater pumping in areas outside the flood plain and sub-adjacent groundwater basins (Leake et al 2008).

## 3.1 USGS Groundwater Model

The regional model is a simple two-dimensional superposition model developed using MODFLOW 2000 code (Harbaugh et al 2000) for the Parker-Palo Verde-Cibola area, which includes the Basin. The model employs a single layer geometry and a large grid spacing to assess how groundwater pumping affects the flux or recharge from the Colorado River. The model assumes a uniform saturated thickness throughout the model domain and sets a constant value of storativity (0.20). In the development of the model, a range of 25 transmissivity values was evaluated by the USGS using a statistical analysis of available aquifer data along the Colorado River in consideration of data gathered from the younger and older alluvium above the Laguna Dam (above the Yuma area). In their model of potential depletion of the Colorado River, the transmissivity was from a low value (6,300 $ft^2/d$) to an average value of 26,000 $ft^2/d$. The lower value is the point where the probability is 0.05 (5 percent) that the transmissivity was equal or less than this value. The average value (26,000 $ft^2/d$) was selected with a probability of 0.5 (50 percent). The model grid uses a spacing of 1,320 feet throughout the domain, which includes the Chuckwalla Valley and Palo Verde Mesa as well as the Cibola area of Arizona (Figure 3). The Palo Verde Valley is not modeled, as groundwater there was assumed to be within the flood plain and directly connected to part of the Colorado River.

Several important elements of the model impact the way the model would predict the extent of drawdown from pumping. The outline of the model domain is assumed to be a no-flow boundary, and as such, there is no recharge to the model from underflow from other groundwater basins (i.e., Pinto or Orocopia) or inflow from mountain front runoff that would originate from precipitation along the margin of the groundwater basin. The way the model is constructed, in response to pumping, groundwater would be supplied solely from storage in the model domain and from changes in flux from the Colorado River. As this is not a flow model that considers groundwater head distribution and movement, the model “sees” the water table as a flat surface. When estimating pumping, the cone of depression develops as a circle since there is no consideration of groundwater flow and gradient. Under normal conditions, the cone of depression for a pumping well would be a parabola with the apex located in the down-gradient direction and fanning or opening in the up-gradient direction. As the model does not consider groundwater flow and the cone develops as a circle, this exaggerates the extent of the down- and cross-gradient influence and underestimates the up-gradient influence from proposed pumping.

As constructed, this model provides a conservative (i.e., tends to “over predict”) estimate in the change in storage from proposed pumping; this is because in the model there are only limited sources of water to the pumping well, and the model excludes recharge. Estimates of drawdown during construction are less affected by the model architecture, as most of the water pumped during the short construction period would come from aquifer storage.

This existing USGS numerical groundwater model was selected to evaluate the impacts from proposed Project pumping because:

- The model includes the Project site and is of sufficient detail and complexity to adequately evaluate impacts from the modest pumping proposed for the Project.
- The model has been reviewed by the USGS and USBR, which represents adequate pre-publication peer review.
- The model provides a conservative estimate of potential change in storage from pumping as it is constructed without consideration of flow into the domain from sub-adjacent groundwater basins and precipitation from runoff.

## 3.2 Project Model Setup and Input Parameters

While the USGS model incorporates the Project site, several changes to the model were required for it to adequately evaluate proposed Project pumping and the influence from the pumping on adjacent water supply wells within a 2-mile radius of the Project site. For the analysis of influence, the model grid was modified by refining the grid spacing (i.e., made much smaller around the proposed pumping well). This allowed for a better assessment of the influence from Project pumping as the grid spacing around the pumping well was varied from about 30 feet around the well and gradually increased to a spacing of 1,320 feet one mile away from the pumping well.

The superposition model (Leake et al 2008) adopts a uniform grid spacing of 0.25 miles (1,320 feet). To better resolve the rapid change in drawdown near the proposed pumping well, the model grid spacing was refined as follows:

- 30 feet from the pumping well for the first 300 feet;
- 100 feet spacing further out from the well for one mile or 5,280 feet; and
- Gradual increase in spacing from 100 feet to 1,320 feet for the remainder of the model domain.

In the application of model stress periods, Project pumping was set on an annualized basis for an initial 2-year period to reflect construction water supply, followed by a 30-year period to simulate the affects of operational supply. Construction activities are expected to take place over a period of approximately 26 months, so the application in the model is slightly more conservative. For the construction period, the pumping well in the model was set at 700 afy for a 24-month period; for the Project's operational period, the pumping well was set at 0.2 afy for 30 years.

The transmissivity was not varied in the USGS model, as one value was uniformly applied over the whole model domain (Leake et al 2008). For this application, the transmissivity was revised to reflect an updated interpretation based on recent investigations of the Chuckwalla Valley Groundwater Basin. The distribution of transmissivity was based on published data from across the basin (AECOM 2009, 2010; GEI 2009; WorleyParsons, 2009) that were used to refine and remap the zones for the groundwater model (Figure 4).

- Zone 1 includes the Project site and the western portion of the Basin. The transmissivity was evaluated in the model at a range of values between 6,300 $ft^2/d$ to 8,500 $ft^2/d$, which is generally within the mid-range reported for this area (GEI 2009).

- Zone 2 includes the Palo Verde Mesa Groundwater Basin east of the Chuckwalla Valley and was set at a transmissivity of 26,000 $ft^2$/d, which is the average value reported by the USGS (Leake et al 2008). This value was not varied in the simulations.
- The lowest transmissivity zone (Zone 3 = 1,000 $ft^2$/d) was applied to the central zone within the basin, Palen Dry Lake and the area around Ford Dry Lake. This value was not varied in the simulations.
- Zone 4, at a transmissivity of 6,300 $ft^2$/d, was established at the very easternmost portion of the Basin. This value was not varied in the simulations.

In most respects the distribution of transmissivity represents a simplification of a heterogeneous environment to the analysis of water supply impacts from the Project, as it presumes through-going uniformity of aquifer characteristics that are not documented in the hydrostratigraphy for the Basin. The range in transmissivity values in the Project area provided for a sensitivity analysis, as the model was run using a range of different values that have been reported for the Project area. As hydraulic conductivity is the ratio of transmissivity to aquifer thickness (T/b), the values selected fall within the range of hydraulic conductivity estimates reported by CH2M-Hill for the Upper Chuckwalla Valley (CH2M-Hill 1996).

The model depth or assumption of saturated thickness was varied between 150 feet and 500 feet to reflect varied interpretations of the aquifer thickness in the area of the Project site. A value of 500 feet was selected for the model because it is the value used in the USGS model and is close to the saturated thickness (i.e., the interval from top of the water table to the base of the well screen interval) of 450 feet for the nearby Kaiser Ventures Chuckwalla Number 4 Well (GEI 2009, Figure E2-6). The Kaiser Ventures well is about a mile due north of the proposed construction water supply well. In contrast, a value of 150 feet was also used in some of the model scenarios. The value follows the GEI (2009) interpretation that the saturated thickness of the coarse-grain alluvial deposits in the area of the Project site is about 150 feet (GEI 2009, Figure E2-6). This is also the value used in their modeling of the proposed Eagle Crest Project.

Lastly, the aquifer storage coefficient was varied from 0.05 to 0.2. The variation of values corresponds to the lowest value reported by GEI (2009) (0.05) for the Desert Center area and the value used in their groundwater model for the Eagle Crest Project. A value of 0.2 was modeled to reflect the interpretation that the aquifer in the western portion of the Basin is unconfined (GEI 2009; AECOM 2009; WorleyParsons 2009). Further, this value is within the lower to middle range of values reported for the area around the Project site (GEI 2009). The variation of storage coefficient was applied to Zone 1 only, which included the Project site. The remainder of the model domain was left at a storage coefficient of 0.2 that was used by the USGS (Table 1).

In summary, several of the key model variables were changed from what was used in the USGS model to reflect a range of interpretations and available data for the western portion of the Chuckwalla Valley. The variation of these input variables in the model provides a measure of uncertainty analyses to better evaluate the potential effects of drawdown around the pumping and surrounding wells. In general, the input values selected tended to produce a conservative estimate of impacts from proposed pumping.

# 4.0 Numerical Groundwater Model Results

The results of the modeling are provided on Table 1 and shown on Figures 5 through Figure 9 for the proposed Project construction period and the range of transmissivity values of 6,300 $ft^2/d$ and 8,500 $ft^2/d$, storage coefficients (0.05 to 0.2) and aquifer thickness (150 feet to 500 feet). Based on the model scenarios, the maximum drawdown predicted for the construction well is about 18 feet and for the operational supply well about 0.3 foot (Table 1). The maximum drawdown of the construction well is approximately 3 percent of the assumed model layer thickness of 500 feet. The modeling result of 3 percent maximum drawdown demonstrates that it is appropriate to apply a superposition model, because a superposition model can be applied if the basin-wide drawdown of the unconfined aquifer is 10 percent or less of saturated thickness.

As would be expected, the drawdown at the well and the radius of influence increase with lower transmissivity and a lower storage coefficient and decrease with higher transmissivity and higher storage coefficient. The lower aquifer thickness (150 feet) tended to produce smaller values of drawdown at the pumping well and correspondingly a smaller cone-of-depression defined to the one-foot contour (Figure 7, 8 and 9). In general, there were some difference in the results as a function of all the model variables, but the most sensitive were the aquifer thickness and transmissivity.

Under any of the scenarios and range of input variables, the model predicts that no well within a 2-mile radius of the proposed construction well will be impacted by a drawdown of 5 feet or more during the construction period, and for most of the simulations only one well (4S/15E-31C1) is predicted to be within the one-foot drawdown contour. The exception is the model scenario that employs the lowest transmissivity and storage coefficient and predicts that four wells (4S/15E-31C1, 4S/16E-19M1, 4S/16E-19N1 and CW#4) are within the one-foot drawdown contour, though none within the 5-foot drawdown contour (Figure 7). This scenario represents a combination of the lowest estimated values and as such, is not anticipated.

These results indicated that the Project will not significantly impact off-site water supply wells during the construction period. The operational period was not illustrated as the drawdown at the pumping well is less than 1 foot after 30 years.

The storage change was also calculated using the model flow budget. As can be seen on Table 1, the largest net change occurs at the end of construction, and the change represents about 1,400 af (Table 1). Assuming a conservative total recoverable storage of 9,100,000 af in the Basin (DWR, 2004), the impact of basin storage is insignificant (0.00015 percent) even for the largest storage change at the end of construction.

Based on the results of these numerical groundwater simulations, the proposed Project pumping will not significantly impact adjacent water supply wells or the groundwater basin storage.

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# Table

**TABLE-1**
**RESULTS OF PREDICTIVE SIMULATIONS**
**NUMERICAL GROUNDWATER MODEL**
**DESERT SUNLIGHT SOLAR FARM**
**DESERT SUNLIGT HOLDINGS, LLC**
**CHUCKWALLA VALLEY GROUNDWATER BASIN**
**RIVERSIDE COUNTY, CALIFORNIA**

| Model Runs[1] | RESULTS SHOWN (FIGURE) | SATURATED THICKNESS | Zone 1[2] | | Zone 2[3] | | Zone 3[4] | | Zone 4[5] | | Period of interest | Maximum Predicted Drawdown at the Pumping Well | | Change in Storage (af) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | feet | T ($ft^2/d$) | S (--) | T ($ft^2/d$) | S (--) | T ($ft^2/d$) | S (--) | T ($ft^2/d$) | S (--) | | Construction Supply[6] | Operational Supply[7] | |
| FS_T6300 | 5 | 500 | 6,300 | 0.2 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 15.46 | -- | 1,401.49 |
| | | | | | | | | | | | 2043 | -- | 0.13 | 1,407.67 |
| FS_T8500 | 6 | 500 | 8,500 | 0.2 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 11.89 | -- | 1,401.48 |
| | | | | | | | | | | | 2043 | -- | 0.12 | 1,407.67 |
| FS_T6300, ADD-1 | 7 | 500 | 6,300 | 0.05 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 17.80 | -- | 1,401.48 |
| | | | | | | | | | | | 2043 | -- | 0.297 | 1,407.67 |
| FS_T8500, ADD-2 | -- | 500 | 8,500 | 0.05 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 13.18 | -- | 1,401.48 |
| | | | | | | | | | | | 2043 | -- | 0.276 | 1,407.67 |
| FS_T6300, ADD-3 | 8 | 150 | 6,300 | 0.2 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 6.78 | -- | 1,401.48 |
| | | | | | | | | | | | 2043 | -- | 0.055 | 1,407.66 |
| FS_T8500, ADD-4 | -- | 150 | 8,500 | 0.2 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 5.24 | -- | 1,401.47 |
| | | | | | | | | | | | 2043 | -- | 0.048 | 1,407.65 |
| FS_T6300, ADD-5 | 9 | 150 | 6,300 | 0.05 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 6.64 | -- | 1,401.47 |
| | | | | | | | | | | | 2043 | -- | 0.124 | 1,407.65 |
| FS_T8500, ADD-6 | -- | 150 | 8,500 | 0.05 | 26,000 | 0.2 | 1,000 | 0.2 | 6,300 | 0.2 | 2013 | 6.46 | -- | 1,401.46 |
| | | | | | | | | | | | 2043 | -- | 0.123 | 1,407.64 |

**Notes**

1 FS_T6300 & FS_T8500 are the "Project Only" simulations
2 Zone 1 - Western Portion of the Chuckwalla Valley Groundwater Basin (Project Area) (See Figure 4)
3 Zone 2 - Palo Verde Mesa Groundwater Basin (See Figure 4)
4 Zone 3 - Central portion of the Chuckwalla Valley Groundwater Basin (See Figure 4)
5 Zone 4 - Easternmost portion of the Chuckwalla Valley Groundwater Basin (See Figure 4)
6 Construction supply modeled at 700 acre-feet per year for 2011 and 2012 for a total supply of 1,400 acre-feet in 24 months.
7 Operational supply modeled at 0.2 acre-feet per year from years 2013 to 2042. Total supply of 6 acre-feet over 30 years.

**Definitions**

T Transmissivity in feet squared per day
S Storage coefficient (unitless)
af Acre-feet (one acre-foot = 325,829 gallons)

# Figures


Map Location


1:1,000,000

0 20 40 Miles

N W E S

**Desert Sunlight Solar Farm Project**

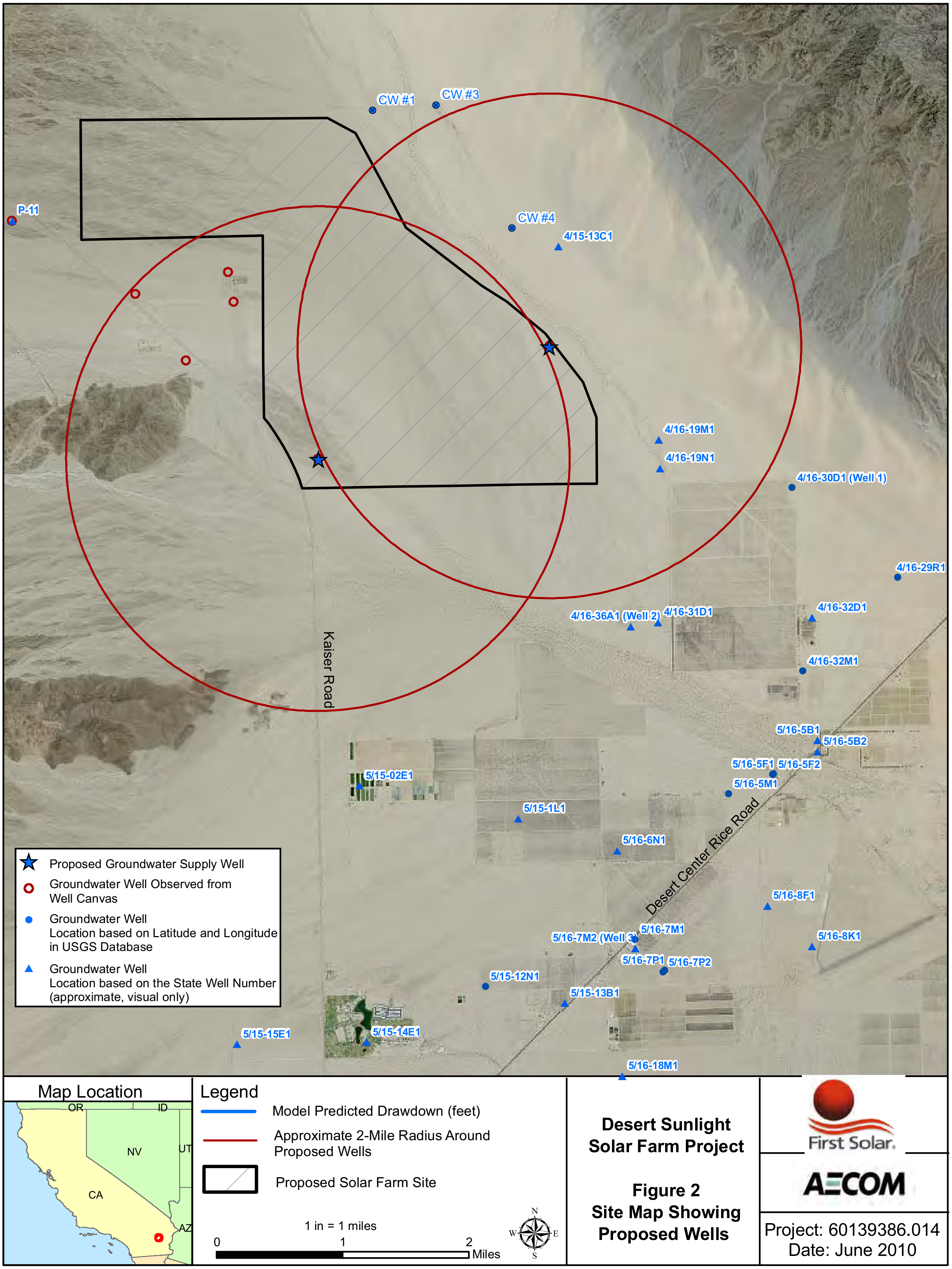
**Figure 1**
**Project Vicinity Map**

First Solar.

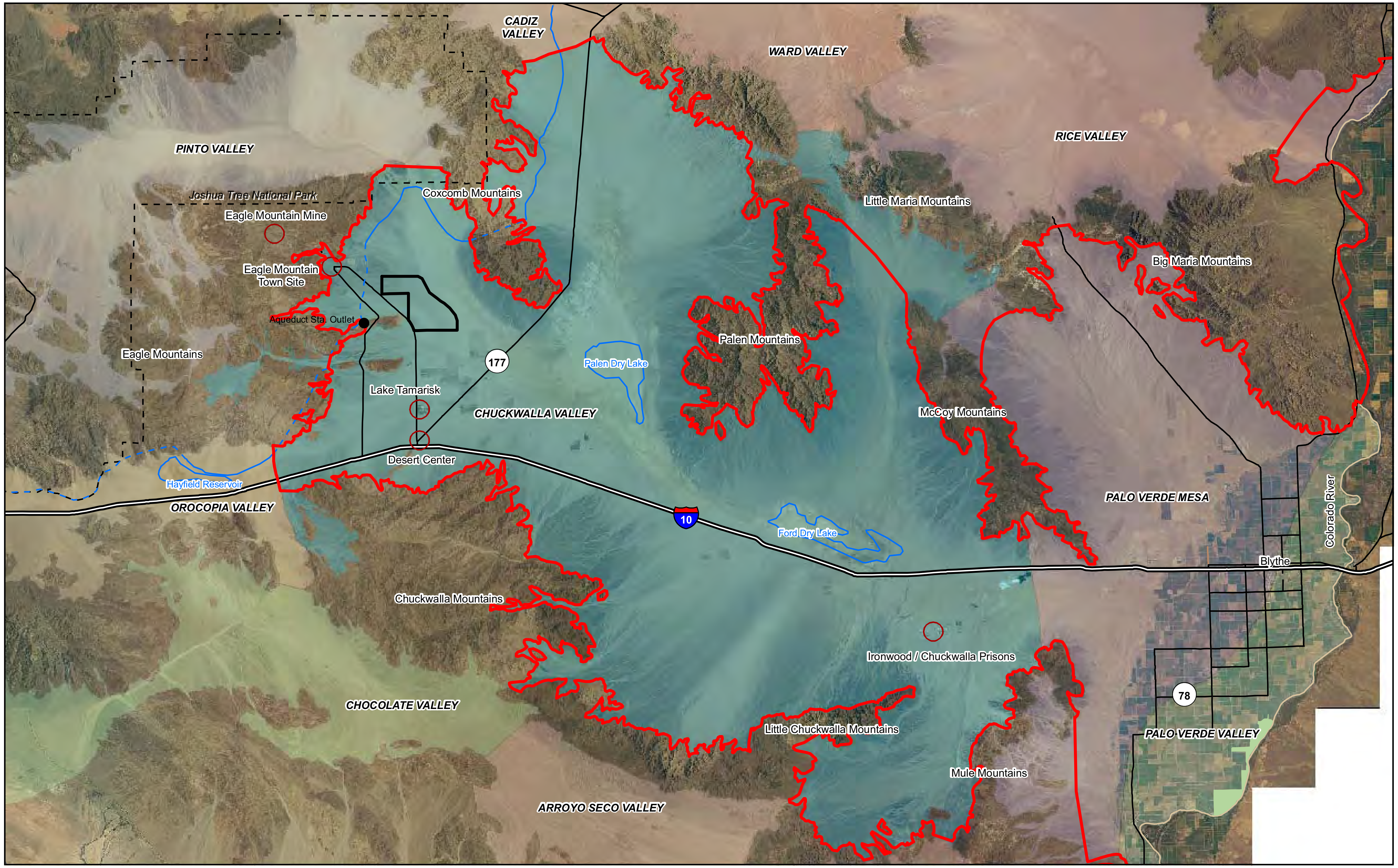
AECOM

Project: 60139386.014
Date: March 2010

J:\GIS\Projects\12414-First_Solar\011-Desert Sunlight\mxd\Feb10Bnd\Figure 1_Project Vicinity Map.mxd




J:\GIS\Projects\12414-First_Solar\011-Desert Sunlight\mxd\Feb10Bnd\Figure 2_Study Area and Site.mxd




**KEY TO GROUNDWATER BASINS**

- ARROYO SECO VALLEY
- CADIZ VALLEY
- CHOCOLATE VALLEY
- CHUCKWALLA VALLEY
- OROCOPIA VALLEY
- PALO VERDE MESA
- PALO VERDE VALLEY
- PINTO VALLEY
- RICE VALLEY
- WARD VALLEY

Map Location


Legend

- USGS (2008) Parker-Palo Verde-Cibola Model Domain
- Proposed Solar Farm Site
- Colorado River Aqueduct
- Colorado River Aqueduct (Dash showing underground interval)
- Freeway
- Highway / Major Road
- Geographic/Cultural Area of Interest

Data Sources:
Air Photo, California Spatial Information Library, NAIP, 2005 Riverside County

Water Basins, Department of Water Resources Website groundwater basin map file B118v3NAD27UTM10.zip

0 6 12 Miles
1 in = 6 miles

**Desert Sunlight Solar Farm Project**

**Figure 3**
**USGS (2008) Model Area**

Project: 60139386.014
Date: June 2010

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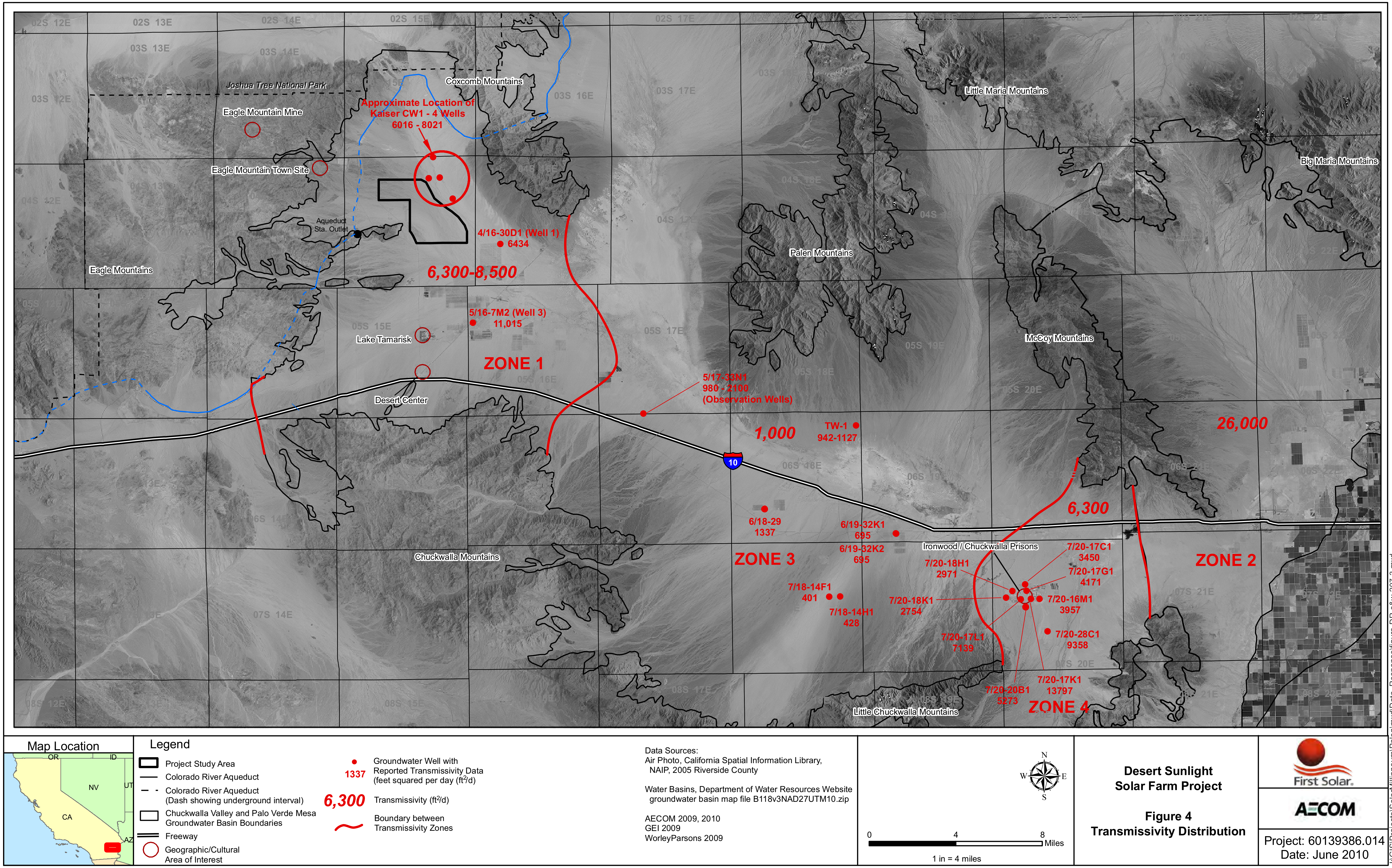
Joshua Tree National Park
Eagle Mountain Mine
Eagle Mountain Town Site
Coxcomb Mountains
Approximate Location of
Kaiser CW1 - 4 Wells
6016 - 8021
Aqueduct
Sta. Outlet
4/16-30D1 (Well 1)
6434
6,300-8,500
Eagle Mountains
5/16-7M2 (Well 3)
11,015
Lake Tamarisk
ZONE 1
Desert Center
5/17-33N1
980 - 2100
(Observation Wells)
1,000
TW-1
942-1127
Little Maria Mountains
Big Maria Mountains
Palen Mountains
McCoy Mountains
26,000
6,300
10
6/18-29
1337
6/19-32K1
695
6/19-32K2
695
Ironwood / Chuckwalla Prisons
Chuckwalla Mountains
ZONE 3
7/18-14F1
401
7/18-14H1
428
7/20-18H1
2971
7/20-18K1
2754
7/20-17C1
3450
7/20-17G1
4171
7/20-16M1
3957
7/20-28C1
9358
7/20-17L1
7139
7/20-17K1
13797
7/20-20B1
5273
ZONE 2
ZONE 4
Little Chuckwalla Mountains
02S 12E
02S 13E
02S 14E
02S 15E
02S 17E
03S 12E
03S 13E
03S 14E
03S 16E
03S 17E
04S 12E
05S 15E
05S 17E
05S 19E
05S 16E
05S 18E
05S 20E
06S 18E
07S 14E
07S 21E
08S 12E
08S 15E
08S 17E
Map Location
OR
ID
NV
UT
CA
AZ
Legend
Project Study Area
Colorado River Aqueduct
Colorado River Aqueduct
(Dash showing underground interval)
Chuckwalla Valley and Palo Verde Mesa
Groundwater Basin Boundaries
Freeway
Geographic/Cultural
Area of Interest
1337
Groundwater Well with
Reported Transmissivity Data
(feet squared per day (ft²/d)
6,300
Transmissivity (ft²/d)
Boundary between
Transmissivity Zones
Data Sources:
Air Photo, California Spatial Information Library,
NAIP, 2005 Riverside County
Water Basins, Department of Water Resources Website
groundwater basin map file B118v3NAD27UTM10.zip
AECOM 2009, 2010
GEI 2009
WorleyParsons 2009
N
W
E
S
0
4
8
Miles
1 in = 4 miles
Desert Sunlight
Solar Farm Project
Figure 4
Transmissivity Distribution
First Solar.
AECOM
Project: 60139386.014
Date: June 2010
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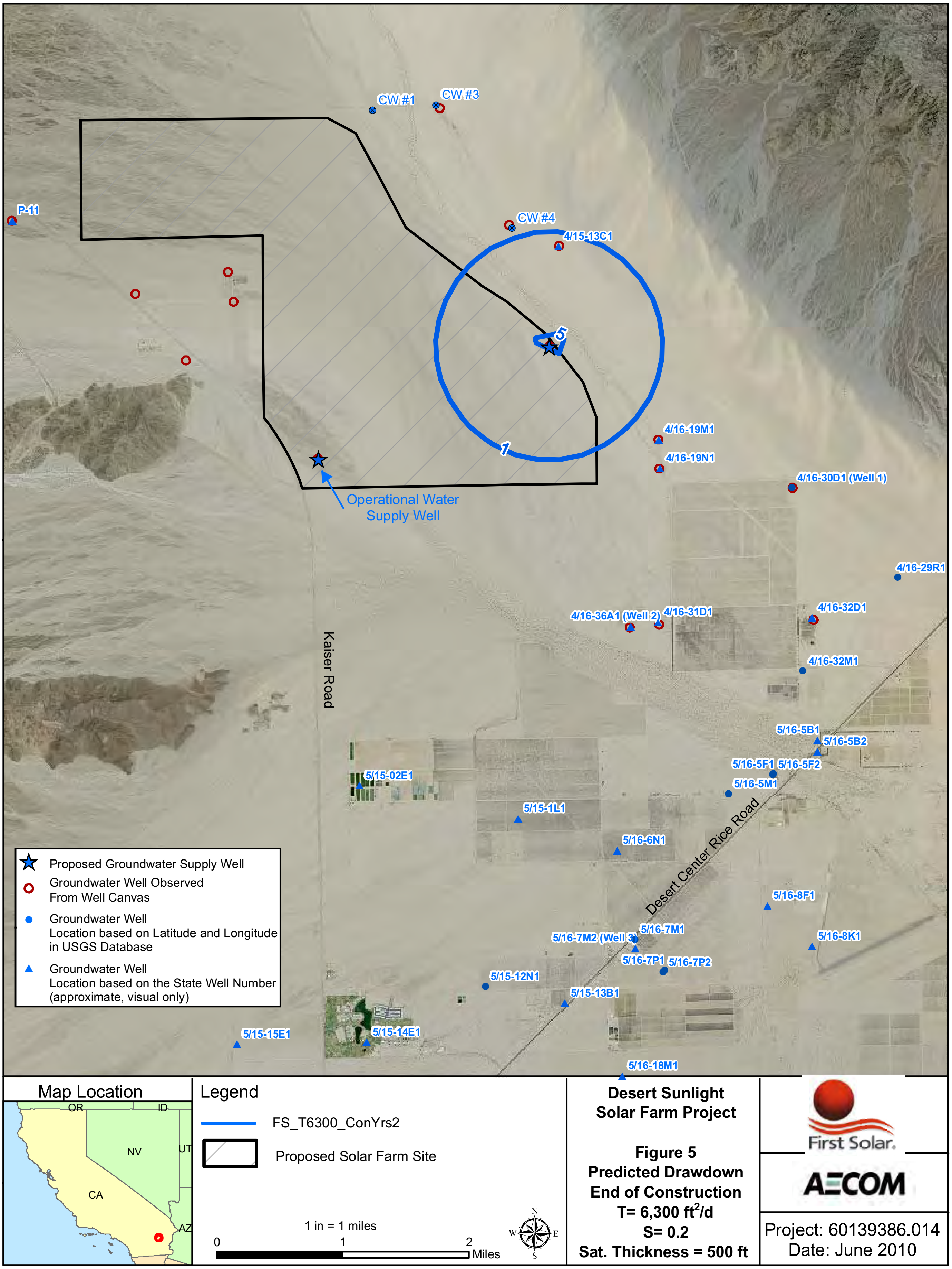
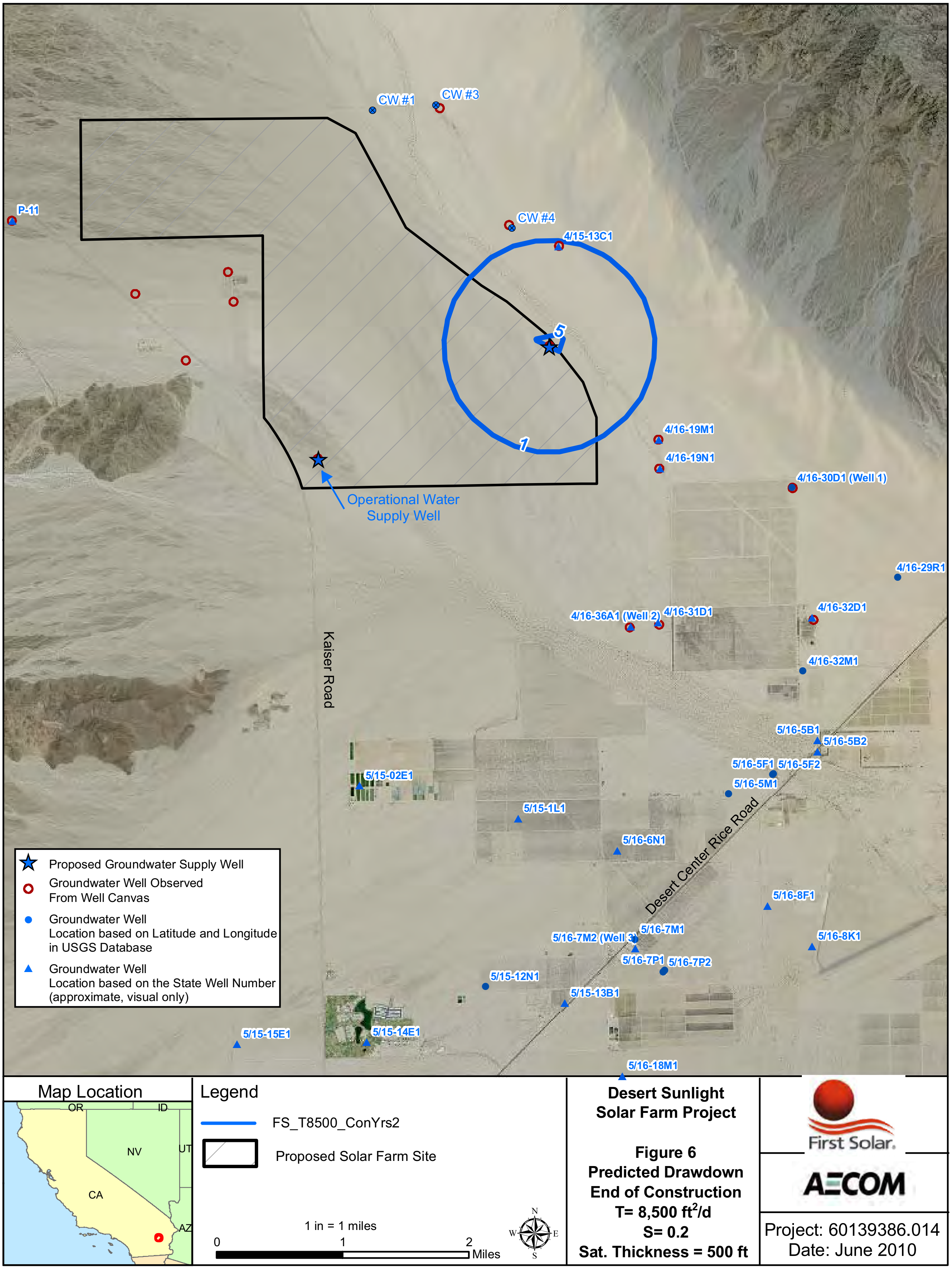



**Desert Sunlight Solar Farm Project**

**Figure 5**
**Predicted Drawdown**
**End of Construction**
**T= 6,300 $ft^2/d$**
**S= 0.2**
**Sat. Thickness = 500 ft**




**Desert Sunlight Solar Farm Project**

**Figure 6**
**Predicted Drawdown**
**End of Construction**
**T= 8,500 ft$^2$/d**
**S= 0.2**
**Sat. Thickness = 500 ft**

First Solar.

AECOM

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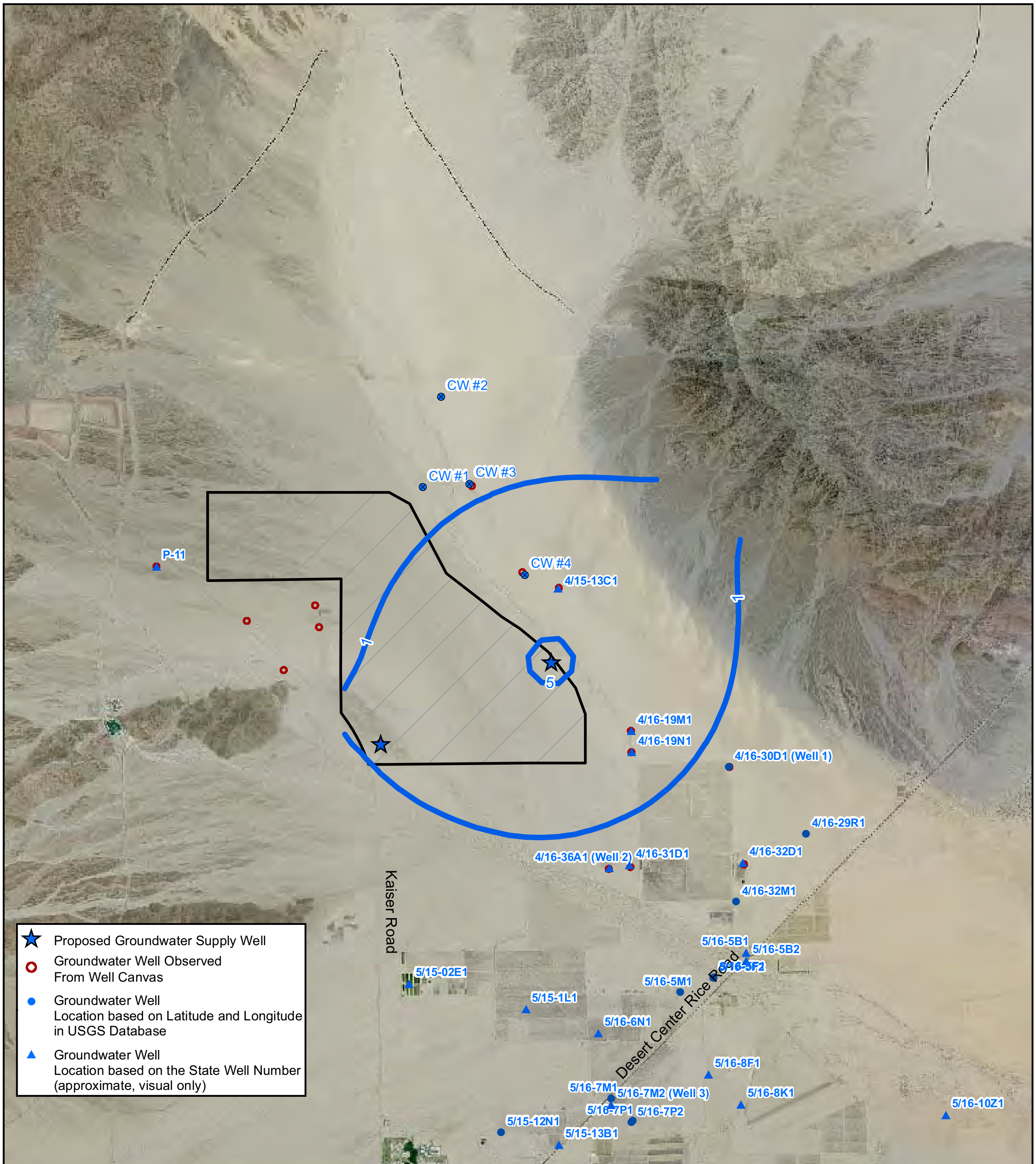



Map Location


Legend

FS_T6300_2w_add1_ConYrs2

Proposed Solar Farm Site

1 in = 1 miles

0 1 2 Miles

**Desert Sunlight Solar Farm Project**

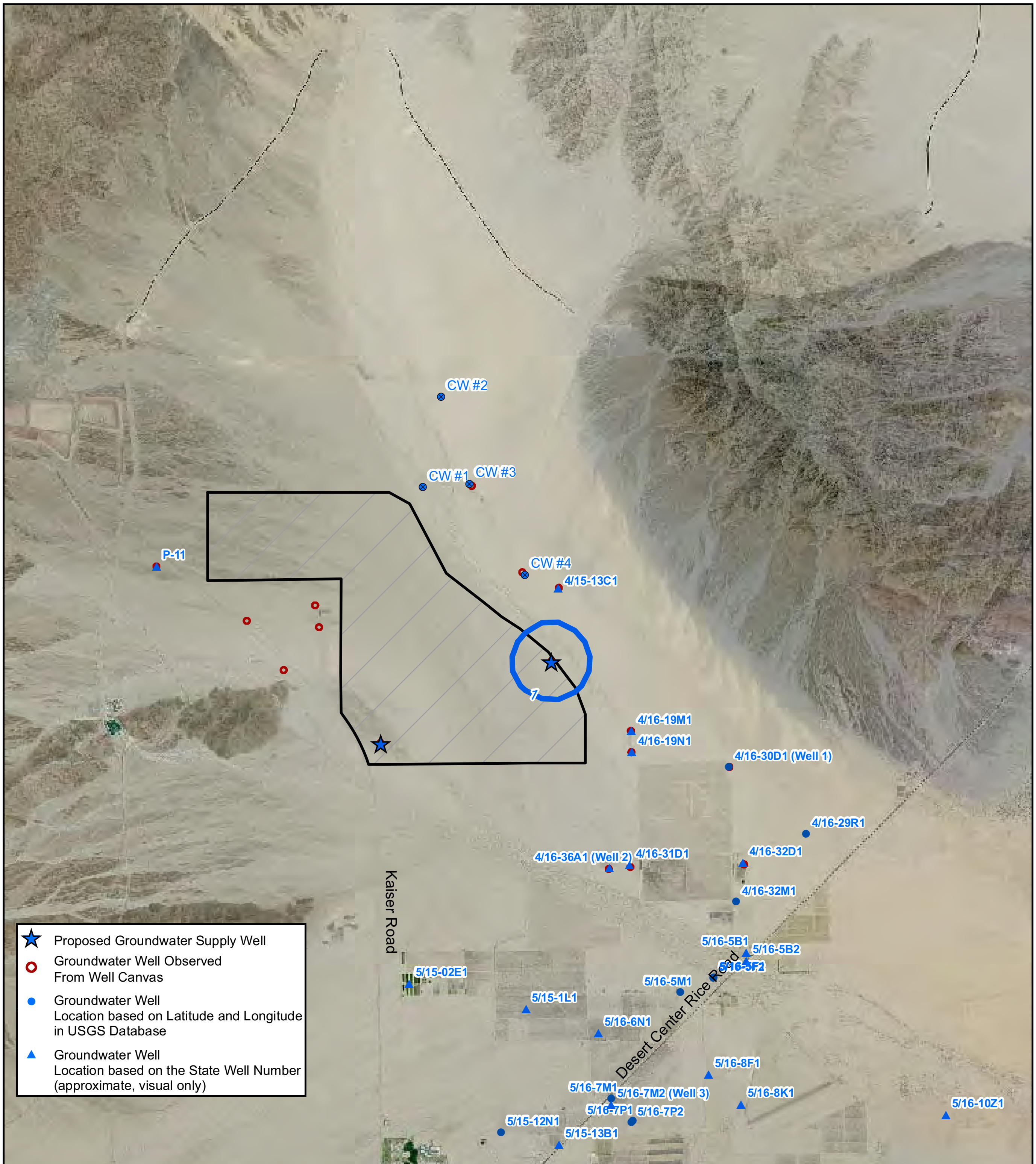
**Figure 7**
**Predicted Drawdown**
**End of Construction**
**T= 6,300 ft$^2$/d**
**S= 0.05**
**Sat. Thickness = 500 ft**

First Solar.

AECOM

Project: 60139386.014
Date: June 2010

J:\GIS\Projects\12414-First_Solar\011-Desert Sunlight\mxd\Feb10Bnd\Figure 2_Study Area and Site.mxd




Map Location


Legend

FS_T6300_2w_add3_ConYrs2

Proposed Solar Farm Site

1 in = 1 miles

0 1 2 Miles

**Desert Sunlight Solar Farm Project**

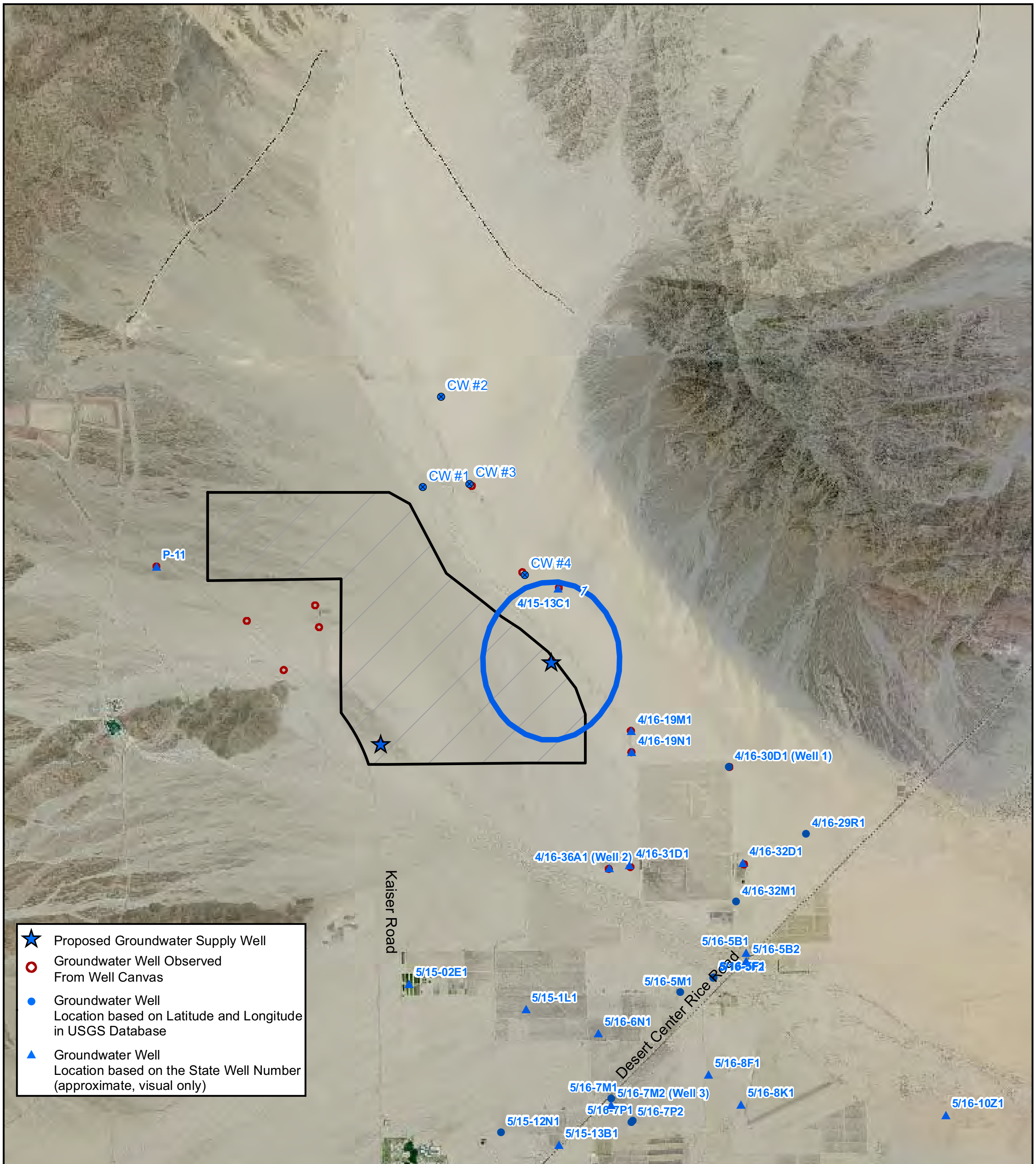
**Figure 8**
**Predicted Drawdown**
**End of Construction**
**T= 6,300 ft$^2$/d**
**S= 0.2**
**Sat. Thick = 150 ft**

First Solar.

AECOM

Project: 60139386.014
Date: June 2010

J:\GIS\Projects\12414-First_Solar\011-Desert Sunlight\mxd\Feb10Bnd\Figure 2_Study Area and Site.mxd




Map Location


Legend

FS_T6300_2w_add5_ConYrs2

Proposed Solar Farm Site

1 in = 1 miles

0 1 2 Miles

**Desert Sunlight Solar Farm Project**

**Figure 9**
**Predicted Drawdown**
**End of Construction**
**T= 6,300 $ft^2$/d**
**S= 0.05**
**Sat. Thick = 150 ft**

First Solar.

AECOM

Project: 60139386.014
Date: June 2010

J:\GIS\Projects\12414-First_Solar\011-Desert Sunlight\mxd\Feb10Bnd\Figure 2_Study Area and Site.mxd