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Submitted On: 12/16/2016
Docket Number: 15-AFC-02

Attachments Supporting Wishtoyo Foundation Comments in Opposition of Mission Rock Energy Center (15-AFC-02)

Additional submitted attachment is included below.

December 16, 2016

VIA e-Comment

California Energy Commission
Attn: Karen Douglas, Presiding Member Commissioner
1516 Ninth Street
Sacramento, CA 95814

RE: Mission Rock Energy Center (15-AFC-02): Attachments supporting Wishtoyo Foundation's letter opposing the Mission Rock Energy Center and requests for further analysis on the impacts of the Project including, but not limited to, tribal cultural resources, tribal cultural landscape resources, natural cultural resources, and environmental justice concerns.

Attachment 1 – Canine Forensic Dogs

Articles Discussing How Forensic Dogs can be and have been successfully used to identify and locate Native American human remains (last visited October 21, 2011)

1.) http://www.ohlonenation.org/?p=264

By charlene on September 20th, 2011

Forensic Dogs Successful in Identifying Ancient Human Remains for Ohlone

Category: Uncategorized, Tags: burial site, forensic dog, kb homes, ohlone, santa cruz

Native Americans are always concerned when their exists the potential of unearthing human remains during construction projects. During a time when regular protocol would dictate the use of drills and tedious ground penetrating strategies that might harm or destroy findings, two alternatives have been incorporated during a recent project.

This fall the remains of an Ohlone boy were discovered during a KB home building project in Santa Cruz, CA. During negotiation meetings between the home builder, the City of Santa Cruz, CA and the Ohlone all parties agreed to respect and accept the results from two alternative proven methods of ground investigation. The two methods include ground penetrating radar or (GPR) and specially trained forensic dogs.

In this case, Ohlone descendant Chuck Strickland recommended the GPR method. A trained GPR technician came to the building site and scanned surface of the earth to see if additional buried remains could be detected. Unfortunately, due to layers of sediment and rock would not allow proper functioning of this method. While this did meet the Ohlone requirement of a non-invasive method for predicting the likelihood of findings, it would not be a good match for this project.

Next, Gregg Castro, also an Ohlone descendant recommended the use of specially trained dogs from the Institute for Canine Forensics.

The institute has it's headquarters in California, but has provided services nationally and internationally. The institute trains for nine distinct types of area scannings. The match for the Ohlone project would be a team of dogs who could detect historical human remains. Dogs are taught not to disturb a scene by digging or retrieving evidence. Further, the dog can discriminate between human remains and all other non-human items. In this case, the dogs were able to detect the spot of the original finding as well as additional findings that would require great care if the construction project were to continue.

In this project, the Ohlone, the city and the home builder came together to agree upon these alternative scientific methods for land surveying. It is the hope of the Ohlone Elders Circle that these non-invasive methods become part of the regular process to be implemented in order to preserve former village sites.

2.) http://www.santacruzsentinel.com/localnews/ci_18929918

Santa Cruz, developer reach agreement not to build on Ohlone site

By J.M. BROWN
Posted: 09/19/2011 03:37:31 PM PDT

Archeologist and helpers sift through burial site on land where KB Homes is... (DAN COYRO/SENTINEL)

SANTA CRUZ - After weeks of negotiations with the city and Native American elders, the developers of a 32-unit housing complex on the Eastside agreed Monday not to build over an Ohlone burial site.

KB Home will set aside a premier, 13,000-square-foot parcel at the top of a knoll, where several remains were discovered this summer, to preserve in perpetuity for Ohlone elders to access for ceremonies. Elders, who believe the spirits of buried people wander if their resting place is disturbed, will be able to use the site for ceremonies in coordination with the site's homeowners association.

"I am ecstatic," said Ann-Marie Sayers, a state-designated Ohlone descendant who negotiated with the city and company to preserve the knoll. "Just the fact that KB Home honored the request of the original people whose land they are building on, it is so long overdue for developers to honor sacred sites. I truly believe they did the right thing."

Sayers, who lives in a Native American community outside Hollister, will join Ohlone elders from other parts of the state in walking the site with company representatives later this week. The elders, who had recommended KB Home fully set aside the parcel containing the knoll, will finalize details of the accord reached after numerous meetings since early August, when the remains of an Ohlone child were discovered.

During an archeological evaluation triggered by the discovery, researchers later recovered remains believed to be teeth and a skull fragment unrelated to the child or each other, officials said. Forensic dogs identified another area on the knoll believed to contain remains, but all sides agreed not to disturb it.

KB Home will establish a permanent cultural easement on land that would have contained a 2,200-square-foot house and driveway, a unit that would have been among the largest and most expensive planned for the community at Market Street and Isbel Drive. The preserved area, where all remains will be buried again, is attached to three acres already set aside to preserve the endangered spineflower.

"We essentially decided to do this out of respect for the elders and folks from the Native American community," said Ray Panek, senior vice president for forward planning at KB Home, who took part in the talks. "It will be just allowed to go to a more natural state. It seems like a good solution."

Panek said he did not have immediate estimates on lost revenue for setting aside the land or the total cost to the company for archeological research. The company agreed to bring in subsurface sonar equipment and forensic dogs at the request of Native American representatives, and two sets of archeologists worked on the site.

The city ordered the company to stop construction work around the knoll after the remains were recovered. Panek said he expected work would resume soon after the elders walk the preservation area.

"KB was generous in what they were willing to do and elders were flexible in understanding what was possible and meaningful," said Vice Mayor Don Lane, who participated in the talks.

Lane said the outcome was "a really nice conclusion," especially amid all of the demonstrations at the site and at City Hall since the first remains were found. "Everyone was a little pessimistic that goodwill wouldn't manifest."

For the past month, demonstrators have been calling for an end to building plans around the knoll. Protesters resumed their demonstrating Monday until they heard from officials outside City Hall that an agreement had been reached.

3.) http://www.k9forensic.org/historical.html (the site has links to many articles about canine forensics detecting Native American Burials)

Historical Grave Detection Group

Group has been formed by several Forensic Evidence
and Historical Human Remains Detection (HHRD) dog teams
under the umbrella of Institute for Canine Forensics

In archaeology, an HHRD trained canine with impeccable manners, slow and methodical search style, properly trained and certified, may be the Remote Sensing Tool of the future. ICF canine trainers are "writing the book" in this field. Certification standards are high insuring that the ICF certified canines are reliable, non-invasive tools to be used in modern archaeology.
tools to be used in modern archaeology.

4.) http://www.pressdemocrat.com/article/20091121/ARTICLES/911219966?p=1&tc=pg

Reclaiming Santa Rosa's century-old graves

By MARY CALLAHAN
THE PRESS DEMOCRAT

Published: Saturday, November 21, 2009 at 5:33 p.m.

Last Modified: Saturday, November 21, 2009 at 5:33 p.m.

The graves are thought to be well over 100 years old, forgotten over time, unclaimed and uncelebrated.

Photo Galleries

- Dogs Search Cemetery

Tiny yellow and red flags newly planted Saturday in several overgrown areas of the Santa Rosa Rural Cemetery began to acknowledge the loved ones who rest there and the history they represent.

But Rhea, Eros, Alice and Osara, four dogs trained to sniff out old bones, were focused firmly on the present as they criss-crossed designated areas of the 17-acre cemetery in search of human remains.

The canine foursome - as well as several others still in training - were brought to Santa Rosa by the Woodside-based Institute for Canine Forensics, which trains and deploys Human Remain Detection Dog teams.

Though some also work in search-and-rescue contexts and seek out human remains from recent tragedies, the Institute is the only such agency in the world focused on detection of historic remains, whether in law enforcement or archaeological contexts, representatives said.

Dogs associated with the Institute have been used, for example, to search for human remains at the home of a Hayward couple charged with kidnapping of Jaycee Dugard, who was snatched off a Lake Tahoe road at age 11 and kept for 18 years.

They've also identified Native American burial sites around the western United States, and served at New York City's Ground Zero and along the trail of the Space Shuttle Columbia, which exploded over Texas.

They came to Santa Rosa at the invitation of the Rural Cemetery's volunteer Preservation Committee. The organization hoped to determine whether human remains were buried in more than 100 plots recently discovered on maps long tucked away from human eyes and never marked by gravestones at the cemetery, said Sandy Frary, who, with her husband Jim, is a key organizer for the committe.

Committee members thought it possible the plots had been mapped and never used, and wanted to find out, part of their effort to restore the cemetery fully and document its history in as precise a manner as possible.

The scent of cadavers lingers in the soil and can be sifted and distinguished with a dog's sensitive nose, though it's sometimes hard to pinpoint precisely from where the odor comes, handlers said.

Dogs can even detect remains in ancient sites after centuries f burial.

The gravesites sought Saturday were probably closer to 130 or 140 years old, though there was plenty of doubt they were there in the first place - especially on a rough, sloping area along Franklin Road where 12 flags were left Saturday, indicating multiple bural plots.

Nobody had thought there were burials in those sections of the cemetery, Sandy Frary said, adding, "I'm totally amazed."

Another 10 or so flags were scattered about a meadow and adjacent hillside at the north side of the cemetery, while half a dozen others remained planted along a back road near the top of the acreage.

Volunteers still hope to rake the areas, pull up weed cover and probe around to see what more can be determined, Frary said.

Attachment 2 – Ground Penetrating Radar Survey: Results from Four Sites in California

GROUND PENETRATING RADAR SURVEY: RESULTS FROM FOUR SITES IN CALIFORNIA

Victor Bjelajac
Failure Analysis Associates, Inc
149 Commonwealth Drive
Menlo Park, California 94025

Randy Wiberg
Holman and Associates
3615 Folsom St.
San Francisco, California 94110

and

Donald Boothby
Failure Analysis Associates, Inc.
149 Commonwealth Drive
Menlo Park, California 94025

ABSTRACT

Non-invasive geophysical survey was utilized as a remote sensing tool at two prehistoric and two historic sites in California. The sites were investigated with Ground Penetrating Radar (GPR) to identify anomalous signals (targets) which might correspond with subsurface archaeological features. Results of GPR testing at SOL-356 are presented in detail discussing depth of penetration, identification of targets, and the feasibility of future use of GPR technology in cultural resource studies.

INTRODUCTION

Ground Penetrating Radar (GPR) has been utilized by geologists and civil engineers for several decades: military personnel use GPR for underground tunnel detection; utility companies use it for subsurface tank and pipe locating; and GPR was utilized on the moon for lunar sounding experiments during Apollo 17. GPR depth penetration ranges from a few centimeters to hundreds of meters in electrically resistive materials such as dense granite or basalt.

Evidence from four sites in California indicates that GPR can be an effective archaeological tool. Surveys at both prehistoric and historic sites were undertaken to determine the feasibility of GPR survey as part of archaeological investigations. GPR was found to be effective at a range of sites with different remote sensing needs.

GEOPHYSICAL METHOD

The concept of GPR is based on the use of high frequency radar pulses to penetrate and reflect off subsurface materials. The downward attenuation of the pulse is dependent upon the electrical properties of subsurface materials. At the interface of electrically different materials, a

Proceedings of the Society for California Archaeology, 1995, Vol. 8, pp. 5-12.

small portion of the electrical pulse will be reflected back to the surface. Receivers located on the surface can intercept this reflected pulse and record the signal. Buried cultural materials, naturally-occurring ground water, and varying soil horizons can provide excellent reflecting interfaces for radar pulses in the subsurface environment. The recorded data, in profile form, allows for the non-invasive investigation of the subsurface.

EQUIPMENT

The surveys reported below utilized a Geophysical Survey Systems Inc.'s Subsurface Interface Radar 10 System (SIR-10). An array of antennas ranging from 100 MHz to 900 MHz were utilized. Best results for optimal profile data were achieved with a 300 MHz antenna at all sites investigated. It should be noted that higher frequency antennas deliver higher resolution profiles, though with less depth penetration, while lower frequency antennas produce lower resolution profiles but with greater depth penetration capability. During all surveys the GPR unit was powered by an ordinary vehicle battery. Generators can be utilized for remote areas where access by vehicle is not possible. A SIR-10 control unit using RADAN III software, equipped with digital tape recording capabilities, was used to acquire field data for further processing. The SIR-10 is equipped with a color monitor for viewing profiles in the field. All the antennas were equipped with handles and were dragged by hand over the ground surface. Antennas were attached to the SIR-10 control unit with one or more 30 meter cables.

FIELD INVESTIGATIONS
SUNOL VALLEY

The first site investigated using GPR survey was located in an agricultural area in Sunol Valley. The site was being investigated by an archaeological field school from San Francisco State University. This late period prehistoric/historic site was primarily located in a recently plowed field. The purpose of the survey was to determine if GPR would achieve sufficient depth penetration to assist with characterization of subsurface materials. Due to time limitations none of the anomalies identified on GPR profiles were excavated, but the survey did establish that GPR equipment could achieve penetration depths up to two meters; culverts buried 76 cm below ground surface were located and provided a means of depth calibration. GPR profile materials have been provided to the principal investigator and await further investigation.

PALACE OF THE LEGION OF HONOR

The Palace of the Legion of Honor (hereafter Palace) in San Francisco has been undergoing extensive renovation and seismic retrofitting. Holman and Associates, an archaeological consulting firm, is monitoring construction to identify and remove coffin burials from a historic pioneer cemetery (in use from 1878 to 1910) located under the Palace. Failure Analysis Associates, Inc. (FaAA) was invited to conduct a GPR survey of the Palace courtyard. The courtyard was excavated down to approximately 30 feet, which allowed excavation of anomalies identified by GPR. Twenty-seven transect lines ranging from 5 to 12 meters long were surveyed. Numerous anomalies and three distinct strata were identified. Depth of penetration was estimated to be approximately 30 feet, extending to bedrock. Over 500 historic burials have been recovered to date from various areas of the cemetery, with approximately 20 interments showing up on radar profiles as anomalies (see Figure 1 for example). This site has provided the first opportunity to identify anomalous radar signals in an archaeological context that were actually tested through excavation.

HISTORIC MARTINEZ CEMETERY

Our third test site is a historic cemetery in

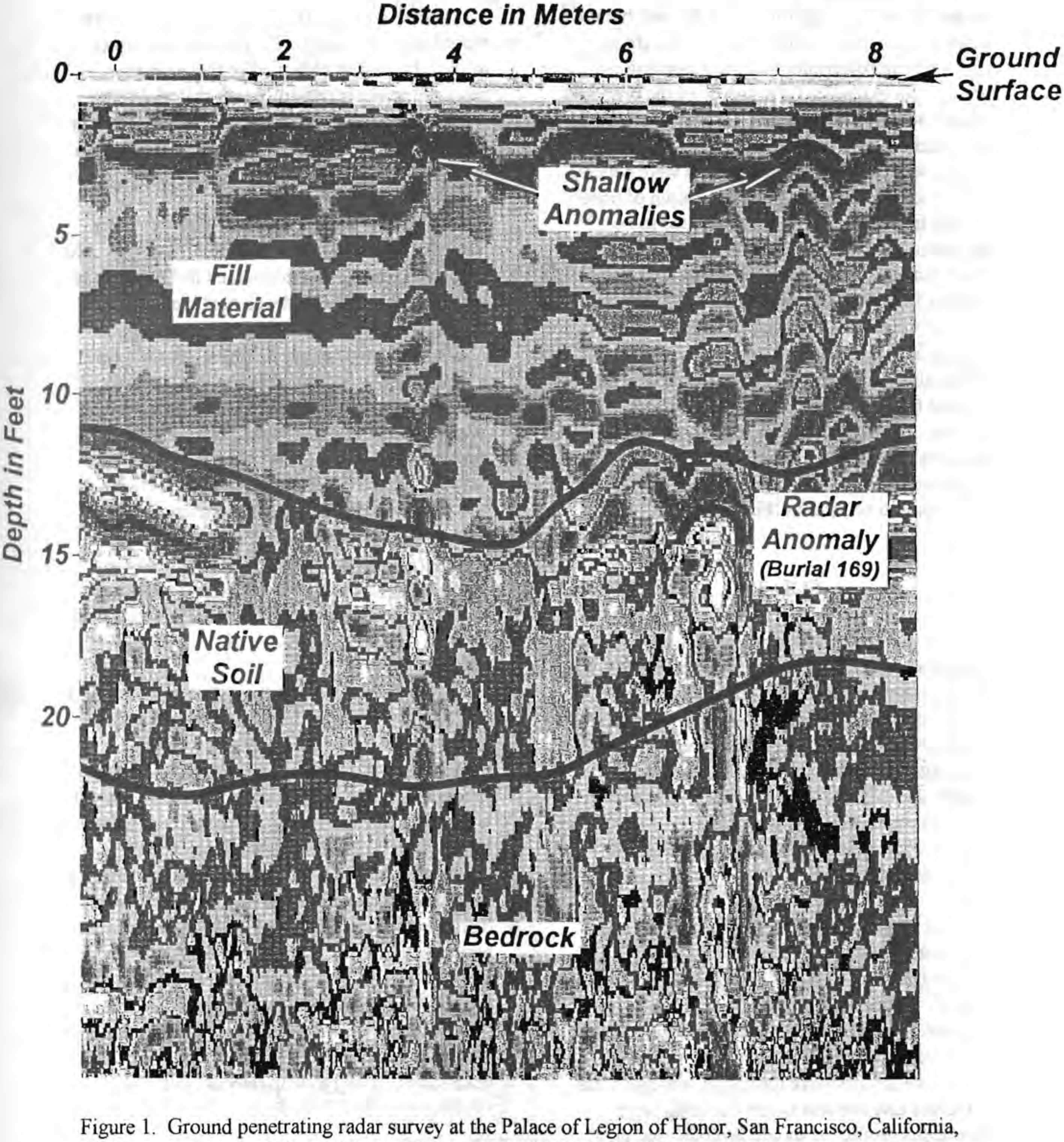

Figure 1. Ground penetrating radar survey at the Palace of Legion of Honor, San Francisco, California, May 1993. Profile number SFL-V115 showing burial 169.

Martinez, in service for approximately 131 years, which was undergoing landscape and other ground surface modifications. Records of some burial locations had been destroyed over the last hundred years and the owner of the cemetery sought to complete improvements without disturbing any graves. An extensive GPR survey of the proposed impact area was undertaken. GPR transect lines were laid out on a three-foot grid; approximately 4380 linear feet of GPR profile data were collected to plot subsurface anomalies. Depth of penetration, in silty clay soil, was estimated to be approximately six feet. Burials associated with grave markers were used to characterize GPR profiles for predictive purposes (see Figure 2). The GPR survey was quite successful in identifying graves in areas that were thought to be free of burials. A ferrous metal survey was also incorporated to identify any coffin material with iron content. No archaeological excavation was undertaken to test targets, but a map prepared subsequent to the GPR survey was used to direct renovation to avoid disturbing graves.

SOL-356

Our last case involves a late period prehistoric midden site in Green Valley, California. Potential development impacts to the site included scarification and keying in of structural fill. Holman and Associates contracted to evaluate the significance of the site under the California Environmental Quality Act (CEQA). FaAA was given the opportunity to conduct a GPR survey, in order to identify anomalies that might be investigated during field testing.

The survey consisted of eight transect lines 140 meters long; 1120 linear meters of GPR profile data were collected and plotted (Figure 3). Four GPR anomalies were chosen for investigation based on anomaly characteristics and sampling needs. Three GPR anomalies were investigated because they were located in strategic areas of the site and one was tested due to its large anomalous profile. It should be noted that great control must be taken when laying out transect lines for GPR surveys so field investigators can precisely locate and investigate potential targets.

Three 1x1 m units and one 1x2 m unit were placed over anomalies. Two of the units either missed the targets identified or the anomalies represented electrically different material composition from surrounding soils. One of the units revealed a large inverted mortar located in an ash lens.

The fourth anomaly investigated was most interesting in profile, covering an area of over five meters (Figure 4). Based on the GPR profile, the anomaly looked like and was predicted to be a compacted layer distinct from surrounding soils. The control unit investigating this anomaly was started as a 1x2 m, but was later expanded to include four additional 1x1 m units separated by 20 cm balks. The hard packed layer identified in the profile turned out to be a house floor, located between 60 and 70 cm below ground surface. A hearth, post holes and several artifacts including clam disk beads, an *Olivella* sp. spire-ground bead, a *Haliotis* sp. ornament/pendant, and a fragment of an obsidian serrated projectile point were recovered in association with the compacted layer.

It was determined from excavating these units that the feature was a probable pithouse structure with a diameter of approximately 5 m. The packed earth and gravel floor was slightly dish-shaped and rimmed with seven postholes, located around the periphery of the structure on a raised berm. Two discrete concentrations of ash, possible hearths or ovens, and a possible entrance were recorded, although no artifact caches were discovered. Testing exposed only portions of the housefloor, and excavation was terminated to preserve this unique and important structure. A layer of breathable outdoor synthetic fabric (Solarex/Molon) was placed over the floor and postholes were filled with plastic film containers prior to backfilling to help relocate this feature in the future.

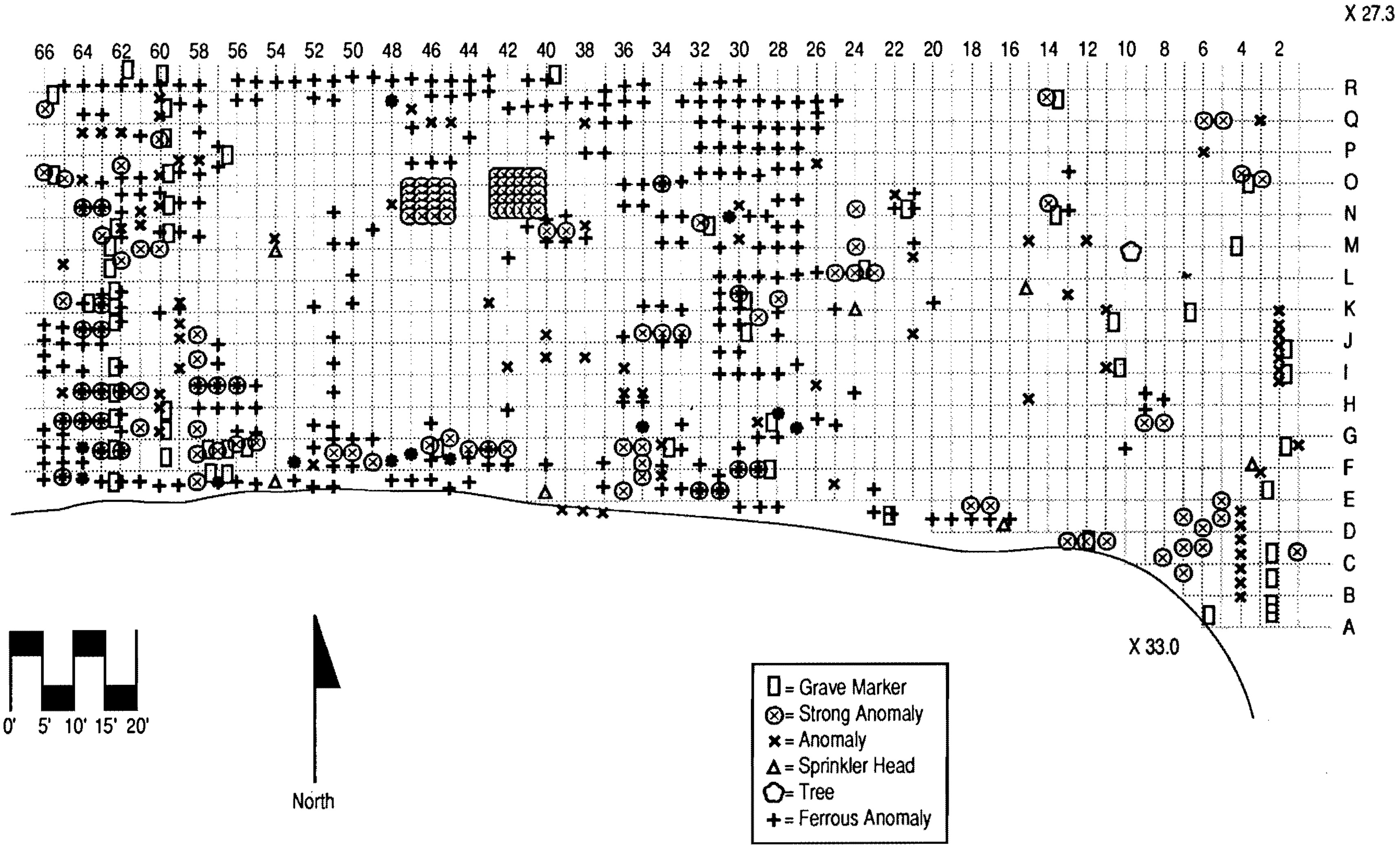

Figure 2. Martinez Cemetery, ground penetrating radar and ferrous metal survey, 11/165/93 and 12/13/93, Failure Analysis Associates, Inc.

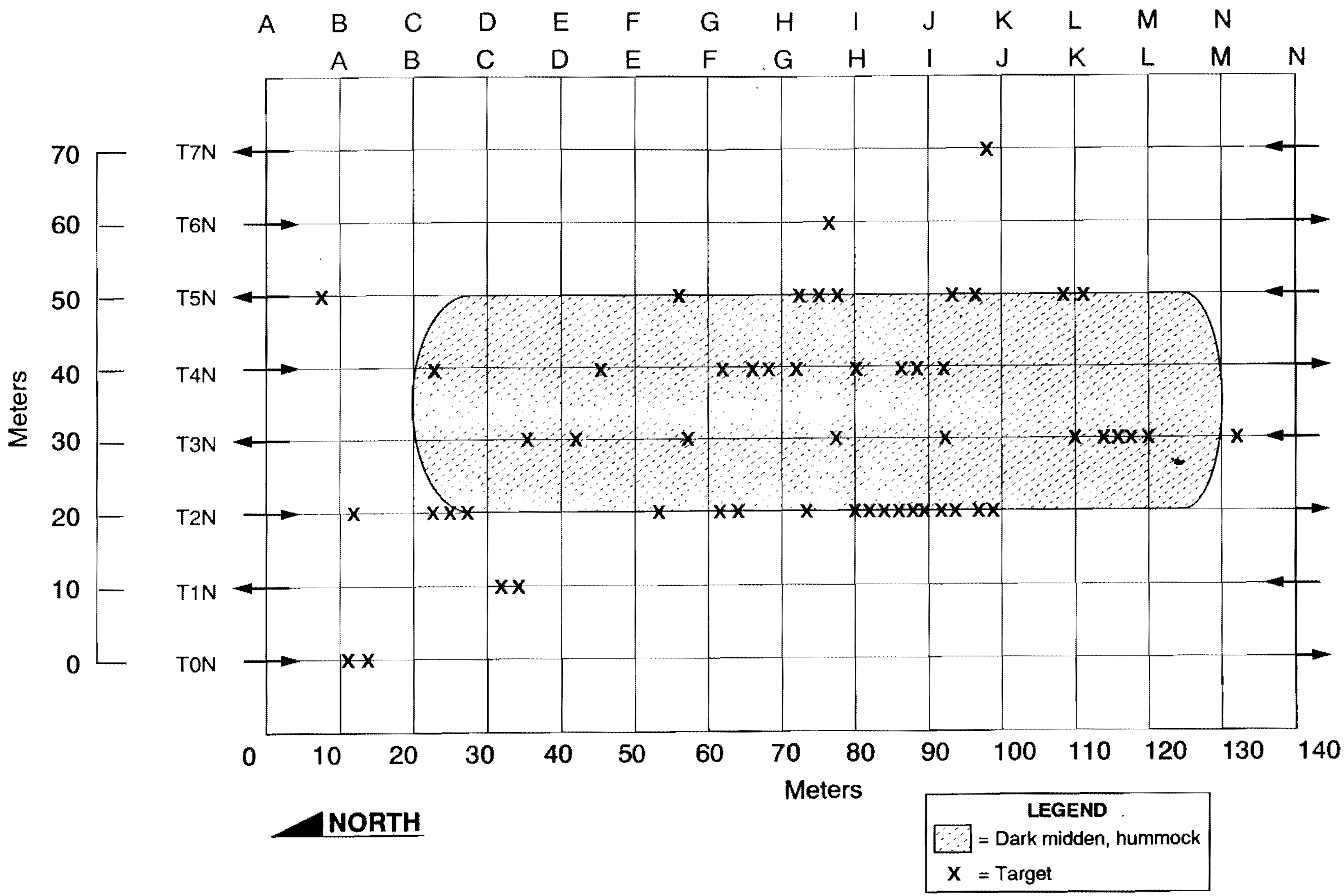

Figure 3. SOL-356, Green Valley Parcel, ground penetrating radar survey, June 24, 1993.
(Note: Penetration depth of GPR, approximately 2.5-3 meters; 300 Mhz antenna; target and midden locations approximate.)

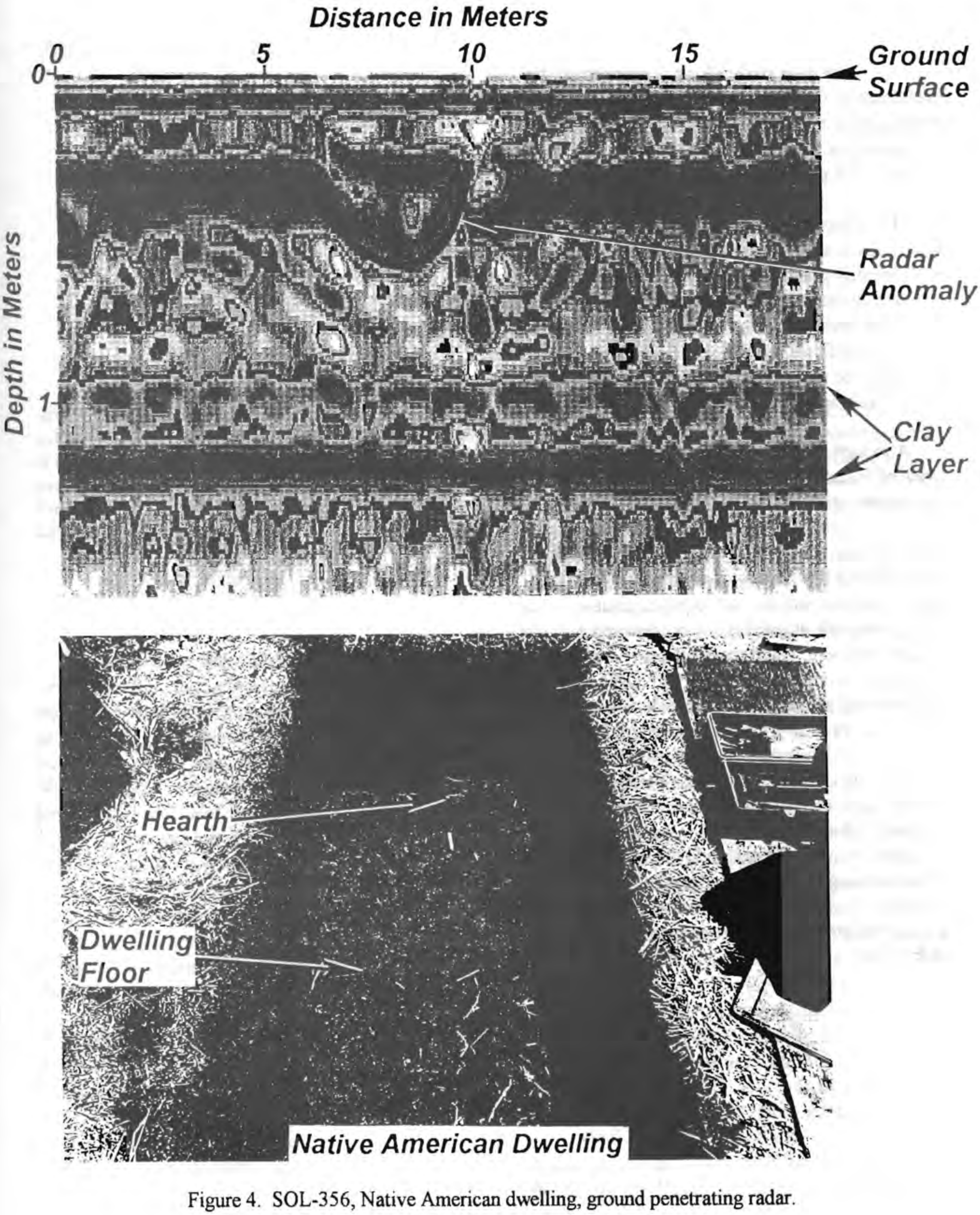

Figure 4. SOL-356, Native American dwelling, ground penetrating radar.

DISCUSSION

The above case studies have demonstrated the usefulness of GPR surveys for archaeologists and developers in a number of ways. By investigating archaeological sites during initial phases of investigation GPR profile data can:

- Characterize soil strata non-invasively
- Locate subsurface features non-invasively
- Identify potential materials or disturbed areas to be avoided
- Map anomalous signals that could represent significant features
- Be used in specific situations to predict and characterize specific features

Although data were acquired from various types of features/anomalies, the specific pattern of an anomaly is often hard to predict without background knowledge. For instance, at the Martinez cemetery where targets were known to be graves, the profiles differed from one another to such a degree that it would be hard to predict that a similar anomaly at another site represented a human interment. With these limitations in mind, we believe anomalies identified with GPR can be useful to archaeologists, using the data as a predictive survey tool when trying to determine areas of a site useful to test. Conversely, GPR data, coupled with other sampling considerations, can suggest areas to avoid due to lack of anomalies/ features. It has become a reality that sites cannot be (fully) excavated, nor should they, but it is in the archaeologist's interest to test those areas containing artifacts and features that contribute to a better understanding of the cultural resource under study.

Attachment 3 – Tending the Wild – Chumash Basket Weavers

Weaving Community: How Native Peoples are Rediscovering Their Basketry Traditions

This KCET episode is viewer-supported.
BECOME A MEMBER

CATEGORY: TRADITIONAL ECOLOGICAL KNOWLEDGE, BASKET WEAVING, BASKETRY

Basketry has been described as the pinnacle of Californian indigenous culture. But the craftsmanship necessary to make these works of art requires much more than weaving techniques. It requires a deep and sustained relationship with the environment. For centuries Native peoples tended the land and used a variety of methods to shape plants to suit their basketry needs, from pruning, weeding, and coppicing to the the cyclical use of controlled burning. Today, many of these techniques have been lost or suppressed and the ability to access traditional gathering locations has been impeded by urban development and the restrictions of private property. In this video, we explore how traditional gathering is practiced today and how Native peoples are rediscovering their basketry traditions in Southern California.

RELATED

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- Rediscovering Their Basketry Traditions
- Maintain Their Relationship With Salmon

Attachment 4 – Notice Letter Discussing Stormwater Concerns with a Generating Station

Wishtoyo VENTURA COASTKEEPER

Wishtoyo Foundation and its Ventura Coastkeeper Program
3875-A Telegraph Road #423
Ventura, California 93003
Phone: (805) 658-1120
Fax: (805) 258-5135

August 22, 2012

VIA CERTIFIED MAIL

GenOn Energy, Inc.
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn Americas, Inc.
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn Asset Management, LLC
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn California North, LLC
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn Energy Management, LLC
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn Energy Services, LLC
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn Power Generation Assets, LLC
Attn: Managing Agent
1000 Main Street, 21st Floor
Houston, TX 77002

GenOn West GP, LLC
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

GenOn West, LP
Attn: Managing Agent
1000 Main Street
Houston, TX 77002

VIA U.S. MAIL

Registered Agent for
GenOn Energy, Inc.
Corporation Service Company Which Will Do Business in California as CSC - Lawyers Incorporating Service
2710 Gateway Oaks Dr. STE 150N
Sacramento, CA 95833

Re: Notice of Violation and Intent to File Suit Under the Federal Water Pollution Control Act

To Whom It May Concern:

I am writing on behalf of Ventura Coastkeeper, a program of the Wishtoyo Foundation, and the Wishtoyo Foundation (collectively "Coastkeeper"), in regard to violations of the Clean Water Act[1] and the State of California's Storm Water Permit[2] occurring at the GenOn Ormond Beach Generating Station located at 6635 South Edison Drive, Oxnard, California 93033 (hereinafter "GenOn Facility" or the "Ormond Beach Generating Station"). The purpose of this letter is to put the Owners and/or Operators of GenOn[3] on notice of the procedural and substantive violations of the Storm Water Permit, including but not limited to the discharges of polluted storm water from the GenOn Facility into local waterways. These violations of the Storm Water Permit are violations of the Clean Water Act and the California Ocean Plan[4]. As explained below, the GenOn Facility Owners and/or Operators are liable for violations of the Storm Water Permit, the Clean Water Act, and the California Ocean Plan.

Section 505(b) of the Clean Water Act, 33 U.S.C. § 1365(b), requires that sixty (60) days prior to the initiation of a civil action under Section 505(a) of the Clean Water Act, 33 U.S.C. § 1365(a), a citizen must give notice of his/her intention to sue. Notice must be given to the alleged violator, the Administrator of the United States Environmental Protection Agency ("EPA"), the Regional Administrator of the EPA, the Executive Officer of the water pollution control agency in the State in which the violations occur, and, if the alleged violator is a corporation, the registered agent of the corporation. *See* 40 C.F.R. § 135.2. This letter is being sent to you as the responsible owners, officers, and/or operators of GenOn, or as the registered agent for these individuals and entities. By this letter, pursuant to 33 U.S.C. §§ 1365(a) and (b) of the Clean Water Act, we hereby put the GenOn Facility Owners and/or Operators on notice that after the expiration of sixty (60) days from the date of this letter, we intend to file an enforcement action in Federal court against them for violations of the Storm Water Permit, the Clean Water Act, and the California Ocean Plan.

I. Background

A. Ventura Coastkeeper and Wishtoyo Foundation

[1] Federal Water Pollution Control Act, 33 U.S.C. §§ 1251 *et seq.*
[2] National Pollution Discharge Elimination System ("NPDES") General Permit No. CAS000001 [State Water Resources Control Board] Water Quality Order No. 92-12-DWQ, as amended by Order No. 97-03-DWQ.
[3] The Owners and/or Operators of the GenOn Facility are identified in greater detail in Section I.B below and referred to hereinafter as the "GenOn Facility Owners and/or Operators."
[4] California Water Code §§ 13000 *et seq.;* State Water Resources Control Board, 2005 California Ocean Plan, Water Quality Control Plan for Ocean Waters of California, adopted by the State Water Resources Control Board on January 20, 2005 and April 21, 2005, approved by the Office of Administrative Law on October 12, 2005, and approved by the U. S. Environmental Protection Agency on February 14, 2006.

Founded in 1997, the Wishtoyo Foundation ("Wishtoyo") is a 501(c)(3) non-profit public benefit grassroots corporation organized under the laws of the State of California and located at 33904 Pacific Coast Highway, Malibu, CA 90265. Wishtoyo's mission is to preserve, protect and restore Chumash culture, the culture and history of coastal communities, cultural resources, and the environment. Wishtoyo has over 700 members consisting of Ventura County's diverse residents, Chumash Native Americans, and the general public who enjoy the recreational, spiritual, cultural, and aesthetic benefits of the Santa Clara River and Ventura County's coastal marine waters and environment.

Ventura Coastkeeper is a program of Wishtoyo. Ventura Coastkeeper's mission is to protect, preserve, and restore the ecological integrity and water quality of Ventura County's inland water bodies, coastal waters, and watersheds. Ventura Coastkeeper strives to maintain clean and ecologically healthy waters for all living beings in Ventura County through advocacy, education, restoration projects, community mobilizing, actively seeking Federal and State agency implementation of the Clean Water Act, and, when necessary, directly initiating enforcement actions on behalf of itself and its members. Ventura Coastkeeper is also a member of the Waterkeeper Alliance, a coalition of nearly 200 member programs on six continents around the world fighting for clean water and strong communities.

As a program of Wishtoyo Foundation, Ventura Coastkeeper also strives to protect, preserve, and restore the natural resources that the Chumash culture, and all cultures, depend upon. The Chumash Peoples, including members of Wishtoyo Foundation, have a long history of interaction with the Ormond Beach Wetlands, Mugu Lagoon, and Ventura's coastal waters, with the native wildlife that utilizes these waterbodies, and natural native cultural resources of these waterbodies, of which, the Chumash Peoples utilize for a variety of cultural purposes including religious and ceremonial ones.

As further explained below, the GenOn Facility discharges polluted storm water to Ormond Beach Wetlands, the Ormond Beach Wetlands Lagoon, Mugu Lagoon, the tributaries of these waterways, all of which flow to the Pacific Ocean. Members of Coastkeeper live near and/or use the waters receiving the polluted discharges from the GenOn to fish, boat, swim, bird watch, view wildlife, and to engage in scientific study and cultural activities. The discharge of pollutants from the GenOn Facility impairs these uses. Thus, the interests of Coastkeeper's members have been, are being, and will continue to be adversely affected by the failure of the GenOn Facility Owners and/or Operators to comply with the Storm Water Permit, the Clean Water Act, and the California Ocean Plan.

B. The GenOn Facility and its Owners and/or Operators

Information available to Coastkeeper indicates that the GenOn Ormond Beach Generating Station, is an approximately 38 acre[5] electricity plant located on the California Coast

[5] This is the size of the Facility reported in GenOn's June 11, 2012 Notice of Intent to comply with the terms of the General Permit to Discharge Stormwater Associated with Industrial Activity (WQ Order No. 97-03-DWQ) submitted to the State Water Resources Control Board. The size of the Facility reported in Reliant Energy's January

in the Ormond Beach Wetlands. The facility consists of two steam boiler electric generating units fueled by natural gas; of metal infrastructure associated with, supporting, surrounding, and rising above the electric generating units; of two tall emissions stacks; and of once-through cooling infrastructure that withdraws water from, and discharges once-through cooling water into, the Pacific Ocean. The GenOn Facility Owners and/or Operators obtained coverage under the Storm Water Permit by submitting a Notice of Intent ("NOI") to obtain Storm Water Permit coverage. This NOI lists GenOn's Standard Industrial Classification code of regulated activity ("SIC Code") as 4911 (Electrical Services).

Information available to Coastkeeper indicates that the GenOn Ormond Beach Generating Station, which is located at 6635 South Edison Drive, Oxnard, California 93033, is owned and/or operated by GenOn Energy, Inc.; GenOn Asset Management, LLC; GenOn Energy Management, LLC; GenOn Power Generation Assets, LLC; GenOn West, LP; GenOn Americas, Inc.; GenOn California North, LLC; GenOn Energy Services, LLC; GenOn West GP, LLC (hereinafter collectively referred to as "GenOn Facility Owners and/or Operators" or "GenOn Energy, Inc."). Information available to Coastkeeper indicates that the registered agent for service of process for GenOn Energy, Inc. and the GenOn Facility Owners and/or Operators is Corporation Service Company Which Will Do Business in California as CSC - Lawyers Incorporating Service located at 2710 Gateway Oaks Dr. STE 150N Sacramento, CA 95833.

The GenOn Facility Owners and/or Operators have discharged and continue to discharge pollutants unlawfully from the GenOn Facility into local waterbodies and groundwater. As explained below, the GenOn Owners and/or Operators are liable for violations of the Storm Water Permit, the Clean Water Act, and the California Ocean Plan.

C. Storm Water Pollution, the Ormond Beach Wetlands, Mugu Lagoon, and the Pacific Ocean

With every significant rainfall event, millions of gallons of polluted rainwater, originating from industrial operations such as the GenOn Ormond Beach Generating Station Facility, pour into Ventura County storm drains and surface waters, and then into the Pacific Ocean. The consensus among agencies and water quality specialists is that storm water pollution accounts for more than half of the total pollution entering the marine, river, estuarine, and wetland environments each year. This discharge of pollutants from industrial facilities in storm water contributes to the impairment of downstream waters and aquatic dependent wildlife, including birds and fish.

Ormond Beach Wetlands

Ormond Beach is a 1,500-acre area composed of agriculture, industry, and wetlands, and the Chumash Native American villages of Wenemu, Kanaputeqnon, and Kasunalmu. A two-mile-long beach, sand dune, and wetlands ecosystem ("Ormond Beach Wetlands Ecosystem")

2002 Notice of Intent obtain Storm Water Permit coverage submitted to the State Water Resources Control Board was 35 acres.

extends from Port Hueneme, through Oxnard and the Ormond Beach Lagoon, to the northwestern boundary of Pt. Mugu Naval Air Station, which encompasses Mugu Lagoon. Although much of the wetlands have been drained, filled and degraded over the past century, the Ormond Beach Wetlands are one of the few areas in southern California with an intact dune-transition zone–marsh system. The Ormond Beach Wetlands ecosystem hosts over 200 migratory bird species and more shorebird species are known to use Ormond Beach wetlands than any other site in Ventura County. In addition, the Ormond Beach Wetlands are home to 8 federal and state listed endangered and threatened species under the Federal Endangered Species Act ("ESA") and California Endangered Species Act ("CESA") [6] including the Tidewater Goby, Western Snowy Plover, California Least Tern, California Brown Pelican, American Peregrine Falcon, Light-footed Clapper Rail, Least Bell's Vireo, and Belding's Savannah; 16 state and federal species of special concern[7]; ospreys; kites; great blue herons; egrets; kestrels; sandpipers; white tundra swans that stop by on their way south from Alaska; and 40 state and federal special status plant species[8].

It is estimated that the wetlands at Ormond Beach once covered approximately 1,100 acres. Today, approximately 250 acres remain, but are degraded in large part from contaminated industrial, municipal, and agricultural storm water runoff and dry weather irrigation discharges; from compaction due to human use and dumping; from metals and radioactive constituents from the U.S. EPA Halaco Superfund Site adjacent to the Ormond Beach Lagoon; and from hypersalinity due to lack of flushing. For instance, a 2008 U.S. EPA technical analysis of the extent and movement of contamination of the contaminants from the Halaco U.S. EPA Region 9 Superfund site[9] indicates that the Halaco site is leaching elevated levels of iron into the Ormond Beach Wetlands surface and groundwater. In addition, a 2006 Ormond Beach Wetlands Restoration Study[10] found that the surface waters of the Ormond Beach Wetlands northwest of the GenOn Facility are impaired for iron, and presence of high levels of iron in the surface waters of the Western Arm of Mugu Lagoon in Oxnard Drain #3 at Arnold Road.

Ormond Beach is considered by wetland experts to be the most important wetland restoration opportunity in southern California. Unlike other coastal wetland restoration projects in southern California, there is room to restore the approximate extent of historic wetlands, provide surrounding upland habitat to complete the ecosystem and accommodate sea level rise. The biological significance of this area has been recognized, and its restoration potential

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[6] Federal Endangered Species Act, 7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.; California Endangered Species Act, California Fish & Game Code §§2050, *et seq.*
[7] *Id*.
[8] Special-status species are plants and animals that are legally protected under the federal Endangered Species Act, California Endangered Species Act, or other state regulations, and species that are considered sufficiently rare by the scientific community to warrant conservation concern.
[9] Technical Memorandum: Preliminary Evaluation of the Sources, Nature, Extent, and Movement of Contamination in Surface Water and Groundwater; Halaco Site; Oxnard, California; Prepared for U.S. Environmental Protection Agency Region 9, 75 Hawthorne Street, San Francisco, California 94105; Prepared by CH2M HILL (December 2008).
[10] Aspen Environmental Group, Final Report Ormond Beach Wetland Restoration, General Site-Wide Investigation for Soil Reuse Options (November 2006).

endorsed by all of the federal and state resource agencies that participate in the Southern California Wetlands Recovery Project.

The Oxnard and Port Hueneme communities, many public interest local non profit organizations, and state entities have devoted considerable resources to protect and restore the Ormond Beach Wetlands. The Nature Conservancy and California Coastal Conservancy respectively, with the unanimous support of the County of Ventura and the City of Oxnard, have acquired significant Ormond Beach Wetlands parcels for conservation and restoration, and are pursuing acquisitions at Ormond Beach with a goal of acquiring at least 900 acres at Ormond Beach to accommodate wetland and other habitat needs. In addition, the local communities surrounding the Ormond Beach wetlands and numerous local grass root non profit groups have devoted substantial resources and energy to conduct significant Ormond Beach Wetlands restoration projects and to advocate for their protection and restoration. Wishtoyo Foundation and its Ventura Coastkeeper Program have, and continue to, help with the Ormond Beach restoration effort. In 2003, Wishtoyo conducted a major Phase I and Phase II Ormond Beach Wetlands Clean Up Project in partnership with Oxnard City Corps that resulted in the removal of invasive ice plant and debris such as rusted automobiles, unused piping, and other large, decayed sharp and toxic metal objects that littered the wetlands for decades; conducted a Ormond Beach Cultural Resources Study for the California Coastal Conservancy's Wetlands Restoration Feasibility Plan; have held numerous Ormond Beach Wetlands and J. Street Drain trash clean up events; have conducted water quality monitoring in the Ormond Beach Wetlands and its tributaries for the last three years; have submitted its Watershed Monitoring Program's data to the State Water Resources Control Board that document that the Wetlands are impaired for nitrate, pH, trash, and E. Coli and that accordingly support 2012 Clean Water Act 303(d) impaired waterbody listings for these constituents; and have actively advocated at local, state, and federal levels for the protection and restoration of the Ormond Beach Wetlands.

A critical mass of restored wetlands and associated habitat at Ormond Beach is expected to create a self-sustaining biological system and enough tidal prism and flushing action to maintain health and hydrologic function. Anticipated restoration at Ormond Beach would include expansion of the wetlands to mirror their historic extent; pollutant free wetlands that do not harm or pose threats to humans and aquatic, benthic, plant and avian wildlife; and modifications of wetlands hydrology to restore tidal action and bring back freshwater flows that had formerly drained across the Oxnard Plain to the coastal wetlands. When integrated with the adjoining 900 acres of freshwater wetlands and the 1,500 acres at Mugu Lagoon, the Ormond Beach Wetlands could be the largest coastal wetland in southern California, spanning nine miles of the coast from Point Hueneme to Point Mugu.

Mugu Lagoon

The portion of Mugu Lagoon, from Laguna Point east to Point Mugu, is part of the Mugu-Latigo Area of Special Biological Significance ("ASBS") as designated by the State of

California for special ecological protections[11]. The Mugu-Latigo ASBS is the largest of the mainland ASBS in Southern California, with 24 miles of coastline and 11,842 acres of marine habitat. Mugu Lagoon and its wetlands, home to the Chumash Native American Village of Muwu, is largely contained within the Mugu-Latigo ASBS. Mugu Lagoon is one of the key coastal wetlands in the state, supporting over 60,000 shorebirds each spring, up to 10,000 shorebirds in the winter, thousands of ducks during duck migration season and the winter, and 18 species of fish. It is an integral component of the Pacific Flyway, and over 205 avian species have been reported in the Lagoon, including five avian species listed under the Federal Endangered Species Act. One of the world's largest populations of Belding's Savannah Sparrow is found in Mugu Lagoon. Mugu Lagoon is also home to the farthest-north remaining population of Light-footed Clapper Rail. In addition, Peregrine Falcon have been observed at Mugu Lagoon, and Mugu Lagoon supports the largest remaining natural Brown Pelican roosting area in southwestern California.

The GenOn Facility, the Ormond Beach Wetlands, and Mugu Lagoon

The GenOn Facility is located on Edison Drive, abutting the Ormond Beach Wetlands, Mugu Lagoon, and the Pacific Ocean. Polluted storm water discharges from the GenOn Facility to: the Pacific Ocean; portions of the Ormond Beach Wetlands that convey water to the Ormond Beach Wetlands Lagoon; portions of the Ormond Beach Wetlands that convey water to Oxnard Drain #3, which is the western most arm of Mugu Lagoon; and to the western most arm of Mugu Lagoon/Oxnard Drain #3 and the Ormond Beach Wetlands via the local storm sewer system on Edison Drive.

Polluted storm water discharges from industrial facilities like the GenOn Facility contribute to the impairment of downstream surface waters, and aquatic dependent wildlife. A water body is impaired if it is unable to support its beneficial uses. The California Regional Water Quality Control Board, Los Angeles Region ("Regional Board") has issued its Water Quality Control Plan for the Los Angeles Region ("Basin Plan"), which lists the beneficial uses for waters in the Santa Clara River Watershed ("Beneficial Uses"). The Beneficial Uses for the waters that receive polluted storm water discharges from the GenOn Facility include: water contact recreation (REC-1), non-contact water recreation (REC-2), navigation (NAV), commercial and sport fishing (COMM), estuarine habitat (EST), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), migration of aquatic organisms (MIGR) and spawning, reproduction and development (SPWN), marine habitat (MAR), Wetland Habitat (WET), Rare, Threatened, or Endangered Species (RARE), Shellfish Harvesting (SHELL), and Preservation of Biological Habitats (BIOL) such as Areas of Special Biological

[11] The California State Water Resources Control Board ("SWRCB"), under its Resolution No. 74-28, designated certain ASBS in the adoption of water quality control plans for the control of wastes discharged to ocean waters. The ASBS are intended to afford special protection to marine life through prohibition of waste discharges within these areas. The concept of "special biological significance" recognizes that certain biological communities, because of their value or fragility, deserve very special protection that consists of preservation and maintenance of natural water quality conditions to practicable extents (from SWRCB's and California Regional Water Quality Control Boards' Administrative Procedures, September 24, 1970, Section XI. Miscellaneous--Revision 7, September 1, 1972).

Significance (ASBS). *See* Basin Plan, pp. 2-1 - 2-5. Polluted storm water discharges from the GenOn Facility cause and/or contribute to the impairment of water quality in the Ormond Beach Wetlands, the Ormond Beach Lagoon, Mugu Lagoon, and the Pacific Ocean; are toxic to aquatic life in these waterbodies and to resident and migratory birds that utilize these waterbodies; and adversely affect the environment. For example, Mugu Lagoon (Calleguas Creek Reach 1) and Oxnard Drain #3, which is the western most arm of Mugu Lagoon, are listed as impaired for sediment toxicity[12], and the Ormond Beach Lagoon and Wetlands adjacent to the Facility are contaminated with iron and other metals.

For the Ormond Beach Wetlands, the Ormond Beach Wetlands Lagoon, Mugu Lagoon, and Ventura's Coastal Waters to regain their health, for the Ormond Beach Wetlands and Mugu restoration and protection efforts to succeed, and for these waterbodies threatened, endangered, migratory, and resident species, to recover and thrive, illegal contaminated storm water discharges must be eliminated.

II. The GenOn Facility and Associated Discharges of Pollutants

Information available to Coastkeeper, including the Storm Water Pollution Prevention Plan ("SWPPP") for the industrial activities occurring at the GenOn Facility, as well as the NOI, indicate that the following industrial operations are conducted at the GenOn Facility: electricity generation; maintenance and operation of electricity generating units including, but not limited to the Facility's two steam boiler electric generating units fueled by natural gas, the Facility's power block structures, the Facility's two tall emissions stacks, the Facility's once-through cooling infrastructure, the Facility's transformers, and the Facility's metal infrastructure associated with, part of, supporting, surrounding, and rising above the electric generating units, emissions stacks, and other infrastructure; the Facility's scrap yard; the Facility's maintenance areas; the Facility's vehicle and equipment maintenance; paint removal; construction activities; regeneration of in-line polishers resins; corrosion inhibition; and vehicular, equipment, and machinery traffic within the Facility. The GenOn Facility also stores hazardous waste such as waste oil, coolant, ammonium hydroxide, sodium nitrite, sodium hypochlorite, sulfuric acid, waste gasoline and diesel.

Review of the Facility's SWPPP and visual observations conducted by Coastkeeper indicate that Facility's industrial operations are conducted outdoors without adequate cover from precipitation. The exposure of pollutants associated with these industrial activities to precipitation combined with the Facility's failure to adequately treat its storm water discharges, results in storm water carrying away pollutants generated from the Facility's industrial operations as storm water flows into the Ormond Beach Wetlands, Ormond Beach Wetlands Lagoon, Mugu Lagoon, and the Pacific Ocean from the GenOn Facility.

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[12] *See* Los Angeles Region Integrated Report Clean Water Act Section 305(b) Report and Section 303(d) List of Impaired Waters, Appendix F, "2008 Clean Water Act 303(d) List of Water Quality Limited Sections," available at http://www.waterboards.ca.gov/losangeles/water_issues/programs/303d/2008_integrated_report_303%28d%29_list.shtml (last visited 18 August 2012).

Information available to Coastkeeper also indicates that oil and grease, metal particles, and other pollutants have been and continue to be tracked throughout the GenOn Facility operations area. These pollutants accumulate at the storm water discharge points, the parking lot, and the driveway leading onto South Edison Drive. As a result, sediment, dirt, oil and grease, metal particles and other pollutants are tracked off-site by trucks and vehicles leaving the GenOn Facility via staging areas and driveways.

Sources of pollutants associated with the industrial activities at the GenOn Facility include, but are not limited to electricity generation; maintenance and operation of electricity generating units including, but not limited to the Facility's two steam boiler electric generating units fueled by natural gas, the Facility's two tall emissions stacks, the Facility's power block structures, the Facility's once-through cooling infrastructure, the Facility's transformers, and the Facility's metal infrastructure associated with, part of, supporting, surrounding, and rising above the electric generating units, emissions stacks, and other infrastructure; the Facility's scrap yard; the Facility's maintenance areas; the Facility's vehicle and equipment maintenance; paint removal; construction activities; regeneration of in-line polishers resins; corrosion inhibition; and vehicular, equipment, and machinery traffic within the Facility; parking areas; shipping and receiving areas; loading and unloading areas; driveway areas; maintenance areas; the office building; and on-site material handling equipment such as forklifts, and trucks. The pollutants associated with operations at Auto Dismantlers include, but are not limited to: heavy metals such as iron; oil and grease; fuel and fuel additives; total suspended solids ("TSS"); coolant; pH-affecting substances; toxic substances associated with the Facility's operations such as ammonium hydroxide, sodium nitrite, sodium hypochlorite, sulfuric acid; and fugitive and other dust, dirt, and debris.

As identified in the Facility's SWPPP site map, there are at least five storm water discharge points from the GenOn Facility into the Ormond Beach Wetlands, the Pacific Ocean, and Oxnard Drain # 3, which is the western branch of Mugu Lagoon: D-1 (Water going out the back gate); D2-D4 (Vault east of the north basin); D5-D12 (Vault north of the maintenance shop); D13 (Vault west of the scrap yard); D14 (Vault east of the G.E. building).

Visual observations, satellite and overhead imagery, the Facilty's SWPPP, and the Facility's own monitoring results indicates that the GenOn Facility Owners and/or Operators have not properly developed and/or implemented best management practices ("BMPs") at the GenOn Facility sufficient to prevent the exposure of pollutants to storm water and the subsequent discharge of polluted storm water from the GenOn Facility during rainstorm events. Consequently, during rain events, storm water carries pollutants from the GenOn Facility's industrial operations areas; industrial infrastructure; retention basins; ground; floors; equipment; scrap areas; shipping and receiving areas; and other sources into the Ormond Beach Wetlands, the Ormond Beach Wetlands Lagoon, the Western Arm of Mugu Lagoon/Oxnard Drain #3; the main body and other arms of Mugu Lagoon, the local storm sewer system on Edison Drive which flows into the Western Arm of Mugu Lagoon/Oxnard Drain #3, and into the Pacific Ocean. These illegal discharges negatively impact the Ormond Beach Wetlands, the Ormond Beach Wetlands Lagoon, Mugu Lagoon, the Western Arm of Mugu Lagoon/Oxnard Drain #3, the Pacific Ocean, Ormond Beach, and Coastkeeper's members' use and enjoyment of these waters and Ormond Beach.

Failure to comply with the Storm Water Permit, and the resulting discharges of pollutants from the GenOn Facility, are violations of the Storm Water Permit, the Clean Water Act, and the California Ocean Plan. Besides violating the law, these failures have resulted in and continue to contribute to the degradation of the ecological, cultural, municipal, domestic, and recreational resources of the Ormond Beach Wetlands, the Ormond Beach Wetlands Lagoon, Mugu Lagoon, the western arm of Mugu Lagoon/Oxnard Drain #3, the Pacific Ocean, and Ormond Beach.

III. Violations of the Clean Water Act, the Storm Water Permit, and the California Ocean Plan

In California, any person who discharges storm water associated with industrial activity must comply with the terms of the Storm Water Permit in order to lawfully discharge pollutants. *See* 33 U.S.C. §§ 1311(a), 1342; 40 C.F.R. § 126(c)(1); Storm Water Permit, Fact Sheet p. VII.

In addition, in furtherance of the California Water Code, to protect California's coastal waters, the State Board created the California Ocean Plan (amended in 1978, 1983, 1988, 1990, 1997, 2001, 2005, 2009, and 2012)[13] to control the discharge of waste to ocean waters. Beneficial Uses of the ocean waters include water contact and non-contact recreation, commercial and sport fishing, marine habitat, and preservation and enhancement of designated Areas of Special Biological Significance ("ASBS"), to name a few. The limitations set forth in the Ocean Plan, including its ASBS discharge prohibitions and combination of numeric and narrative water quality standards for bacterial, physical, chemical, and biological characteristics, are intended to protect the designated beneficial uses. Any person who discharges storm water or non storm water to an Ocean Plan Designated ASBS in violation of the Ocean Plan, is in violation of the California Water Code.

A. Discharges of Storm Water from the GenOn Facility in Violation of Effluent Limitation B(3) of the Storm Water Permit, and the Clean Water Act

Effluent Limitation (B)(3) of the Storm Water Permit requires dischargers to reduce or prevent pollutants associated with industrial activity in storm water discharges through implementation of BMPs that achieve BAT for toxic pollutants[14] and BCT for conventional pollutants.[15] EPA Benchmarks are relevant and objective standards to evaluate whether a

[13] California Water Code §§ 13000 *et seq.;* State Water Resources Control Board, 2005 California Ocean Plan, Water Quality Control Plan for Ocean Waters of California.
[14] Toxic pollutants are listed at 40 C.F.R. § 401.15 and include iron, copper, lead, and zinc, among others.
[15] Conventional pollutants are listed at 40 C.F.R. § 401.16 and include biological oxygen demand, total suspended solids, oil and grease, pH, and fecal coliform.

permittee's BMPs achieve compliance with BAT/BCT standards as required by Effluent Limitation B(3) of the Storm Water Permit. [16]

As reported in the GenOn Facility's Annual Reports and attached in Table 1, storm water samples taken by the GenOn Facility Owners and/or Operators from the 2007 -2008 rainy season through the 2011-2012 rainy season contained iron and TSS in excess of the EPA Benchmark concentrations. Exceedances of EPA Benchmarks demonstrate that the GenOn Facility Owners and/or Operators have not implemented BMPs at the GenOn Facility that achieve compliance with the BAT/BCT standards. Coastkeeper's visual observations and photographic evidence further confirms that the GenOn Facility Owners and/or Operators have failed and continues to fail to develop and/or implement BMPs to prevent the exposure of pollutants to storm water and to prevent the discharge of polluted storm water from the GenOn Facility in violation of Effluent Limitation B(3) of the Storm Water Permit. Information available to Coastkeeper indicates that the storm water discharges from the GenOn Facility violate Effluent Limitation B(3) of the Storm Water Permit during each significant rain event, dates of which are identified in Exhibit A attached hereto.[17] These discharge violations are ongoing and Coastkeeper will update the number and dates of violations when additional information and data becomes available.

Every day storm water is discharged or continues to discharge from the GenOn Facility in violation of Effluent Limitation (B)(3) of the Storm Water Permit is a separate and distinct violation of the Storm Water Permit and Section 301(a) of the Clean Water Act, 33 U.S.C. §1311(a). These violations are ongoing, and will continue each day contaminated storm water is discharged from the GenOn Facility in violation of Effluent Limitation (B)(3).

B. Discharges of Contaminated Storm Water from GenOn Facility in Violation of Receiving Water Limitations C(1) and C(2) of the Storm Water Permit, and the Clean Water Act

Receiving Water Limitation C(1) of the Storm Water Permit prohibits storm water discharges and authorized non-storm water discharges to surface water or groundwater that adversely impact human health or the environment. The GenOn Facility's storm water discharges contain elevated concentrations of iron in amounts that may cause: acute and chronic toxicity to aquatic life and aquatic plants; change in the diversity and abundance of aquatic life; change in aquatic community structure and function; impacts to metabolism and osmoregulation of aquatic life; change in the structure and quality on benthic invertebrate habitat and food resources leading to decline in benthic invertebrate populations and diversity; and increases in aquatic organisms dietary supply of metals that can result in toxicity effects that ripple through an ecosystem's food chain. These impacts from the GenOn Facility's discharges of iron not only can impact aquatic, avian, and terrestrial life of the Ormond Beach Wetlands, Mugu Lagoon, the western branch of Mugu Lagoon/ Oxnard Drain #3, the Ormond Beach Lagoon, and the Pacific Ocean, but the humans that catch and or eat fish from theses waterbodies.

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[16] *See* Multi-Sector Permit (2008), Fact Sheet, p. 106; *see also*, Storm Multi-Sector Permit, 65 Federal Register 64839 (2000).

[17] A significant rain event is an event that produces storm water runoff, which according to the United States Environmental Protection Agency occurs with more than 0.1 inches of precipitation.

For example, samples of storm water discharged from the GenOn Facility from December 2007 through the 2012 rainy season, taken by the GenOn Facility Owners and/or Operators and as reported in the Facility's Annual Reports, have continuously contained iron at concentrations from 1.1 milligrams per liter to 18 milligrams per liter, in exceedance of the U.S. Environmental Protection Agency National Recommended Water Quality Criteria for Freshwater Aquatic Life Protection of 1 mg/L. Discharges that contain pollutants in concentrations that exceed levels known to adversely impact aquatic species and the environment constitute violations of Receiving Water Limitation C(1) of the Storm Water Permit and the Clean Water Act.

Receiving Water Limitation C(2) of the Storm Water Permit prohibits storm water discharges and authorized non-storm water discharges that cause or contribute to an exceedance of an applicable water quality standard.[18] Samples of storm water discharged from the GenOn Facility, taken by the GenOn Facility Owners and/or Operators and as reported in the Facility's Annual Reports, have demonstrated exceedance of the Basin Plan's water quality standards for pH (see Table 2 attached to this letter). Discharges that contain pollutants in excess of an applicable water quality standard violate Receiving Water Limitation C(2) of the Storm Water Permit and the Clean Water Act.

Information available to Coastkeeper indicates that the storm water discharges from the GenOn Facility to surface waters and groundwater contain pollutants that adversely impact human health or the environment and/or cause or contribute to a violation of an applicable water quality standards in violation of Receiving Water Limitations (C)(1) and C(2), respectively. Information available to Coastkeeper indicates that the storm water discharges from the GenOn Facility violate these Receiving Water Limitations during each significant rain event, dates of which are identified in Exhibit A. These discharge violations are ongoing and Coastkeeper will update the number and dates of violation when additional information and data becomes available.

Every day discharges of storm water from the GenOn Facility adversely impact human health or the environment or cause or contribute to a violation of applicable water quality standards is a separate and distinct violation of the Storm Water Permit and Section 301(a) of the Clean Water Act, 33 U.S.C. §1311(a). These violations are ongoing, and will continue each day contaminated storm water is discharged to surface water or groundwater in violation of the Receiving Water Limitations of the Storm Water Permit.

C. Failure to Develop, Implement, and/or Revise an Adequate Storm Water Pollution Prevention Plan

[18] Water Quality Standards are pollutant concentration levels determined by the State Water Resources Control Board and the EPA to be protective of the Beneficial Uses of the receiving waters. Discharges above Water Quality Standards contribute to the impairment of the receiving waters' Beneficial Uses. Applicable Water Quality Standards include, among others, the Criteria for Priority Toxic Pollutants in the State of California, 40 C.F.R. § 131.38 ("CTR"), the California Ocean Plan, and the Los Angeles Regional Board's Water Quality Control Plan for the Los Angeles Region ("Basin Plan").

Section A(1) and Provision E(2) of the Storm Water Permit requires dischargers to have developed and implemented a SWPPP by 1 October 1992, or prior to beginning industrial activities, that meets all of the requirements of the Storm Water Permit. The objective behind the SWPPP requirements is to identify and evaluate sources of pollutants associated with industrial activities that may affect the quality of storm water discharges from the GenOn Facility, and to implement site-specific BMPs to reduce or prevent pollutants associated with industrial activities in storm water discharges. Storm Water Permit, Section A(2). To ensure its effectiveness, the SWPPP must be evaluated on an annual basis pursuant to the requirements of Section A(9), and must be revised as necessary to ensure compliance with the Storm Water Permit. *Id.*, Sections A(9), (10).

Sections A(3) – A(10) of the Storm Water Permit set forth the requirements for a SWPPP. Among other things, the SWPPP must include: a site map showing the facility boundaries, storm water drainage areas with flow patterns, nearby water bodies, the location of the storm water collection, conveyance and discharge system, structural control measures, areas of actual and potential pollutant contact, and areas of industrial activity (*see* Section A(4)); a list of significant materials handled and stored at the site (*see* Section A(5)); and, a description of potential pollutant sources including industrial processes, material handling and storage areas, dust and particulate generating activities, a description of significant spills and leaks, a list of all non-storm water discharges and their sources and a description of locations where soil erosion may occur, (*see* Section A(6)). Sections A(7) and (8) require an assessment of potential pollutant sources at the facility and a description of the BMPs to be implemented at the facility that will reduce or prevent pollutants in storm water discharges and authorized non-storm water discharges, including structural BMPs where non-structural BMPs are not effective.

Information available to Coastkeeper demonstrates that the GenOn Facility Owners and/or Operators have not developed and/or implemented a SWPPP that meets the requirements of the Storm Water Permit, in violation of Section A and Provision E(2) of the Storm Water Permit. For example, the GenOn Facility Owners and/or Operators have failed and continue to fail to develop and/or implement adequate BMPs to prevent the exposure and subsequent discharge of pollutants from GenOn Facility at levels that achieve EPA Benchmarks. In addition, the SWPPP site map for the GenOn Facility does not identify all locations where storm water discharges, or the location of storm drain inlets and nearby surface waters that receive discharges from the GenOn Facility, in violation of Section A(4) of the Storm Water Permit. Further, despite continuing violations of the Storm Water Permit, information available to Coastkeeper indicates that the GenOn Facility Owners and/or Operators have not revised the SWPPP as necessary to ensure compliance with the Storm Water Permit, in violation of Sections A(9) and (10) of the Storm Water Permit.

Every day the GenOn Facility operates with an inadequately developed, implemented, and/or properly revised SWPPP is a separate and distinct violation of the Storm Water Permit and the Clean Water Act. The GenOn Facility Owners and/or Operators have been in daily and continuous violation of the Storm Water Permit's SWPPP requirements every day since at least

August 22, 2007. These violations are ongoing, and Coastkeeper will include additional violations when information becomes available.

D. Failure to Develop, Implement, and/or Revise an Adequate Monitoring and Reporting Program

Section B(1) and Provision E(3) of the Storm Water Permit require facility operators to develop and implement an adequate Monitoring and Reporting Program ("MRP") by October 1, 1992, or prior to the commencement of industrial activities, that meets all of the requirements of the Storm Water Permit. The primary objective of the MRP is to detect and measure the concentrations of pollutants in a facility's discharge to ensure compliance with the Storm Water Permit's Discharge Prohibitions, Effluent Limitations, and Receiving Water Limitations. *See* Storm Water Permit, Section B(2). The MRP must therefore ensure that BMPs are effectively reducing and/or eliminating pollutants at the facility, and are evaluated and revised whenever appropriate to ensure compliance with the Storm Water Permit. *Id*.

Sections B(3) through B(16) of the Storm Water Permit set forth the MRP requirements. Specifically, Section B(3) requires dischargers to conduct quarterly dry season visual observations of all drainage areas within their facility for the presence of authorized and unauthorized non-storm water discharges. Section B(4) requires dischargers to conduct visual observations of storm water discharges from one storm event per month during the wet season (defined as October 1-May 30). Sections B(3) and (4) further require dischargers to document the presence of any floating or suspended material, oil and grease, discolorations, turbidity, odor and the source of any pollutants. Dischargers must maintain records of observations, observation dates, locations observed, and responses taken to eliminate unauthorized non-storm water discharges and to reduce or prevent pollutants from contacting non-storm water and storm water discharges. Storm Water Permit, Sections B(3) and (4). Dischargers must also revise the SWPPP to ensure that BMPs are effectively reducing and/or eliminating pollutants at the facility. *Id*. Section B(4).

Sections B(5) and (7) of the Storm Water Permit require dischargers to visually observe and sample storm water discharges from all locations where storm water is discharged. Facility operators, including the GenOn Facility Owners and/or Operators, are required to collect samples from at least two qualifying storm events each wet season, including one set of samples during the first storm event of the wet season. *See* Storm Water Permit, Sections B(5). Required samples must be collected by Facility operators from all discharge points and during the first hour of the storm water discharge from the Facility. *Id*. Sampling of stored or contained storm water shall occur any time the stored or contained storm water is released. *Id*. Storm water samples shall be analyzed for TSS, pH, specific conductance, total organic carbon or oil and grease, toxic chemicals and other pollutants that are likely to be present in significant quantities in the discharges. *Id*., Section B(5)(c).

The GenOn Facility has not developed, implemented and/or revised an MRP for its Facility as required by the Storm Water Permit. Specifically, GenOn Facility has failed to collect storm water samples from the first qualifying storm event of each wet season from 2007 to the present, and has routinely failed to collect storm water samples from the first hour of the storm water discharge from the Facility from 2007 to the present.[19] The GenOn Facility thus has failed to collect two samples from all discharge locations as required by the Storm Water Permit. *See* Storm Water Permit, Sections B(5)(a).

Further, GenOn Facility failed to record visual observations of storm water discharges from one storm event per month during each wet season from 2007 to the present, as required by Section B(4) of the Storm Water Permit. Qualifying storm events occurred at the GenOn Facility, but visual observations of storm water discharges were not made, during each of the months identified in Exhibit B.[20] Each of these failures constitutes a violation of Section B(4) of the Storm Water Permit and the Clean Water Act. Because the GenOn Facility Owners and/or Operators failed to take visual observations of storm water discharges as required during these months, they also failed to document the presence of any floating or suspended material, oil and grease, discolorations, turbidity, trash, odor and the source of any pollutants, in violation of Section B(4) of the Storm Water Permit.

The GenOn Facility's failure to conduct sampling, monitoring, and reporting as required by the Storm Water Permit demonstrates that the GenOn Facility Owners and/or Operators have failed to develop, implement and/or revise an MRP that complies with the requirements of Section B and Provision E(3) of the Storm Water Permit. Every day that the GenOn Facility Owners and/or Operators conducts operations in violation of the specific monitoring and reporting requirements of the Storm Water Permit, or with an inadequately developed and/or implemented MRP, is a separate and distinct violation of the Storm Water Permit and the Clean Water Act. The GenOn Facility Owners and/or Operators have been in daily and continuous violation of the Storm Water Permit's MRP requirements every day since at least August 22, 2007. These violations are ongoing, and Coastkeeper will include additional violations when information becomes available.

E. Discharges of Contaminated Storm Water from GenOn Facility in Violation of the Ocean Plan

1.) The Ocean Plan Requirements and Areas of Special Biological Significance

In the 1970s, the State Board designated thirty-four areas off California's Pacific Coast as Areas of Special Biological Significance ("ASBS"). These areas have been re-designated State Water Quality Protection Areas, but are still referred to as ASBSs.[21] The Mugu Lagoon ASBS in Ventura

[19] Exhibit B, attached and incorporated by reference, sets forth dates on which qualifying rain events during which samples could have been taken occurred at the GenOn Facility in the past five (5) years. A qualifying rain event for sampling purposes is defined in the Storm Water Permit as a discharge that occurs during working hours and that is preceded by at least (3) three working days without a storm water discharge. Storm Water Permit, Section B(5)(b).

[20] Exhibit B, sets forth months during which rain events occurred in which observations of discharges should have been taken in the past five (5) years. A qualifying rain event for visual observations is defined in the Storm Water Permit as a discharge that occurs during working hours and that is preceded by at least (3) three days without a storm water discharge. Storm Water Permit, Section B(4)(b).

[21] According to State Water Board Resolution No. 2005-0035, the State Water Quality Protection Areas are protected by the same laws and regulations as ASBSs.

County and Los Angeles County begins at Mugu Lagoon (Laguna Point) and ends at Latigo Point in the City of Malibu in the County of Los Angeles (the "Mugu to Latigo ASBS"). Like all other ASBSs, the Mugu to Latigo ASBS was determined to be a unique area that deserves special protection. For example, Mugu to Latigo ASBS contains five major sub-tidal habitat types, including extensive sub-tidal reefs.

Because of the "intrinsic value" and fragile nature of ASBSs, the State Water Resources Control Board has determined that in order to preserve and enhance the Beneficial Use of ASBSs, the water quality objectives in the Ocean Plan shall prohibit the discharge of any pollutants to an ASBS. Specifically, the Ocean Plan states that "[w]aste shall not be discharged to areas designated as being of special biological significance." Ocean Plan, Section III(E), Section III(I). Discharges of waste near ASBSs are also prohibited. *Id*. Waste is "a discharger's total discharge, of whatever origin, i.e., gross, not net, discharge." Appendix I, Ocean Plan. Therefore, the GenOn Facility's discharges of waste containing pollutants such as iron in any amount into or near the Mugu to Latigo ASBS, or containing iron exceeding the U.S. Environmental Protection Agency National Recommended Water Quality Criteria for Freshwater Aquatic Life Protection for iron of 1 mg/L, violate the Ocean Plan's waste discharge prohibition.

2.) The GenOn Facility's Violations of the Ocean Plan's Waste Discharge Prohibition into the Mugu Lagoon to Latigo Point ASBS

As indicated in the attached Table A, information available to Coastkeeper indicates that during each significant rain event, dates of which are identified in Exhibit A, the GenOn Facility has been discharging waste containing pollutants in its storm water discharges, such as iron in elevated concentrations, into and near the Mugu to Latigo ASBS since at least December 17, 2007 in violation of the California Ocean Plan and its waste discharge prohibition. Ocean Plan, Section III(E), Section III(I). Every day the GenOn Facility discharges storm water, into and near the Mugu to Latigo ASBS, with waste containing pollutants such as iron or with waste containing iron exceeding the U.S. Environmental Protection Agency National Recommended Water Quality Criteria for Freshwater Aquatic Life Protection for iron of 1 mg/L, is a separate and distinct violation of the Ocean Plan and California Water Code. These violations are ongoing, and will continue each day contaminated storm water containing waste such as iron is discharged into and near the Mugu to Latigo ASBS from the GenOn Facility. In light of the GenOn Facility's history of violations and the nature of the violations, the GenOn Facility will continue to violate the Ocean Plan's requirements in the future unless and until they are enjoined from doing so.

F. Relief and Penalties Sought for Violations of the Clean Water Act and the California Ocean Plan

Pursuant to Section 309(d) of the Clean Water Act, 33 U.S.C. § 1319(d), and the Adjustment of Civil Monetary Penalties for Inflation, 40 C.F.R. §19.4, each separate violation of the Clean Water Act subjects the violator to a penalty for all violations occurring during the period commencing five years prior to the date of a notice of intent to file suit. These provisions of law authorize civil penalties of up to $32,500 per day per violation for all Clean Water Act violations between March 15, 2004 and January 12, 2009, and $37,500 per day per violation for all Clean Water Act violations after January 12, 2009. In addition to civil penalties, Coastkeeper will seek injunctive relief preventing further violations of the Clean Water Act pursuant to Sections 505(a) and (d), 33 U.S.C. §1365(a) and (d), injunctive relief preventing further violations of the California Ocean Plan, declaratory relief, and such other relief as permitted by law. Lastly, pursuant to section 505(d) of the Clean Water Act, 33 U.S.C. § 1365(d), Coastkeeper will seek to recover its costs, including attorneys' and experts' fees, associated with this enforcement action.

IV. Conclusion

Upon expiration of the 60-day notice period, Coastkeeper will file a citizen suit under Section 505(a) of the Clean Water Act for the GenOn Facility Owners and/or Operator's violations of the Storm Water Permit, Clean Water Act, and California Ocean Plan. During the 60-day notice period, however, Coastkeeper is willing to discuss effective remedies for the violations noted in this letter. If you wish to pursue such discussions in the absence of litigation, we suggest that you initiate those discussions immediately.

Please direct all communications to Wishtoyo Foundation's and its Ventura Coastkeeper Program's Staff Attorney at:

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Sincerely,

Mati Waiya
Executive Director
Wishtoyo Foundation & itsVentura
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Table 1 - Exceedences of EPA Benchmarks

Date	Sampler	Outfall	Parameter	Total or Dissolved Fraction	Units	* U.S. EPA Benchmark	Concentration in Discharge
12/17/2007	GenOn	D1	Iron	Total	mg/L	1.0	4.2
12/17/2007	GenOn	D2/4	Iron	Total	mg/L	1.0	1.1
12/18/2007	GenOn	D14	Iron	Total	mg/L	1.0	2.0
12/18/2007	GenOn	D13	Iron	Total	mg/L	1.0	1.3
1/4/2008	GenOn	D2/4	Iron	Total	mg/L	1.0	4.0
1/4/2008	GenOn	D5/12	Iron	Total	mg/L	1.0	3.2
1/5/2008	GenOn	D1	Iron	Total	mg/L	1.0	2.4
1/5/2008	GenOn	D13	Iron	Total	mg/L	1.0	18.0
1/5/2008	GenOn	D13	TSS	Total	mg/L	100	130.0
1/5/2008	GenOn	D14	Iron	Total	mg/L	1.0	4.3
11/1/2008	GenOn	D1	Iron	Total	mg/L	1.0	3.6
11/1/2008	GenOn	D1	TSS	Total	mg/L	100	330.0
11/1/2008	GenOn	D2/4	Iron	Total	mg/L	1.0	1.5
11/1/2008	GenOn	D13	Iron	Total	mg/L	1.0	3.8
11/1/2008	GenOn	D13	TSS	Total	mg/L	100	110.0
11/1/2008	GenOn	D14	Iron	Total	mg/L	1.0	2.7
11/1/2008	GenOn	D14	TSS	Total	mg/L	100	150.0
10/14/2009	GenOn	D1	Iron	Total	mg/L	1.0	1.2
10/14/2009	GenOn	D13	Iron	Total	mg/L	1.0	2.0
1/18/2010	GenOn	D13	Iron	Total	mg/L	1.0	1.3
2/16/2011	GenOn	D13	Iron	Total	mg/L	1.0	2.8
10/5/2011	GenOn	D1	Iron	Total	mg/L	1.0	2.2
10/5/2011	GenOn	D2/4	Iron	Total	mg/L	1.0	3.3
10/5/2011	GenOn	D2/4	TSS	Total	mg/L	100	130
10/5/2011	GenOn	D13	Iron	Total	mg/L	1.0	1.3
10/5/2011	GenOn	D14	Iron	Total	mg/L	1.0	2.1
1/21/2012	GenOn	D13	Iron	Total	mg/L	1.0	1.1

GenOn = GenOn Self Reporting

Table 2 - Exceedences of Basin Plan Limits

Date	Sampler	Outfall	Parameter	Units	* Basin Plan Limits	Concentration in Discharge
1/4/2008	GenOn	D2/4	pH	Units	6.5	6.4
1/4/2008	GenOn	D5/12	pH	Units	6.5	6.4
10/14/2009	GenOn	D5/12	pH	Units	6.5	6.2

GenOn = GenOn Self Reporting

Exhibit A: Rain Table - Number of Days with Rain Above .1 Inches
Station Name: OXNARD VENTURA CO AIRPORT, CA US
Station Id:GHCND:USW00093110

YEAR	MO	DA	Total Rain (Inches)
2007	12	18	0.24
2008	1	4	0.57
2008	1	22	0.17
2008	1	23	0.9
2008	1	24	0.16
2008	1	27	0.11
2008	2	23	0.14
2008	11	1	0.21
2008	11	25	0.2
2008	12	15	0.28
2008	12	22	0.23
2009	1	23	0.19
2009	1	24	0.18
2009	2	5	0.97
2009	2	6	0.63
2009	2	7	0.81
2009	2	9	0.54
2009	2	13	0.55
2009	2	16	2.13
2009	2	17	0.21
2009	3	4	0.39
2009	5	5	0.1
2009	6	5	0.13
2009	10	13	0.54
2009	10	14	0.33
2009	12	7	0.88
2009	12	10	0.37
2009	12	11	0.31
2009	12	12	0.78
2009	12	13	0.2
2010	1	13	0.23
2010	1	17	1.12
2010	1	18	1.01
2010	1	19	1.01
2010	1	20	1.36
2010	1	21	0.63
2010	1	22	0.77

YEAR	MO	DA	Total Rain (Inches)
2010	2	5	1.95
2010	2	6	0.27
2010	2	9	0.18
2010	2	19	0.28
2010	2	24	0.17
2010	2	27	1.51
2010	3	3	0.14
2010	3	6	0.39
2010	4	4	0.18
2010	4	5	0.18
2010	4	11	0.69
2010	4	20	0.12
2010	5	18	0.1
2010	10	4	0.17
2010	10	5	0.15
2010	10	6	0.61
2010	10	18	0.1
2010	10	19	0.29
2010	10	30	0.93
2010	11	7	0.14
2010	11	20	0.3
2010	11	21	0.42
2010	12	5	0.54
2010	12	17	0.6
2010	12	18	2.92
2010	12	19	2.15
2010	12	20	0.44
2010	12	21	0.42
2010	12	22	0.93
2010	12	25	0.87
2010	12	29	0.67
2011	1	2	0.4
2011	1	30	0.18
2011	2	15	0.34
2011	2	16	0.42
2011	2	18	0.31
2011	2	19	0.37

Exhibit A: Rain Table - Number of Days with Rain Above .1 Inches
Station Name: OXNARD VENTURA CO AIRPORT, CA US
Station Id:GHCND:USW00093110

YEAR	MO	DA	Total Rain (Inches)
2011	2	25	0.37
2011	3	23	0.42
2011	3	24	0.23
2011	3	25	0.11
2011	5	17	0.27
2011	6	6	0.13
2011	10	5	1.04
2011	11	6	0.24
2011	11	11	0.38
2011	11	20	0.72
2011	12	12	0.3
2012	1	21	0.91
2012	1	23	0.72
2012	3	17	0.81
2012	3	25	1.56
2012	4	10	0.25
2012	4	11	0.75
2012	4	25	0.12

Exhibit B: Rain Table –Qualifying Rain Events During Business Hours
Station Name: OXNARD VENTURA CO AIRPORT, CA US
Station Id:GHCND:USW00093110

YEAR	MO	DA	Total Rain (Inches)	Day of Week
2007	12	18	0.24	T
2008	1	4	0.57	F
2008	1	22	0.17	T
2008	1	23	0.9	W
2008	2	23	0.14	Sa
2008	11	1	0.21	Sa
2008	11	25	0.2	T
2008	12	15	0.28	M
2008	12	22	0.23	M
2009	1	23	0.19	F
2009	2	5	0.97	Th
2009	2	13	0.55	F
2009	3	4	0.39	W
2009	5	5	0.1	T
2009	10	13	0.54	T
2009	12	7	0.88	M
2010	1	13	0.23	W
2010	1	17	1.12	F
2010	2	5	1.95	F
2010	2	19	0.28	F
2010	2	24	0.17	W
2010	3	3	0.14	W
2010	4	4	0.18	S
2010	4	11	0.69	S
2010	4	20	0.12	T
2010	5	18	0.1	T
2010	10	4	0.17	M
2010	10	18	0.1	M

YEAR	MO	DA	Total Rain (Inches)	Day of Week
2010	10	30	0.93	Sa
2010	11	7	0.14	S
2010	11	20	0.3	Sa
2010	12	5	0.54	S
2010	12	17	0.6	F
2010	12	25	0.87	Sa
2010	12	29	0.67	W
2011	1	2	0.4	S
2011	1	30	0.18	S
2011	2	15	0.34	T
2011	2	25	0.37	F
2011	3	23	0.42	W
2011	5	17	0.27	T
2011	6	6	0.13	M
2011	10	5	1.04	W
2011	11	6	0.24	S
2011	11	11	0.38	F
2011	11	20	0.72	S
2011	12	12	0.3	M
2012	1	21	0.91	Sa
2012	3	17	0.81	Sa
2012	3	25	1.56	S
2012	4	10	0.25	T
2012	4	25	0.12	W

SANTA PAULA

Santa Clara Waste Water defendants told to return to court next month

ANTHONY PLASCENCIA/THE STAR Smoke billows above the scene of an explosion near Mission Rock Road in Santa Paula, where Ventura County Hazmat teams tried to contain a spill of organic peroxide. 11/18/14

By Marjorie Hernandez of the Ventura County Star
Posted:

0

Defendants accused of criminal charges connected to a 2014 explosion at the Santa Clara Waste Water Co. plant near Santa Paula were ordered to return next month to discuss potential conflicts of interest involving defense attorneys.

Seven defendants, as well as attorneys for Santa Clara Waste Water and its parent company, Green Compass, appeared Tuesday before Ventura County Superior Court Judge Kent Kellegrew for an arraignment on an indictment.

Kellegrew ordered all parties to appear back in court Feb. 8.

officials and employees including CEO William Mitzel. The indictment was spawned by an explosion and spot fires at the company's plant at 815 Mission Rock Road on Nov. 18, 2014, that caused several injuries, led to evacuations of businesses and homes, and required the treatment of dozens of people for potential exposure.

The defendants are accused of conspiracy to commit a crime, handling hazardous waste with a reckless disregard for human life, disposal of hazardous waste, committing violations causing injuries and other charges.

On Nov. 20, managers Mark Avila and Brock Gustin Baker pleaded guilty to some of the charges. The two men face a maximum of three years in the county jail or home confinement.

Defense attorneys for the company, have characterized the explosion as an industrial accident.

The company handles wastewater from sources such as chemical toilets, industrial uses, and some oil and natural gas operations.

Senior Deputy District Attorney Karen Wold said Tuesday that law firms Musick, Peeler & Garrett LLP, and Burke, Williams & Sorensen LLP currently represent multiple defendants, as well as witnesses and victims in the case.

"There is a potential conflict where corporations and corporate officers are charged along with lower-level employees, particularly if the corporation is paying the bill," Wold wrote in a motion filed Nov. 30. "Will counsel's advice to lower-level employees and strategic litigation decisions be in the best interest of those employees, or will they be designed to protect the corporations and their high-ranking officials? The court should determine whether counsel can give undivided loyalty to every client under these circumstances."

Kellegrew on Tuesday ordered defense attorneys to respond to the motion by Jan. 29 and both sides will reconvene Feb. 8 to discuss the issue.

alleging misconduct.

Santa Clara Waste Water filed a motion in November to sanction the District Attorney's Office. The company alleges Senior Deputy District Attorney Christopher Harman made "misleading statements" to the court regarding an employee file seized by investigators.

Harman since has been removed from the case. The state Attorney General's Office announced in November it would join the county District Attorney's Office in prosecuting the case.

Attorneys for Santa Clara Waste Water last week filed a challenge to the sufficiency of the indictment.

"In addition to being vague, ambiguous, lacking in factual particulars and failing to provide proper notice, several of the counts of the indictment are defective because they do not constitute a 'public offense,' either as charged or as against some of the named defendants," company attorney Barry Groveman wrote.

Groveman added that the indictment failed to provide adequate notice of the charged offense and defendants were charged with identical and multiple violations for the same offense.

Carter said Santa Clara Waste Water also plans to file a motion to disqualify the District Attorney's Office from the case.

"Just as the People believe the conflicts (of interest) motion is important for them ... it is equally important for the defendant that discovery with respect to potential misconduct to see whether or not the district attorney is the appropriate entity to be pursuing any of their motion," Carter said at Tuesday's hearing. "That is a fundamental issue for the defendant."

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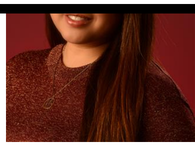

Attachment 6 – News Article Discussing Helicopter Crash and Fire

SANTA PAULA TIMES

A Las Vegas man was killed Friday morning when the helicopter he was flying crashed into the Santa Clara River bottom about three miles west of the Santa Paula Airport. *Photo Courtesy Ventura County Sheriffs Department*

May 28, 2014

Las Vegas man killed in helicopter crash west of Santa Paula

Santa Paula News

A Las Vegas man was killed Friday morning when the helicopter he was flying crashed into the Santa Clara River bottom about three miles west of the Santa Paula Airport.

The pilot, identified Saturday as 42-year-old Philip Isaac Margolis III, apparently had rented the helicopter about 9 a.m. at Oxnard Airport and was expected to return at about 10 a.m.
But at 10:13 a.m., the Santa Paula and Ventura County Fire departments responded to a report of a downed helicopter and a small fire near the 900 block of Corporation Road.
It is not clear if Margolis clipped power lines south of Highway 126 during his descent or as a cause of the descent but the fallen lines started a small fire in riverbed bamboo. A couple of hundred yards from the downed power lines the helicopter crashed.
Although there was no fire where the helicopter hit the ground, the force of the crash mangled the copter, bending its rotor blades.
Emergency responders declared Margolis dead at the scene and covered his body with a yellow tarp until the Medical Examiner could arrive for a preliminary investigation and to transport the body.
Investigators from the Federal Aviation Administration and National Transportation Safety Board (NTSB) also responded to the scene; the NTSB will lead the investigation. It usually issues a preliminary report within a few weeks but takes months to determine a probable cause.
Santa Paula Fire helped extinguish the fire in the bamboo and kept the blaze to under an acre.
Members of Margolis' family came to the scene but were kept from the crash site.
Margolis had rented the Robinson R22 from Channel Islands Helicopters and filled up the tank before taking off at about 9 a.m. He reportedly was practicing at the Oxnard Airport before leaving for Camarillo, later received clearance to leave Camarillo air space and headed toward Santa Paula where he crashed.
The exact cause of Margolis' death will be released following an autopsy.
A crew from Southern California Edison de-energized the fallen power lines and three customers were without power until late that evening.
Channel Islands Helicopters has been providing flight services and instruction since 2009.
The R22 is a two-seated, two-bladed, single-engine helicopter manufactured by Robinson Helicopter Co. since 1979. The Channel Islands Helicopters website notes a Robinson R22 was added to its flight instruction fleet in September 2013.
The Robinson R22 is a two-bladed, single-engine light utility helicopter manufactured by Robinson

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Helicopter. The cruise speed for the 29-foot-
R22 is 110 mph.
Friday's crash was the second fatal helicopter incident that occurred in the Santa Clara River Valley in the past five years: on January 31, 2009, a Japanese man left Camarillo Airport and lost control of his Robinson R22 helicopter, crashing along the Santa Clara River in the Piru area.
Elsewhere in Ventura County two Southern California Edison workers - a 48-year-old Upper Ojai man and 41-year-old Temecula man - were killed September 6, 2006, when their helicopter crashed while they were checking power lines north of Somis.

Attachment 7 – T. Van Renterghem, et. al., Comparison of Measurements and Predictions of Sound Propagation in a Valley-Slope Configuration in an Inhomogeneous Atmosphere, (Feb. 27, 2007).

Comparison of measurements and predictions of sound propagation in a valley-slope configuration in an inhomogeneous atmosphere

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(Received 7 September 2006; revised 27 February 2007; accepted 27 February 2007)

Mountainous areas form a very specific context for sound propagation: There is a particular ground effect and meteorological conditions are often extreme. In this paper, detailed sound propagation calculations are compared to noise measurements accompanied by meteorological observations. The sound source considered is road traffic along the center axis of a valley. Noise levels were measured in two cross sections, at three locations each: one on the valley floor and two on the slopes, up to 166 m above the source. For the numerical calculations, the rotated Green's function parabolic equation method is used, taking into account the undulation of the terrain and an inhomogeneous atmosphere. Typical parameters of this method were optimized for computational efficiency. Predictions agree with measurements to within 3 dBA up to propagation distances of 1 km, in windless conditions. The calculations further show that the terrain profile is responsible for an increase in sound pressure level at distant, elevated points up to 30 dBA compared to a flat ground situation. Complex temperature profiles account for level changes between −3 dBA and +10 dBA relative to a homogeneous atmosphere. This study shows that accurate sound level prediction in a valley-slope configuration requires detailed numerical calculations. © *2007 Acoustical Society of America.* [DOI: 10.1121/1.2717765]

PACS number(s): 43.28.Js, 43.28.Fp, 43.28.En [VEO] Pages: 2522–2533

I. INTRODUCTION

When comparing sound propagation in valley-slope configurations with sound propagation over flat terrain, two main differences are observed.

First, the undulation of the terrain influences sound propagation strongly. At some locations, the receiver is shielded from the source by the terrain. In that case, there is no direct sound path, and sound reaches the receiver only by diffraction and refraction over hills. In other situations, receivers are located on slopes high above the valley floor and have direct visibility of the source. They are exposed to significantly higher sound pressure levels than receivers at the same distance at the level of the valley floor would have. The main reason for this is the reduced ground attenuation. In addition, in concave valleys, multiple reflected sound may converge at the up-slope receiver.[1] In very narrow valleys, sound reflected on the opposite slopes may also contribute significantly to the overall level.[1]

Second, typical meteorological conditions are found in mountainous regions. There is often a large variability of the meteorological parameters in space and time. Besides the influence that mountains exert on the large-scale wind flow (e.g., channeling along the valley axis and the presence of recirculation zones behind orographic obstacles), some typical, thermally driven air currents occur in valley-slope configurations (so-called slope winds). Wind parameters were not measured in sufficient detail during the measurement campaign in the underlying study, and will therefore not be considered in this paper.

Temperature effects can be more prominent in valleys compared to flat terrain. The transition from the (stable) nightly temperature inversion situation to an unstable atmosphere during daytime can happen very quickly, once the sun rays reach the valley floor. The valley orientation plays an important role in this respect and might cause a delay of several hours with regard to the moment of temperature inversion breakup.[2] The width-height ratio of a valley influences both the depth and lifetime of the temperature inversion layer.[3]

In Ref. 4, a meteorological meso-scale model was used to simulate temperature profiles and the development of slope-wind systems in a narrow, two-dimensional valley, in the absence of large-scale winds. This information was then used by a numerical sound particle model. This study yielded large variations of sound levels during the course of a day because of the state of the atmosphere. No measurement campaign was set up to check their findings.

In this paper, simultaneous noise measurements and meteorological measurements were performed in order to check sound propagation calculations. The situation of interest is upslope sound propagation, orthogonal to the valley axis. This corresponds to a typical situation in valley-slope con-

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 0001-4966/2007/121(5)/2522/12/$23.00

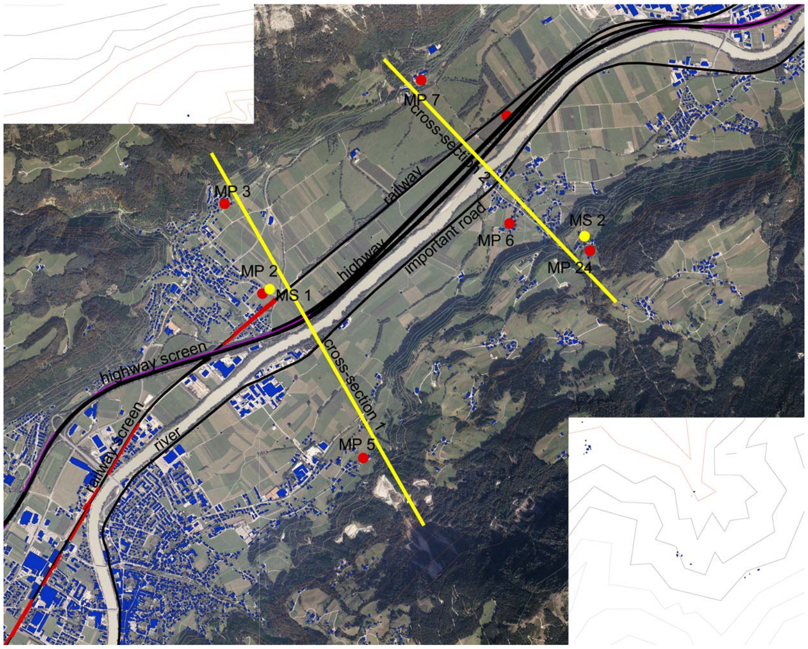

FIG. 1. (Color online) Orthophoto of the valley under consideration. The following items are indicated: the microphone positions (MP), the locations of the meteo stations (MS), the highway, the main road, the railway, the river, the locations of highway screens and railway screens, and the buildings. Height contours are shown as well.

figurations, where a highway or railway follows the valley axis and where dwellings are present on the slopes. A detailed comparison between noise measurements and (wave-based) sound propagation calculations in such situations has not been reported previously. Focus is on the effect of an inhomogeneous atmosphere. Large-scale wind systems will influence sound propagation to a lesser extent in this—typical—configuration since wind direction is usually aligned with the valley axis. Slope winds are directed orthogonal to the valley axis, but are not considered here.

This paper is organized as follows. In Sec. II, the region where the study was performed is described. In Sec. III, the acoustical and meteorological measurement setup is described. It is also indicated how the data was preprocessed. Details on the numerical model and the calculation methodology can be found in Sec. IV and Appendix. A comparison between measurements and predictions is made in Sec. V. In Sec. VI, conclusions are drawn.

II. SITE DESCRIPTION

The Unterinntal region is located in the Alps, in the western part of Austria. The measurements were performed in a 2-km-wide valley in the district Schwaz. An orthophoto of the area under consideration is shown in Fig. 1. The valley floor is located at an elevation between 530 and 540 m. The valley is oriented in general from North-East to South-West. The mountains surrounding the valley have ridges of over 2000 m in height. In the center of the valley, there is a highway (Inntal Autobahn, A12), an important main road (Tiroler Bundesstrasse, B171), and a railway close to the highway.

In this paper, focus is on sound propagation from road sources to a number of locations on the slopes of the valley, at lower elevation. The difference in elevation between the road and the microphone positions is at most 166 m. The presence of dwellings and thus possibly noise annoyed people at higher altitude on the slope is limited.

Two cross sections were selected and in each of them three microphones were placed. The microphone positions in each cross section lie more or less on a straight line, orthogonal to the roads. Near cross section 1, the highway (A12) is the dominant noise source. Near cross section 2 a busy road (B171) dominates the noise climate. An overview of the orthogonal distances to the relevant roads, the ground elevation at the microphone locations, as well as the elevation of the roads near each microphone can be found in Table I. All microphones, with the exception of microphone 6, are placed 2 m above the ground. Microphone 6 is placed on the roof of a small building for practical reasons. A portable meteo station is used to gather on-site meteorological data.

Figure 1 shows a map of the area clearly indicating the roads, railway, noise barriers along highway and railway, houses and other buildings, and the measurement locations. Sound measurement stations are identified by the microphone numbers used in Table I.

III. MEASUREMENTS AND PROCESSING

The measurement campaign lasted from November 2005 till January 2006. Simultaneous noise measurements and meteorological observations were performed.

TABLE I. Overview of microphone positions during the measurement campaign.

Cross-section ID	Microphone ID	Orthogonal distance towards dominant road noise source (m)	Elevation of the roads (m) near microphone	Elevation at receiver (m)
1	2	331	530–541	540
1	3	1188	530–560	583
1	5	1216	530–563	579
2	6	542	530–540	541
2	7	796	530–540	542
2	24	1153	530–541	696

TABLE II. Overview of clustered datasets.

Cross-section ID	Cluster ID (temperature profile ID)	Number of locations	Number of retained measurements in cluster	Additional meteo information in cross section	Measurement period: day(s)	Measurement period: hours
1	1	3	53	Yes (MS 1)	20/11/05	16.00–19.00 h
2	2	3	148	No (MS 1 is used)	26/11/05–01/12/05	9.00–16.00 h
2	3	3	67	No (MS 1 is used)	27/11/05	11.00–13.00 h
2	4	2	59	Yes (MS 2)	20/12/05–21/12/05	23.00–08.00 h

A. Meteo measurements and processing

A Vaisala MAWS201 Automatic Weather Station was used to gather basic meteorological information in each cross section. The data consist of air temperature, relative humidity, atmospheric pressure, wind speed, and wind direction, all measured at a single height. Every minute, this data was logged. The wind speed was measured with an anemometer at 2 m above the ground. This information is insufficient to estimate wind speed profiles. It nevertheless allows one to exclude 1 min periods where wind might influence sound propagation. At the same time, selecting measurements at low wind speeds only also prevents microphone induced wind noise. A maximum value of the wind speed equal to 0.5 m/s was used. To exclude measurements made during precipitation, only those measurements made when relative humidity was lower than 80% were retained. As a result, the comparison between prediction and measurement will be limited to dry, windless conditions.

Temperature profiles were obtained by means of eight ventilated temperature sensors attached to the posts of a cable way (the "Kellerjoch Bahn"). The heights of the sensors ranged from 540 m (valley floor) to 1341 m. The Kellerjoch Bahn is located North-West from cross section 1 and cross section 2, at 4.5 and at 6.5 km, respectively. Every 15 min, the temperature at all heights was logged simultaneously. Thus, air temperature is known along a single line on a slope. In an ideal situation, temperature should be measured at a fixed location (e.g., in the center of the valley) at different heights but this was not practically achievable.

B. Noise measurements and processing

In each cross section, simultaneous measurements were performed with Svantek 1/2 in. SV22 condenser microphones. Overall equivalent A-weighted sound pressure levels are stored every second ($L_{\mathrm{Aeq,1\ s}}$).

Besides the main road noise that is of interest for this study, noise from train passages and local events like the passing of a car on a nearby, small road are also recorded by the microphones. To eliminate these disturbances, the raw $L_{\mathrm{Aeq,1\ s}}$ measurements are pre-processed based on the hypothesis that the main road noise under study constitutes the constant part of the sound level. The following rule was used: The sound pressure level at a given second is considered to be an event if it is higher than the median noise level in a time window of 5 min, centered on the second under consideration, plus 5 dBA. After events were removed in this way, sound pressure levels were summed to 1 min equivalent sound pressure levels. Only if at least 40 s of measurements remain after event canceling, the 1 min equivalent sound pressure level is kept for further analyses.

C. Combined dataset

The measurement campaign led to a dataset of combined noise and meteorological data. A clustering of these data was done based on (similar) range-independent temperature profiles, in order to limit the number of calculations. The minimum number of data points in each cluster was set to 50 to allow one to draw statistically stable conclusions. The parameters used for clustering were the gradients in air temperature between successive sensors, up to a height of 767 m. Gradients at larger heights did not influence sound propagation over the distances and height differences considered. The (absolute) value of temperature may differ within a cluster. This is acceptable since the gradient in temperature is responsible for refraction of sound.

The preprocessing of the dataset to retain windless periods without precipitation, together with the demand that at least 50 measurements are characterized by similar air temperature profiles, resulted in a drastic decrease of available combined noise and meteo data. The 4270 measurements (available after removing events) in cross section 1 resulted in 53 usable combined data records. For cross section 2, 21,601 measurements gave 274 combined data records, split up into three temperature profiles clusters.

In Table II, the number of (non-successive) 1 min combined data records are shown for the different clusters considered. During all of these selected periods, the ground was snow-covered.

The data for cross section 1 was measured on a single day, between 16.00 and 19.00 h. For cluster 2, data come from different days and were recorded during day hours. The data in cluster 3 come again from a single day, around noon. Cluster 4 contains mainly observations during night hours.

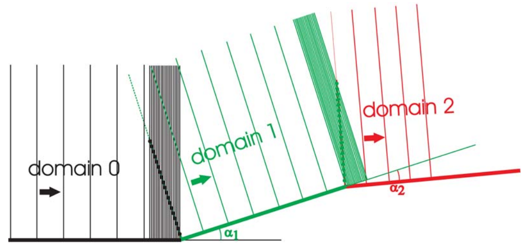

FIG. 2. (Color online) Schematic representation of sound propagation with the GFrPE method in the case of concave and convex ground surface transitions. Three successive flat domains are shown. The vertical lines represent the positions where a column of pressures is calculated. In the transition zones, a large number of propagation steps are needed; α_i represent the difference in slope angle between successive domains.

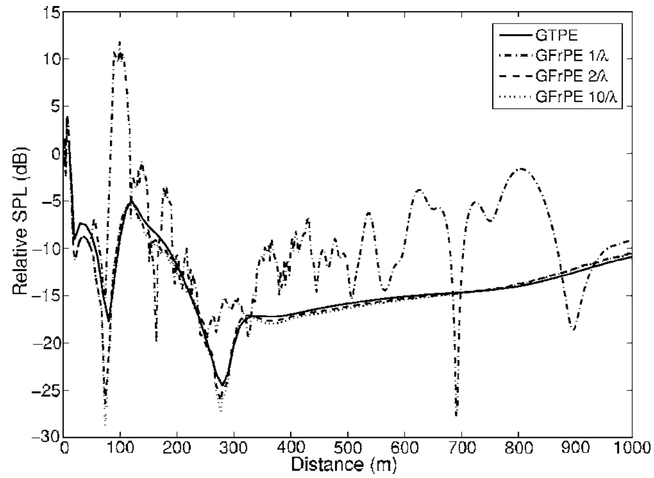

FIG. 3. Effect of the number of calculations per wavelength (n/λ) on the starting fields for GFrPE calculations. See the caption of Fig. 11 for more details on the calculation parameters. The GTPE calculation is used as a reference solution. When two points per wavelength or more are calculated, accuracy is not improved anymore.

IV. NUMERICAL PREDICTIONS

A. GFrPE method

A two-dimensional Green's Function Parabolic Equation (GFPE)[5,6] method with a rotated reference frame (abbreviated as GFrPE) is used for the numerical predictions. In this model, the undulating terrain is approximated by a succession of flat domains with different slopes. In each of them, ordinary GFPE calculations are performed. As shown in Fig. 2, the sound field calculation in each domain starts from an array of pressure values, orthogonal to the local slope. The starting field for domain $n+1$ is constructed based solely on calculations in domain n, which is in line with the progressive character of the PE method. When there is a change in the slope angle between successive domains, a number of reduced propagation steps are needed in domain n near the transition to the next domain, to allow one to obtain the pressures at the correct heights for constructing the starting field for domain $n+1$.

This methodology is illustrated in Fig. 2, for both a concave transition (from domain 0 to 1) and a convex transition (from domain 1 to 2). In the case of a convex ground surface, PE calculations are necessary along the (virtual) continuation of the ground in domain n for calculating the pressures of the starting field of domain $n+1$.

This modification to the GFPE method was proposed in Refs. 7 and 8. The GFrPE method has the same benefits as GFPE:

- The computational cost of GFPE is based mainly on the efficiency of the fast Fourier transform (FFT) algorithm. Very fast FFT algorithms are available.
- GFPE allows one to use large step sizes in horizontal direction, that are limited by the inhomogeneity of the atmosphere rather than by the sound wavelength (λ). The maximum acceptable range step varies roughly between 5λ and 50λ in a refracting atmosphere.[6] Since we are aiming at distances up to a few kilometers from the source and for typical traffic noise (including relatively high frequencies), the use of large step sizes is an important advantage. Section IV B discusses how this advantage could be jeopardized by the use of GFrPE.
- Refraction of sound by arbitrary sound speed profiles can be modeled: The sound speed profiles may contain upward and downward refracting parts.
- Locally reacting, range-dependent impedance planes can be used to model reflection from the ground.
- Diffraction near hard, infinitely thin screens can be modeled with the Kirchoff approach.[9]

The method was validated for typical road embankment configurations by comparing it with results obtained using the boundary element method.[8] In the Appendix, the GFrPE code is validated for the case of the smooth hill presented in Ref. 10.

B. Improving computational efficiency of GFrPE

The construction of the starting field for domain $n+1$ from field calculations in domain n is computationally very costly. As shown in Fig. 2, a large number of very small propagation steps are needed in the transition zone. A typical starting field would be described by about ten values per wavelength in the vertical direction. In practice, it is not necessary to accurately calculate the field with this resolution on the basis of the propagation in domain n. Instead, linear interpolation in both amplitude and phase can be used to construct the starting field from a lower number of known values. In Fig. 3, the relative sound pressure level as a function of distance for the validation case, described in the Appendix, is shown, with a decreasing number of explicitly calculated points per wavelength on the starting fields. Once 2 points per wavelength (indicated as $2/\lambda$) or more are calculated, the result converges.

GFrPE calculations can also be accelerated by truncating the height of the calculated starting field below the top of the computational grid (or up to the beginning of the absorbing layer). The starting pressure field above this truncation height is obtained by linear extrapolation of the phase angle of the pressure and linear tapering to zero of the magnitude of the pressure as was proposed in Ref. 11. The maximum height still containing relevant information depends on the propagation distance to be covered by the PE model. Figure 4 shows that the relative sound pressure level converges for

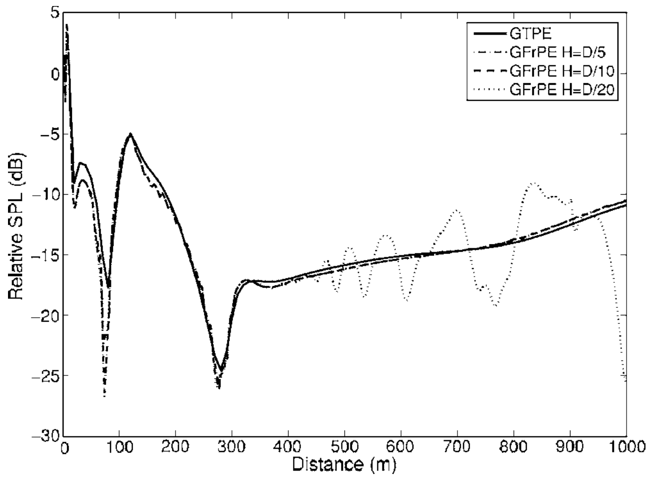

FIG. 4. Effect of the ratio between the maximum height on the starting fields taken into account (H) and the distance between source and receiver (D). See the caption of Fig. 11 for more details on the calculation parameters. The GTPE calculation is used as a reference solution. The use of values of H larger than D/10 only increase the computational cost, while accuracy is not improved anymore.

the test case of the Appendix when the ratio between the propagation distance to be covered (D) and the truncation height of the starting field (H) is at least 10. Decreasing this ratio only increases the computational cost, while there is no gain in accuracy.

C. Comparing relative levels between predictions and measurements

Detailed traffic counts, traffic composition, and traffic speed distribution were not available for the motorways during the measurement campaign. This lack of information can be circumvented by validating the numerical results on relative rather than absolute measurements. In each cross section, the location closest to the road was chosen as the reference measurement: microphone with ID 2 in cross section 1, and microphone with ID 6 in cross section 2. Sound pressure levels at the distant points relative to the reference points were compared with numerical calculations.

The number of vehicles on the road will not influence the comparison of relative sound levels as proposed in the previous paragraph if it can be assumed that the flow is homogeneous over a sufficiently long stretch of the road. This does not hold for vehicle type and vehicle speed. Each combination of vehicle type and vehicle speed results in a typical source spectrum. Keeping in mind the difference in distance between reference point and the more distant points, the contributions of different frequency bands to the total sound pressure level will change. As a result, the relative sound pressure levels will vary. To account for this, the spread in sound pressure level caused by different vehicle types, driving at typical velocities, will be predicted.

D. Calculation methodology for the valley-slope configuration

The methodology for calculating the sound pressure levels from traffic noise at distant receivers uses a number of aspects from the HARMONOISE reference model.[12]

First the three-dimensional propagation problem is split up into a set of two-dimensional problems by subdividing the roads in a number of point sources along its axes.

In a second step, the terrain profile along the line between each point source location and the receiver is extracted from the digital terrain map. In GFrPE, the terrain is approximated as a succession of flat segments, each with a different slope.

The points of intersection between a source-receiver line and obstacles (buildings, highway screens and railway screens) are determined. The GFrPE method is able to handle diffraction over thin, hard screens using the Kirchoff approach: The acoustic field is set to zero on the barrier, and then propagated in forward direction. For simplicity, a building is approximated by such a thin, hard screen located in the center of the building. In this two-dimensional approach, only diffraction over the top of the obstacles is accounted for. It is also assumed that the obstacles are rotated in such a way that their main axis becomes perpendicular to the source-receiver line. These same assumptions were made in the HARMONOISE reference model[12] (except when a three-dimensional ray model is used).

In a third step, the transmission loss from each point source to the receiver is calculated using GFrPE. Temperature profiles are available on a single line along a slope. For simplicity, horizontal temperature stratification throughout the valley is assumed: Only the elevation determines the air temperature. The validity of this approach could be questioned, but it remains the best possible approach with the available meteorological data.

The highest temperature sensor in our case was located at a height of 1341 m (or 801 m above the valley floor). This large span in heights of temperature observations is more than sufficient to accurately model refraction of sound, keeping in mind the distances between sources and receivers. The temperature and sound speed at each position in the vertical PE grid is obtained by linear interpolation between measured data.

Atmospheric attenuation is not included in the GFrPE model, and is therefore added afterwards, using the product αr, where α is the absorption coefficient which is calculated following ISO 9613-1[13] and r is the distance traveled by the direct sound ray between source and receiver. All combinations of air temperature, relative humidity and air pressure that are present in each temperature profile cluster are considered.

In the case of an upward refracting atmosphere, turbulent scattering into the acoustic shadow zone that is formed becomes important. Neglecting this effect often results in unrealistically large attenuations. A standard approach to account for turbulent scattering consists in calculating sound propagation through a number of turbulent realizations of the atmosphere (see, e.g., Ref. 14). The ensemble average of all these realizations follows statistical laws. To have statistically stable results however, at least 50 realizations of the turbulent atmosphere need to be taken into account. As a result, computing times increase dramatically.

Based on experiments, it was found that the sound pressure level relative to free field propagation stays more or less constant in the acoustical shadow zone formed by an upward refracting atmosphere.[15,16] This constant value depends on the geometry of the problem and on the strength of the turbulence. A value of −20 dB is common in acoustical literature.[10] Truncating the sound pressure level relative to free field comes at no additional computational cost and is therefore preferred for the large scale problem considered in our work. It was observed that this approach led to acceptable results in situations where turbulent scattering into shadow zones becomes important (see further).

In a fourth step, the sound pressure level at the receivers is calculated by choosing an appropriate traffic source spectrum.

Finally, the contributions from all two-dimensional cross sections are added incoherently to find the total sound pressure level at the receiver.

This approach assumes that in each point source, the same type of vehicle is present driving at the same speed. When multiple vehicle types and vehicle speeds are considered, step four (and five) are repeated with an appropriate source spectrum.

E. Model parameters

The numerical parameters were chosen as a compromise between numerical accuracy and computational efficiency.

1. Frequency range

One-third octave bands ranging from 50 to 2500 Hz were considered, covering sufficiently the frequency spectrum of road traffic. Propagation calculations were performed for a single frequency per one-third octave band. The calculations were repeated in the first cross section using three frequencies per one-third octave band for validation. This resulted in differences in total A-weighted sound pressure levels that were less than 0.3 dBA, while the computational cost was three times higher. Thus it was decided to use a single frequency per one-third octave band in all further predictions.

2. Source and receiver heights

A source height above the road surface of 0.5 m was chosen to represent an average over all possible physical noise sources at different speeds for different types of vehicles. The HARMONOISE reference model [12] suggests using different source heights for each source mechanism (rolling noise, engine noise) and each class of vehicles (cars, light trucks and heavy trucks). Since each source height would result in a new propagation calculation, this suggestion was not followed here. The receiver height at all locations was 2 m, except for the microphone with ID 6, which was placed 2 m above the roof of a small building.

3. Discretization of the roads

The stretch of road considered to contribute to the overall noise level was limited by the furthest points being at a distance from the receiver equal to three times the orthogonal distance between road and receiver. In the case of direct sound and in a still and homogeneous atmosphere, a source at this distance has a contribution to the overall sound level that is nearly 10 dB below the largest contribution. The discretization distance between successive source points along the road axis was first chosen to be 200 m. The number of source points that were used for the different microphone positions ranges from 9 to 35 with such a discretization along the road and using such a marking off. This rough sampling of point sources along the road revealed the zone with the most important contributions, which was in most cases centered around the source point with the shortest distance to the receiver. The stretch of road between the first and the last source point resulting in a sound pressure level of 10 dBA below the most contributing source was subject to further refinement. Additional source points were placed every 100 m. If the total A-weighted sound pressure level obtained using the refined road discretization deviated less than 1 dBA from that obtained using the rougher discretization, convergence was assumed. If not, the refinement procedure was repeated. In most situations a single refinement proved sufficient.

4. Discretization of sound paths

Along each sound path between the source and receiver, the terrain is approximated by flat domains with a length of 100 m. This approximation is acceptable because the relief is reasonably smooth up to the microphone positions. Taking smaller segments largely increases the computational cost mainly because of the smaller spatial step and corresponding larger number of calculations needed in each transition zone.

5. Obstacles

The railway screens in the area under consideration have a height of 3 m. The height of the highway noise barriers ranges from 3 to 4.5 m. The height of individual buildings and houses is not known. An average height of 5 m is chosen. All obstacles are considered to be rigid.

6. Ground modeling

A range-dependent ground impedance is used. The ground directly under the source points is assumed rigid. The river, which is close to the roads, is modeled as a rigid surface as well. All remaining grounds in the source-receiver lines are assumed to be covered with snow. The soil in the buildup areas is not considered separately.

Sound propagation over snow-covered ground has been investigated in detail in acoustical literature. [17,18] Information on, e.g., the thickness of the snow layer or its state (old snow, fresh snow, the degree of compaction, etc.) was not available during the measurement campaign. Therefore, the general-purpose one-parameter ground impedance model of Delany and Bazley[19] was used, with a measured flow resistivity for snow equal to 30 kPa s/m^2 (Ref. 12).

7. Traffic source spectrum

The NORD 2000 traffic source spectra [20] are used. The range of differences in total A-weighted sound pressure level between the distant receivers and the reference receiver are calculated for passenger cars driving at 70, 90, 110, and

130 km/h, for medium-heavy vehicles driving at 70, 90, and 110 km/h, and for heavy vehicles driving at 50, 70, and 90 km/h.

8. GFrPE parameters

A standard Gaussian starting function [5,6] is used to initiate the GFrPE calculations. The absorbing layer as described in the Appendix is applied. The maximum horizontal propagation step is 10λ, and is used as much as possible. Variable horizontal propagation steps are used in order to exactly account for the locations of screens, houses, receivers and impedance changes.

The optimization of characteristic parameters for the GFrPE method was discussed in Sec. IV B. To construct a new starting field for the next domain, two calculations per wavelength are performed in vertical direction followed by linear interpolation to obtain a vertical discretization of 0.1λ. The maximum height of the starting field that is calculated was one tenth of the distance between source and receiver. The starting field above this maximum height is found by extrapolation, as described in Sec. IV B.

A change in slope inclination between successive domains of less than 1° is ignored. The starting field for domain $n+1$ is in that case the vertical array of pressures at the border of domains n and $n+1$.

9. Parallel computations

The proposed calculation methodology is computationally costly. This holds especially for the highest frequencies considered, for the oblique (and thus long) sound paths and for the sound paths with a large number of differences in slope inclination between successive domains. In the proposed methodology, calculations are easy to parallelize. Either different sound paths were calculated on different CPU's, or different frequencies were calculated on different CPU's.

V. COMPARISON BETWEEN MEASUREMENTS AND PREDICTIONS

An overall comparison between measurements and predictions is shown in Figs. 5(a)–5(d). The measurements are presented by means of so-called boxplots. The (middle) horizontal line in the box indicates the median of the data. The box is closed by the first and third quartile. The whiskers extend to 1.5 times the interquartile distance above the maximum value inside the box, and to 1.5 times the interquartile distance below the minimum value inside the box. Data points that fall outside the whiskers are considered to be outliers, and are indicated with the plus signs.

Three sets of predicted relative noise levels are included in the plots, indicated by different symbols. The first set is the best available prediction. To gain understanding in the significance of the terrain elevation and temperature effects, additional calculations were performed. First, a homogeneous atmosphere was assumed in the presence of the actual relief. Second, a flat terrain is assumed in a homogeneous atmosphere. In both calculations all other numerical and geometrical parameters (locations of houses and screens, ground impedance, etc.) remain unchanged.

As discussed in Sec. III C, the combined noise-meteo measurements were clustered based on the temperature profiles. This still leaves an important variance in the relative measurements. The reasons for this variance are summarized below:

- Traffic composition and vehicle speed may be different during the non-successive minutes considered, resulting in different source spectra.
- In each cluster, there is a variation in the combination of air temperature, relative humidity and atmospheric pressure, which is responsible for the magnitude of the atmospheric absorption. An additional clustering on this data would lead to too few cases per cluster.
- An average, clustered temperature profile is chosen for the calculations [see full lines in the temperature profile plots in Figs. 5(a)–5(d)]. Within each cluster, temperature profiles might be slightly different [see dashed lines in the temperature profile plots in Figs. 5(a)–5(d)].

The first two causes of variance in the relative sound pressure levels are accounted for (see Sec. IV C and IV D) and result in the spread in calculation results that can be observed in Figs. 5(a)–5(d). The last one is not included for reasons of computational cost.

The agreement between measurements and numerical predictions is good. The average of the calculations lies close to the median of the measurements. Differences range up to 2−3 dBA. The spread in the calculations is in most situations very similar to the measured one. This gives confidence in the followed approach.

A comparison between the flat terrain calculations and the calculations using the actual relief, both in a homogeneous atmosphere, indicates that the presence of the sloping terrain is responsible for an increase in sound pressure level for the distant observation points of at least 5 dBA and at most 30 dBA. Comparing the calculations in the case of a homogeneous and an inhomogeneous atmosphere, both using the actual relief, reveals that temperature gradients in this Alpine valley result in a change of sound pressure level ranging from −3 dBA to +10 dBA between the distant and reference receiver.

The temperature profiles in the dataset are complex: They contain upward and downward refracting parts, depending on the height. Temperature profiles 1 (see Fig. 5(a)) and 4 (see Fig. 5(d)) are mainly upward refracting. Very close to the ground, a thin temperature inversion layer is observed. This holds also for temperature profile 2 (see Fig. 5(b)); in addition, starting from about 100 m above the valley floor, a temperature inversion layer is observed. Temperature profile 3 (see Fig. 5(c)) is characterized by a well-mixed, unstable layer starting from the ground surface, capped by a strong inversion layer, starting at the same height as in temperature profile 2.

In the first cross section, the relief increases the sound pressure levels at the distant points 3 and 5, relative to the reference point 2. This is shown in Fig. 5(a). When the tem-

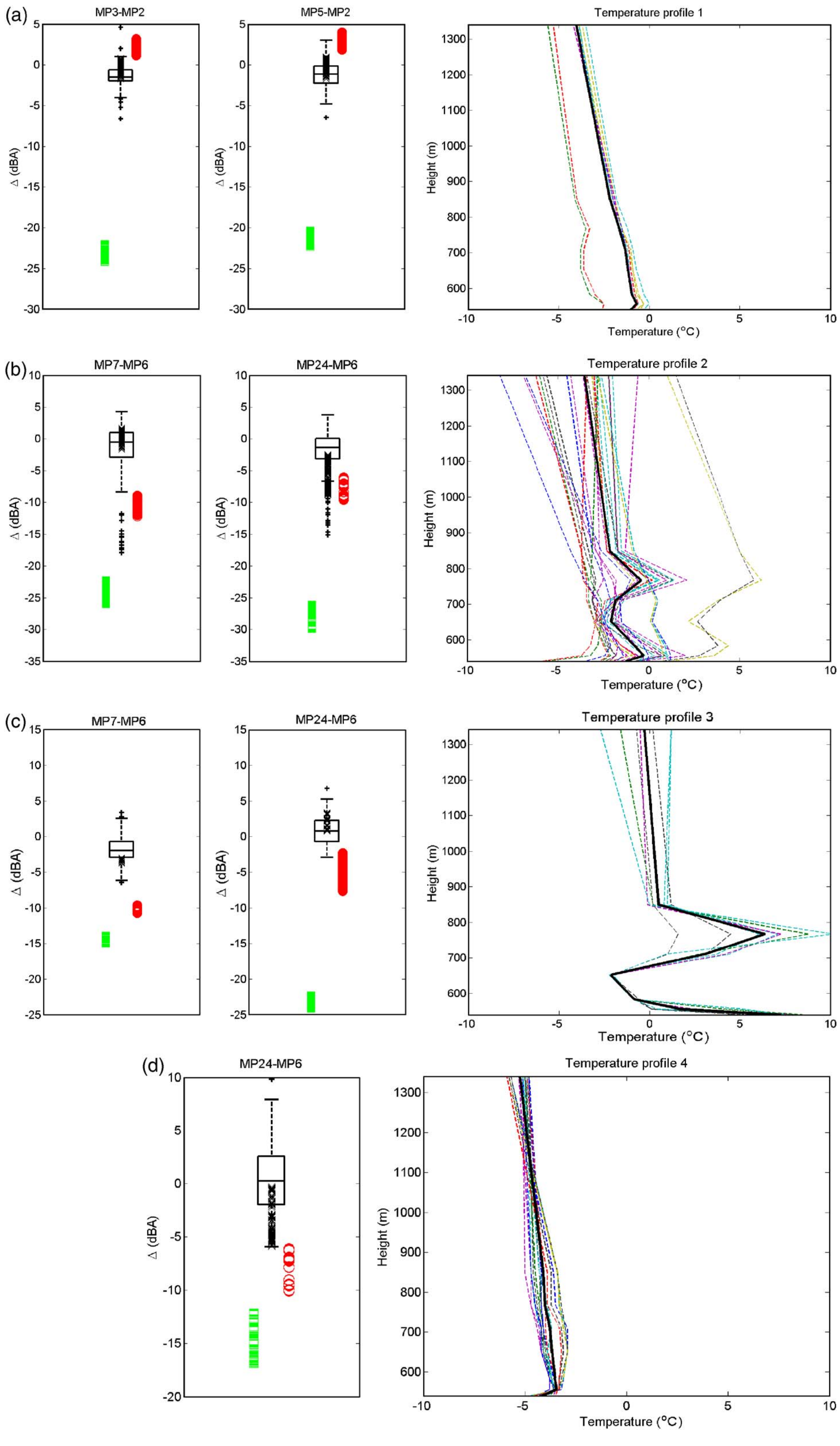

FIG. 5. (Color online) The figures on the left show a comparison between measurements and calculations. The measurements are represented by means of boxplots. + − signs indicate outliers of the measurements. The series of x − signs indicate the calculations accounting for the actual relief and the actual temperature profile (that can be compared to the measurements). The series of ○ − signs indicate the calculations with the actual relief in a homogeneous atmosphere, the series of □-signs indicate the calculations with a flat terrain in a homogeneous atmosphere. The figures on the right show the temperature profiles forming the clusters (dashed lines), together with the average temperature profiles that were used for the calculations (thick full lines). In part (a), cross section 1 is considered. The sound pressure levels at measuring points (MP) 3 and 5 are shown, relative to the sound pressure level at MP 2 (closest to the road). In parts (b), (c), and (d), cross section 2 is considered. In parts (b) and (c), the sound pressure levels at MP 7 and MP 24 are shown relative to MP 6, for two temperature profile clusters. In part (d), the sound pressure level at MP 24 relative to MP 6 is shown, for temperature profile cluster 4.

perature profile is included, a shift in the other direction is observed. The sound pressure level at microphone 2 slightly increases because of the thin temperature inversion layer very close to the ground. Microphones 3 and 5 receive less sound, because of the upward refracting atmosphere. As a result, the difference in sound pressure level, relative to the homogeneous atmosphere (with relief), decreases, and a relative sound pressure level near 0 dBA is found.

In cross section 2 (see Figs. 5(b)–5(d)), the effects of both the elevation of the terrain and the inhomogeneous atmosphere tend to decrease the difference in sound pressure level between the reference point and the more distant points. Qualitative analysis of what is happening is difficult because of the complex interaction of the mechanisms involved. The terrain profiles corresponding to the different source-receiver lines for microphone 24 are complex, and are

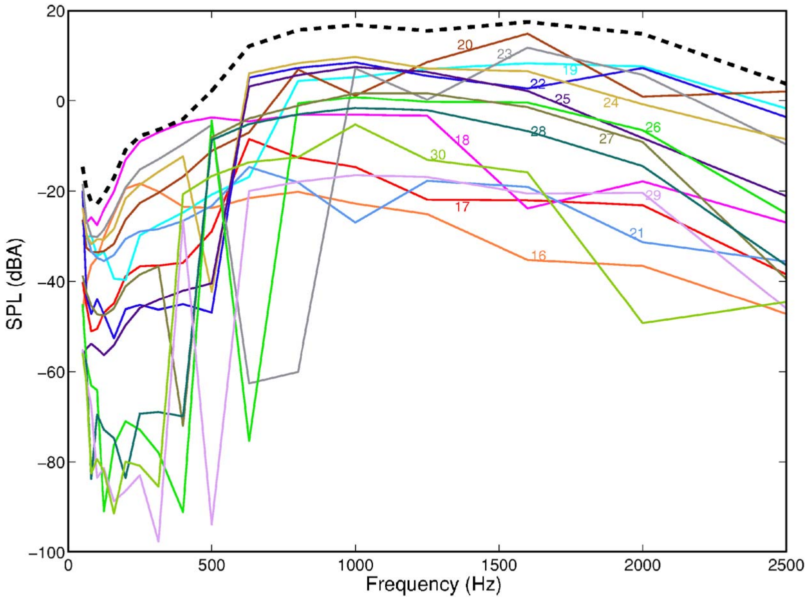

FIG. 6. (Color online) Calculated frequency spectrum at receiver 3 for the 15 most contributing sound paths. A passenger car at 110 km/h is assumed in each source point. The temperature is 0 °C, the relative humidity is 65%. Temperature profile 1 is used. The total A-weighted spectrum is indicated by the thick, dashed line. The magnitudes of the sound pressure levels are arbitrary. Source points after the refinement are not shown. For each source point, the frequency spectrum is clearly different.

characterized by a sudden increase in the elevation of the ground, close to the receiver. These profiles further contain successions of pronounced concave and convex parts. The strongly upward refracting part in temperature profile 3 (see Fig. 5(c)) results in an acoustic shadow zone. Limiting the attenuation in this situation is important to account for turbulent scattering (see Sec. IV D). The situation is further complicated because microphone 6 was placed on the roof of a building. This receiver was (slightly) shielded by the edge of the roof, and this intensifies differences in sound pressure level by the different states of the atmosphere. In contrast to a situation with direct sound, the contribution caused by atmospheric refraction, although small, results in an important increase in the sound pressure level. A similar conclusion could be drawn in the case of sound propagation between adjacent street canyons in an urban environment.[21] The numerical model nevertheless manages to produce sufficiently accurate results.

In both cross sections, the medians of the measured relative sound pressure levels range from −3 to 3 dBA. The relief in combination with the refracting atmosphere compensate for the effect of geometric divergence of the sound wave, ground attenuation and atmospheric absorption.

Note that the calculated relative sound pressure levels also change considerably in the case of a homogeneous atmosphere, because of changes in the magnitude of and the variation in atmospheric attenuation during the periods of the different temperature profile clusters. In the case of temperature profile 4 in cross section 2 (see Fig. 5(d)), the high and constant relative humidity in that period induces almost no atmospheric absorption. The variation in the calculations in that case is caused only by differences in the modeled source spectrum. In the other situations in cross section 2 (see Figs. 5(b) and 5(c)), lower values of relative humidity also occur, leading to more atmospheric absorption. As a result, about 10 dBA difference can be observed between the different clusters when considering the relative sound pressure levels at microphone 24 in the case of a flat and homogeneous atmosphere.

The calculations also allow one to have a closer look at, e.g., frequency spectra. In Fig. 6, the computed sound pressure levels of the 15 most contributing sound paths to the overall sound pressure level at receiver 3 are shown, as a function of frequency. Detailed geometrical information is shown in Figs. 7 and 8: the source-receiver lines plotted on the orthophotos, and the terrain profile between each source point and the receiver. The sound pressure level frequency spectrum for each sound path is clearly different. In Fig. 9, this same information is compacted to total A-weighted sound pressure levels per sound path. The sum of all sound paths (which is the data that are used for the comparison with measurements) is indicated with the horizontal line. The source point closest to the receiver is number 17. Its contribution to the total sound pressure level at the receiver is smaller than, e.g., for sound path 20. On the other hand, an important contribution could have been expected from point 21. As is clear from Fig. 9, this source point is not contrib-

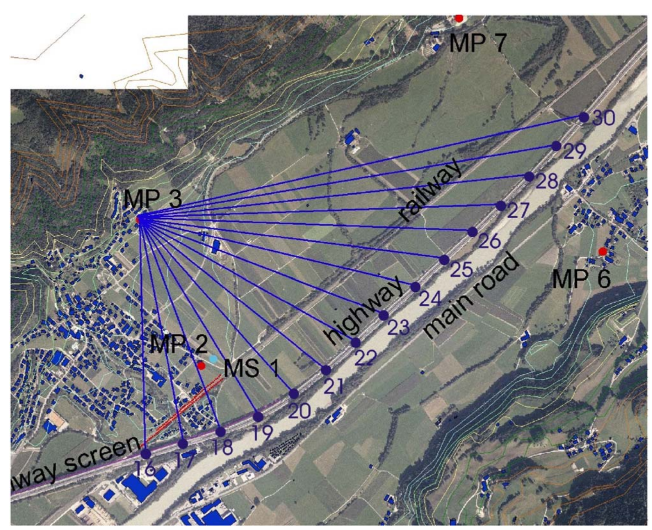

FIG. 7. (Color online) Orthophoto of the 15 source points under consideration for microphone position 3. The source points after refinement are not shown. Height contours are shown on the map.

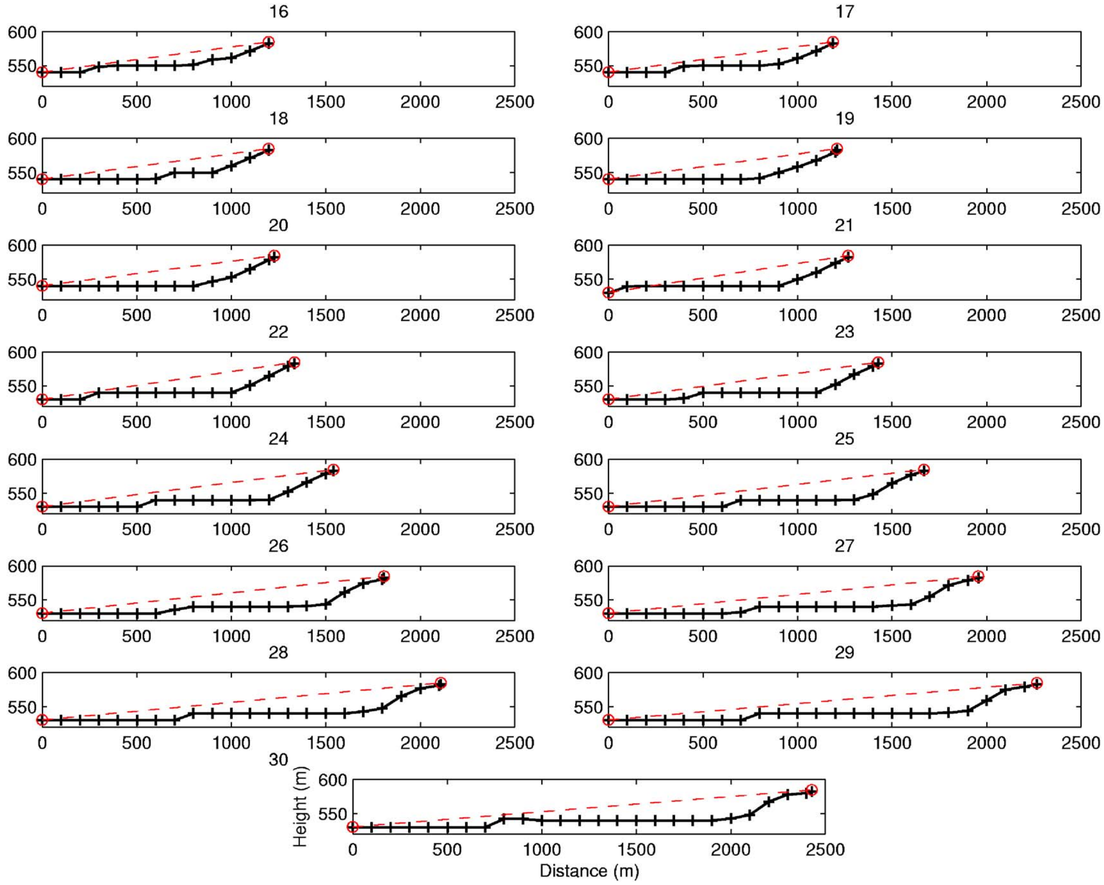

FIG. 8. (Color online) Terrain profiles for the 15 source points under consideration for microphone position 3. The distance towards the source is shown on the horizontal axis, the height is shown on the vertical axis. The source and the receiver (open circles) are connected with a straight, dashed line. The vertical axis is not true to scale. Source points after refinement are not shown.

uting to the sound field at the receiver; the difference in sound pressure level relative to source point 20 is more than 25 dBA. The relief is responsible for this. Starting from source point 21, the road becomes somewhat depressed. As a result, sound is shielded effectively at source point 21: There is no direct view between source and receiver. This analysis

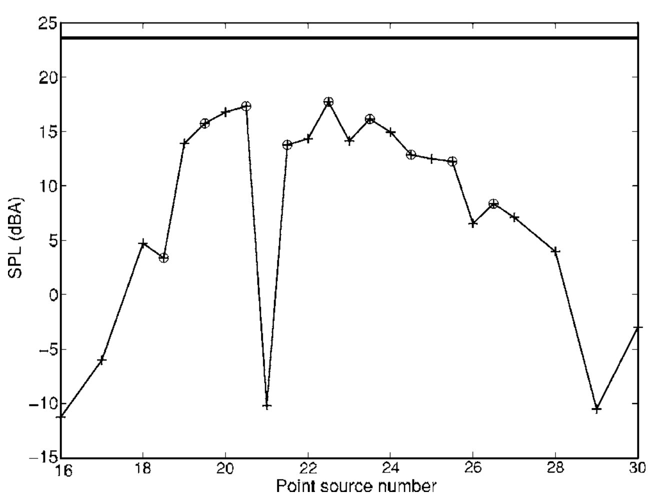

FIG. 9. Total A-weighted sound pressure level resulting from different sound paths, at microphone position 3. A description of the parameters involved is found in the caption of Fig. 6. The source points after refinement are shown with the open circles. The sum of all profiles is indicated with the horizontal line. The magnitudes of the sound pressure levels are arbitrary.

of the source points contributing to microphone position 3 clearly shows that the degree of detail included in our calculations is necessary.

VI. CONCLUSIONS

In this paper, a comparison is made between measured and calculated sound pressure levels in a valley-slope configuration, during windless periods without precipitation. A rotated Green's Function Parabolic Equation (GFrPE) method was used for the numerical calculations. Typical parameters related to GFrPE like the number of actual calculations needed near the transition of successive domains, and the maximum height to be considered on the starting fields, were optimized to increase computational efficiency.

A methodology is presented to calculate sound pressure levels from road traffic. This calculation methodology is related to the HARMONOISE reference model. The road traffic noise source is discretized by a number of point sources, and two-dimensional calculations are performed for each source-receiver vertical plane. The detailed sound propagation calculations include the undulation of the terrain, the presence of obstacles (like noise screens and houses), (ground) impedance discontinuities, and refraction by arbitrary sound speed profiles.

The agreement between numerical calculations and measurements is good; differences are smaller than 3 dBA. The

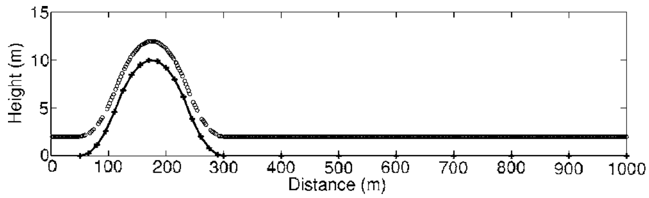

FIG. 10. Terrain profile used for the validation of the GFrPE model. The vertical axis is not true to scale. The open circles indicate the receiver positions.

spread of the sound pressure levels is similar for both the measurements and the calculations. Additional calculations allow one to separate effects from the relief and the refractive state of the atmosphere. The elevation of the terrain is responsible for an increase in the sound pressure level at distant points up to 30 dBA. The temperature profiles observed in this mountainous area are complex and contain upward and downward refracting parts. Their influence ranges from −3 dBA to +10 dBA. The sound pressure levels at the distant points, relative to the reference points, are in most cases near 0 dBA. The relief in combination with the refracting atmosphere compensates the expected decrease in sound pressure level caused by geometric spreading of sound, ground attenuation and atmospheric absorption.

The detailed validation of the GFrPE model for valleys in mountainous areas shows both that the proposed model is accurate enough to predict sound levels up to distances of 1000 m and that further simplification of full wave calculations is not possible. Although computational requirements are strongly reduced by careful tuning of the numerical parameters, the GFrPE method remains too computationally demanding to be used in noise mapping. The method is nevertheless very well suited as a reference model to which an engineering approach—to be used in the noise mapping process—can be validated, also in this particular valley-slope context.

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APPENDIX: VALIDATION OF THE GFrPE METHOD

The GFrPE code is validated for the case of the smooth hill presented in Ref. 10. The height of the top is 10 m, and the hill is stretched over a distance of 200 m (see Fig. 10). A reference solution with the General Terrain Parabolic Equation method (GTPE)[22] in this configuration is found in Ref. 10. The effect of this hill on sound propagation is significant, notwithstanding the fact that the height of the top is only 10 m and that the slope angles are limited. The source is situated 2 m above the ground; a set of receivers is placed 2 m above the ground as well, up to a distance of 1000 m from the source. The sound frequency is 300 Hz. The one-parameter Delany and Bazley ground impedance model[19] is used with a flow resistivity of 200 kPa s/m^2. A logarithmic, sound speed profile $340+\ln(z/0.1+1)$ m/s is used, where z is the height above the ground in meters.

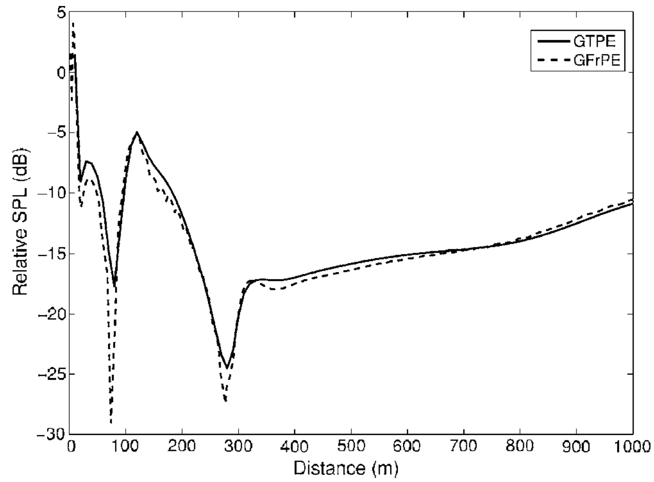

FIG. 11. Comparison between GTPE and GFrPE results in the case of the configuration shown in Fig. 10. The sound pressure level, relative to free field sound propagation, is shown with distance, for a sound frequency of 300 Hz. The one-parameter Delany and Bazley ground impedance model is used with a flow resistivity of 200 kPa s/m^2, in a downward refracting atmosphere.

The following parameters are used during the GFrPE calculations. A standard Gaussian starter[5,6] is applied. In vertical direction, ten points per wavelength (λ) are used. The horizontal propagation step is 2λ. Every 15 m, a new flat domain is used to discretize the hill (see Fig. 10). The thickness of the absorbing layer on top of the computational domain is 150λ. Inside this layer, an imaginary term is added to the wave number equal to $iA_t(z-z_t)^2/(z_M-z_t)^2$, where z is the height, z_t is the height where the absorbing layer starts, and z_M is the top of the computational domain. The optimum choice of the constant coefficient A_t depends on frequency and is chosen to be 0.5.[10]

In Fig. 11, a comparison between GFrPE and GTPE is shown. The sound pressure level is expressed relative to free field sound propagation. The agreement between both models is very good. The terrain in the GFrPE calculation is not completely smooth because of the subdivision in flat segments. This causes some small, local distortions of the sound field, especially in the shadow zone of the hill. GFrPE results in a somewhat stronger destructive interference as well.

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Attachment 8 – Clinton D. Francis, et. al., Noise Pollution Alters Ecological Services: Enhanced Pollination and Disrupted Seed Dispersal, (Feb. 28, 2012).

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Noise pollution alters ecological services: enhanced pollination and disrupted seed dispersal

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Noise pollution is a novel, widespread environmental force that has recently been shown to alter the behaviour and distribution of birds and other vertebrates, yet whether noise has cumulative, community-level consequences by changing critical ecological services is unknown. Herein, we examined the effects of noise pollution on pollination and seed dispersal and seedling establishment within a study system that isolated the effects of noise from confounding stimuli common to human-altered landscapes. Using observations, vegetation surveys and pollen transfer and seed removal experiments, we found that effects of noise pollution can reverberate through communities by disrupting or enhancing these ecological services. Specifically, noise pollution indirectly increased artificial flower pollination by hummingbirds, but altered the community of animals that prey upon and disperse *Pinus edulis* seeds, potentially explaining reduced *P. edulis* seedling recruitment in noisy areas. Despite evidence that some ecological services, such as pollination, may benefit indirectly owing to noise, declines in seedling recruitment for key-dominant species such as *P. edulis* may have dramatic long-term effects on ecosystem structure and diversity. Because the extent of noise pollution is growing, this study emphasizes that investigators should evaluate the ecological consequences of noise alongside other human-induced environmental changes that are reshaping human-altered landscapes worldwide.

Keywords: anthropogenic noise; birds; ecological service; human disturbance; pollination; seed dispersal

1. INTRODUCTION

Human activities have altered over 75 per cent of the Earth's land surface [1,2]. Concomitant with these surface changes is a pervasive increase in anthropogenic noise, or noise pollution, caused by expanding dendritic transportation networks, urban centres and industrial activities [3]. The geographical extent of noise exposure varies by region and scale, but estimates suggest that one-fifth of the United States' land area is impacted by traffic noise directly [4] and over 80 per cent of some rural landscapes are exposed to increased noise levels owing to energy extraction activities [5]. Despite the potentially substantial scale of noise exposure across the globe, surprisingly little is known about how these ecologically novel acoustic conditions affect natural populations and communities.

We are beginning to understand the impacts of increased noise exposure on the behaviours of individuals and the distributions of species [6–10], and several recent reviews outline potential and some known effects of noise [3,11–13]. Despite this recent attention given to the effects of noise, we still have limited knowledge of how these impacts scale to community and ecosystem-level processes. A few studies have shown that predators avoid noisy areas [7,14–16], presumably because noise impairs predators' abilities to locate prey. These studies provide us with insights on how noise may directly affect predator–prey interactions, but do not provide information on whether noise may have cumulative, indirect consequences for other interactions and organisms that are not impacted by noise directly.

Our goal was to investigate whether noise pollution can reverberate through ecological communities by affecting species that provide functionally unique ecological services. We focused our efforts on ecological services provided primarily by birds because they are considered to be especially sensitive to noise pollution owing to their reliance on acoustic communication [11]. However, because not all species respond uniformly to noise exposure [6,7,10,17], we can evaluate how different responses by functionally unique species impact other organisms indirectly and trigger further changes to community structure. We studied ecological services provided by *Archilochus alexandri* (black-chinned hummingbird) and *Aphelocoma californica* (western scrub-jay), which serve as mobile links for pollination and *Pinus edulis* (piñon) seed dispersal services, respectively [18–20]. Because *A. alexandri* preferentially nests in noisy environments and *A. californica* avoids noisy areas [5,7], we proposed that their noise-dependent distributions could result in a higher rate of pollination

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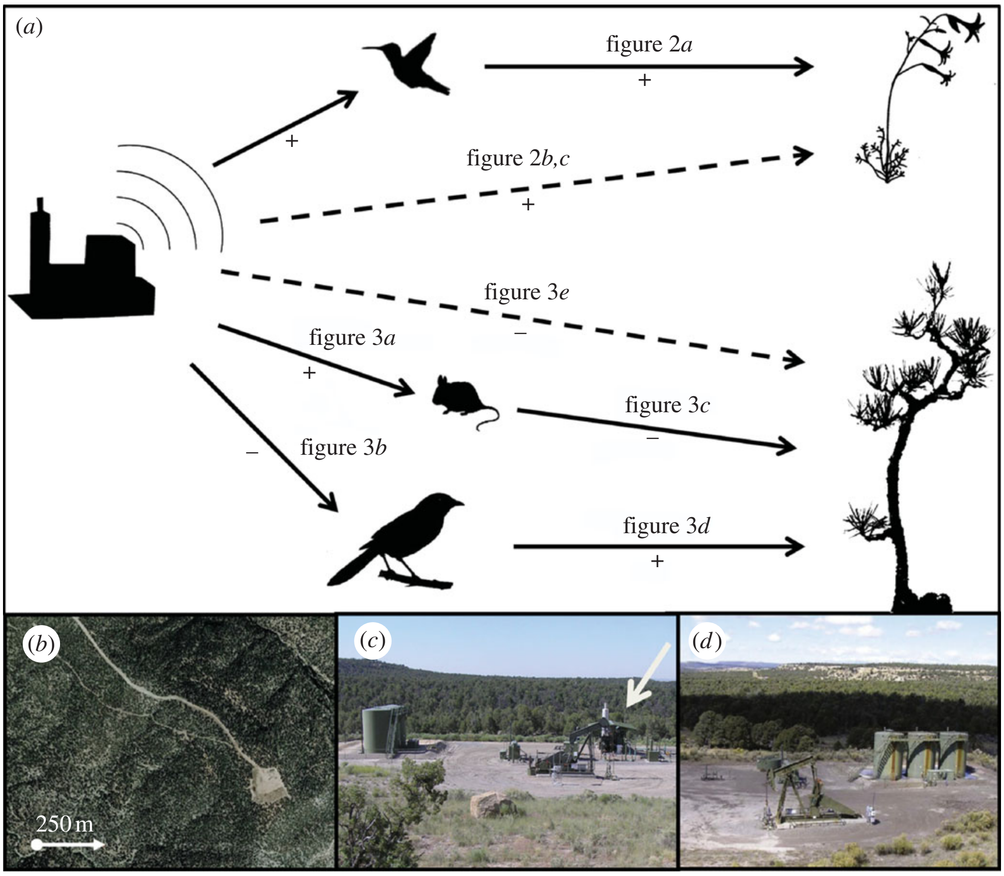

Figure 1. (*a*) Pathway by which noise alters pollination and seed dispersal services. Solid and dashed arrows denote direct and indirect interactions, respectively. Signs refer to effect direction, and support for each effect is indicated by figure number. See main text for results and citations supporting the dependence of *I. aggregata* on *A. alexandri* (arrow labelled figure 2*a*) and for the functional quality of *Peromyscus* mice and *A. californica* as *P. edulis* seed dispersers (arrows labelled figure 3*c*,*d*). (*b*) Active gas wells located at the end of access roads served as (*c*) noisy treatment sites owing to the presence of noise-generating gas well compressors (white arrow) or (*d*) quiet control sites.

for hummingbird-pollinated plants and disrupt *P. edulis* seed dispersal services in noisy areas and potentially affect seedling recruitment (figure 1*a*).

To test these predictions, we used a unique study system that isolates the influence of noise exposure from many confounding factors common to noisy areas, such as vegetation heterogeneity, edge effects and the presence of humans and moving vehicles (see below). We used observations, vegetation surveys and pollen transfer and seed-removal experiments on pairs of treatment and control sites to determine how ecological interactions differ in noisy and quiet areas and whether noise indirectly affects plants that depend on functionally unique avian mobile links.

2. MATERIAL AND METHODS

Our study took place in the Rattlesnake Canyon Habitat Management Area (RCHMA), located in northwestern New Mexico. Study area and site details can be found elsewhere [5–7]. Briefly, RCHMA is dominated by woodland consisting of *P. edulis* and *Juniperus osteosperma* (juniper) and has a high density of natural gas wells (figure 1*b*). Many wells are coupled with compressors that run continuously and generate noise at high amplitudes (greater than 95 dB(A) at a distance of 1 m), and, like most anthropogenic noise, compressor noise has substantial energy at low frequencies and diminishes towards higher frequencies (electronic supplementary material, figure S1) [5–7]. Additionally, human activity at wells and major vegetation features in the woodlands surrounding wells do not differ between wells with (noisy treatment sites) and without noise-generating compressors (quiet control sites, figure 1*c*,*d*) [7], providing an opportunity to evaluate the indirect effect of noise on supporting ecological services in the absence of many confounding stimuli common to most human-altered landscapes.

(a) *Pollination experiment*

To determine whether hummingbird-pollinated flowers indirectly benefit from noise, we used a field experiment controlling for the density and the spatial arrangement of hummingbird nectar resources with patches of artificial flowers that mimicked a self-incompatible, hummingbird-pollinated plant common to our study area: *Ipomopsis aggregata* (electronic supplementary material, figures S2 and S3*a*). In May 2010, we established seven pairs of treatment and control sites within RCHMA for the pollination experiments. Sites were paired geographically to minimize potential differences in vegetation features within each pair; however, to ensure that background noise levels were significantly different between paired sites, sites were greater than or equal to 500 m apart and resulted in relatively quiet conditions at control sites. The resulting distance between treatment-control pairs was 767 m (±57 s.e.m., minimum = 520 m, maximum = 954 m).

Artificial flower patches were established 125 m from either the wellhead or compressor on control and treatment sites, respectively (electronic supplementary material, figure S2*a*). The direction of the first patch relative to the wellhead or compressor was determined randomly and the second patch was established 40 m from the first and also at 125 m from the wellhead or compressor. Prior to the experiment, at each patch, we measured background noise amplitude as A-weighted decibels (dB(A)) for 1 min to confirm that noise levels were significantly higher at treatment patches relative to control patches. In all cases, measurements on paired treatment and control sites were completed on the same day and at approximately the same time. We measured amplitude as the equivalent continuous noise level (L_{eq}, *fast* response time) with Casella convertible sound dosimeter/sound pressure metres (model CEL 320 and CEL 1002 converter). We used 95 mm acoustical windscreens, and we did not take measurements when wind conditions were categorized three or above on the Beaufort Wind Scale (approx. 13–18 km h^{-1}), or when sounds other than compressor noise (i.e. bird vocalizations and aircraft noise) could bias measurements.

Artificial flowers are frequently used in pollination studies [21,22] and those used in our experiment were constructed from 0.6 ml microcentrifuge tubes. This microcentrifuge tube size had been used previously in pollination experiments with *A. alexandri* [23]. To mimic the appearance of *I. aggregata*, we wrapped each microcentrifuge tube with red electrical tape (electronic supplementary material, figure S3). Additionally, we attached three small pieces of yellow yarn to provide a substrate for marking flowers with fluorescent dye and subsequent transfer and deposition on other flowers by pollinators. Each artificial plant consisted of three flowers attached to a 53 cm long metal rod with green electrical tape (electronic supplementary material, figure S3*b*). Patches of plants were arranged in a 3 m^2 area with four plants marking each corner and one at the centre (electronic supplementary material, figure S2*a*).

Plant patches were established simultaneously or one immediately after another (less than or equal to 30 min) on paired sites. Because *I. aggregata* nectar is 20–25% sucrose [24,25], we filled each flower with a reward of 0.4 ml 25 per cent sucrose solution with pipettes and calibrated plastic droppers, returning each day at approximately the same time to refill the flower with the sucrose reward so that pollinators learned to use the flowers as a foraging resource. Only rarely did we encounter a single artificial flower completely depleted of the reward between visits to replenish the reward, but never all three flowers on the same plant.

We conducted observations to determine pollinator visitation rates at 11 (79%) of 14 pairs of treatment and control patches. Because the establishment of our patches took several days, prior to our observations, four pairs of patches were refilled for 4 days, two patches were refilled for 3 days and five patches were refilled for 2 days and all observed patches had been established for greater than 38 h prior to observation. We then conducted observations at patches on pairs of control and treatment sites simultaneously or one immediately after the other. We watched flowers at focal patches for 15 min and tallied the number of visits to each plant from a distance of 5 m, using binoculars when necessary to identify arthropods visiting the flowers. All non-hummingbird pollinators were separated into their orders (Hymenoptera, Diptera and Lepidoptera) and we used Poisson generalized linear-mixed models (GLMM) within the lme4 package in R [26] to examine whether patch visitations by *A. alexandri* or other pollinators differed between treatment and control sites. Individual sites and geographically paired sites were treated as random effects.

Following focal observations, on 28 May 2010, we returned to all patches between 07.00 and 12.00 to refill all artificial flowers with the sucrose reward and uniquely marked one plant per patch with either yellow or red fluorescent powder (Day-Glo Color Corporation, Cleveland, Ohio, USA) such that plants within the same site but at different patches received a unique coloured powder. Use of fluorescent powder as a proxy for pollen transfer is a technique widely used in pollination studies because the transfer of powder is strongly correlated with the transfer of pollen [27,28]. Each patch was permitted 24 h of exposure for pollinator visits before we collected each plant for subsequent examination for powder transfer in the laboratory.

In the laboratory, we used an ultraviolet lamp under dark conditions to record the presence or absence of powder on each inflorescence, noting whether the powder was from the marked plant within the same patch or the patch located at 40 m. We then used Poisson GLMMs to examine within-patch and between-patch pollen transfer with number of individual flowers per patch with transferred pollen as response variables. We treated each site and geographically paired treatment and control site as random effects in all models.

(b) Pinus edulis *seed-removal experiment*

We conducted *P. edulis* seed-removal experiments throughout RCHMA to determine whether and how seed-removal rates and the community of seed predators and dispersers respond to noise exposure. *Pinus edulis* trees within a region typically synchronize production of large-cone crops every 5–7 years [20]. As cones gradually dry and open in September, seeds not harvested by corvids from cones in the canopy fall to the ground where rodents, corvids and other bird species consume and harvest seeds for several months [20]. Monitoring rates of autumn seed removal from the ground can be problematic as seeds continue to fall from trees; therefore, we conducted our experiments in June–July when no other *P. edulis* seeds were available, similar to other studies that have examined *P. edulis* seed removal and dispersal during summer months [29].

We used six pairs of treatment and control sites that were geographically coupled. Sites met those same criteria described for the pollination experiment. The mean distance between treatment-control pairs was 821 m (±51 s.e.m., minimum = 642 m, maximum = 1029 m). At each site, we established seed stations at 10 locations within 150 m of each well or compressor (electronic supplementary material, figure S2*b*). Locations were selected randomly provided that the distance between each station was greater than or equal to 40 m, and each station was located on the ground under a reproductively mature *P. edulis* tree.

Seed-removal experiments lasted for 72 h with visits to each station every 24 h to quantify the daily rate of seed removal. At the beginning of each 24 h period, we simulated natural seed fall by scattering 20 *P. edulis* seeds on the ground in a 0.125 m^2 area. We then returned 24 h later to document the number of removed seeds, determine whether there was evidence for *in situ* seed predation by carefully searching the immediate area (approx. 2 m^2) for newly opened *P. edulis* seeds (usually conspicuous as a clumped collection of seed-coat fragments from several seeds) and to again scatter 20 seeds at the station. Evidence of seed predation at a station was defined as whether recently opened (and empty) seed coats were detected during any of the three visits used to quantify seed-removal rate. All seeds were collected locally within RCHMA and were handled with latex gloves so that human scent was not transferred to the seeds. During one of the four visits to each station, we measured background noise amplitude following the methods described above for the pollination experiment.

To document the identity of animals removing seeds, we paired each station with a motion-triggered digital camera (Wildview Xtreme II). Cameras were mounted on a trunk or a branch of an adjacent tree within 1–3 m from the seed station for a clear view, yet positioned in a relatively inconspicuous location to avoid drawing additional attention to the station. Cameras remained on each station for the entire 72 h period and documented both diurnal and nocturnal seed removal. A positive detection of a species removing seeds was recorded only when an individual was documented removing or consuming seeds.

The number of seeds removed per 24 h period was used to calculate a daily mean proportion of seeds removed, which we arcsine square-root transformed to meet assumptions of normality and homogeneity of variance. We used linear-mixed models (LMMs) to examine whether the proportion of seeds removed differed between treatment and control seed stations or owing to the presence or absence of individual species. We used binomial GLMMs to determine how the presence of individual species explained *in situ* seed predation, evidenced by the presence of newly opened *P. edulis* seed coats. For the models in which we examined the influence of individual species on seed removal or predation, we started with models containing all documented species as predictor variables and proceeded to remove each non-significant variable one at a time based on the highest p-value until only significant effects remained. We used Poisson and binomial GLMMs to examine whether species richness of the seed removing community and detections of individual species differed at treatment and control seed stations, respectively. For all models, we treated each site and geographically paired treatment and control sites as random effects. Some models evaluating detections of individual species on treatment and control sites would not converge; therefore, for these cases, we used χ^2-tests to determine whether there was a difference between the total number of detections on control and treatment sites.

(c) *Seedling recruitment surveys*

In 2007, we completed 129 random vegetation surveys on 25 m diameter vegetation plots (approx. 490 m^2) located on nine treatment and eight control sites, some of which were not the same sites used in the seed-removal experiments, which included only six pairs of sites (12 total). Ten treatment sites were surveyed in 2007, but we excluded vegetation plots from one site from this analysis because the compressor was installed in 2006, thus confounding the acoustic conditions during which many seedlings may have been established (see below). Compressors on all other treatment sites had been in place for at least 6 years, but over 10 years for several sites.

Because our fieldwork in previous years had documented an avoidance of noise by *A. californica* [7], in 2007, we counted all *P. edulis* seedlings per vegetation plot. We restricted counts of seedlings to those less than or equal to 20 cm to make sure that they had been dispersed and established relatively recently and under the same acoustic conditions that were present in 2007. We assumed seedlings less than or equal to 20 cm had been dispersed and established within the previous 6 years because 1 year-old *P. edulis* seedlings were measured to have an average height of 5.3 cm [30] and because the closely related *Pinus cembroides* reaches a height of 1 m at around 5 years old [31]. Thus, our assumptions should be considered conservative. We analysed seedling recruitment with the number of seedlings per plot as the response variable using Poisson GLMMs. Predictor variables included plot location on either a treatment or control site, but also plot-level features that may influence seedling establishment and recruitment, such as the number of shrubs, *P. edulis* and *J. osteosperma* trees, the amount of canopy cover, leaf litter depth and the proportion of ground cover classified as living material, dead matter or bare ground. Site identity was treated as a random effect. We followed the same model selection procedure described above for seed removal and seed predation. Data for seedling recruitment, plus data from the seed removal and pollination experiments have been deposited at Dryad (www.datadryad.org; doi:10.5061/dryad.6d2ps7s7).

3. RESULTS

(a) *Pollination*

Noise amplitude values were significantly higher (approx. 12 dB(A)) at treatment patches relative to control patches (LMM: $\chi^2_1 = 25.550, p < 0.001$, electronic supplementary material, figure S2*c*) and similar to those experienced approximately 500 m from motorways [32,33]. Focal observations at a subset of patches revealed that several taxa visited artificial flowers supplied with a nectar reward (electronic supplementary material, table S1), yet only *A. alexandri* visits differed between treatment and control sites. *Archilochus alexandri* visits were five times more common at treatment patches than control patches (Poisson GLMM: $\chi^2_1 = 6.859, p = 0.009$, figure 2*a*).

Consistent with more *A. alexandri* visits to plants in noisy areas, within-patch pollen transfer occurred for 5 per cent of control site flowers, but 18 per cent of treatment site flowers (Poisson GLMM: $\chi^2_1 = 15.518, p < 0.001$, figure 2*b*) and between-patch pollen transfer occurred for 1 per cent of control site flowers and 5 per cent of treatment site flowers (Poisson GLMM: $\chi^2_1 = 6.120, p = 0.013$, figure 2*c*). Analyses using the presence or absence of transferred pollen at the patch level revealed the same pattern (within-patch binomial GLMM: $\chi^2_1 = 8.800, p = 0.003$; between-patch binomial GLMM: $\chi^2_1 = 5.608, p = 0.018$).

(b) Pinus edulis *seed removal*

Noise amplitude values were consistently higher (approx. 14 dB(A)) at treatment seed stations relative to control seed stations (LMM: $\chi^2_1 = 19.084, p < 0.001$, electronic supplementary material, figure S2*d*), yet neither seed-removal rate (LMM: $\chi^2_1 = 2.209, p = 0.137$), nor documented species richness per seed station differed between sites with and without noise (Poisson GLMM: $\chi^2_1 = 0.461, p = 0.497$).

The majority of animals detected with motion-triggered cameras removing seeds from stations were easily identified to species; however, for two groups, *Peromyscus* mice and *Sylvilagus* rabbits, we were not always able to identify individuals to species; therefore, they were assigned to their

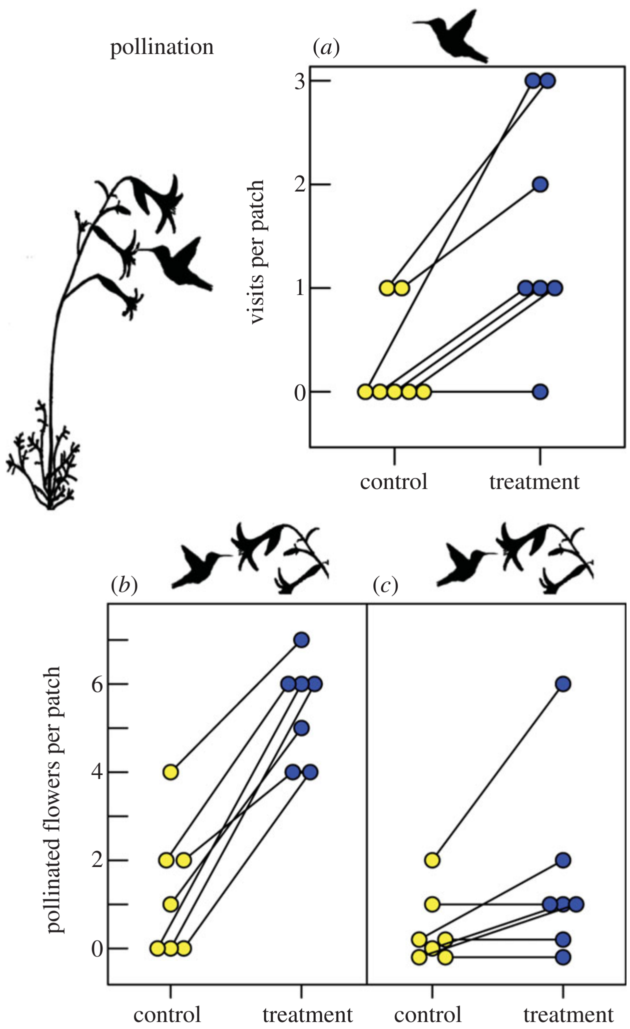

Figure 2. Evidence from pollination experiment. (*a*) *Archilochus alexandri* visited artificial flowers on noisy treatment patches more than quiet control site patches. The values displayed reflect the sum of visits per site (14 sites total with two patches per site, five plants per patch and three flower per plant). (*b*,*c*) Pollination of individual flowers was higher on treatment sites relative to control sites both (*b*) within and (*c*) between patches. Values displayed reflect the sum of pollinated flowers in both patches per site. (*a*-*c*) Lines link geographically paired sites.

respective genera. In total, we document 11 taxa removing seeds, nine of which were considered seed predators (electronic supplementary material, table S2). Cameras failed to detect the identity of animals that removed seeds at approximately one station per site, primarily owing to battery failure. However, there was no difference in the number of camera failures between treatment and control sites that would suggest our detections were biased towards one site type over the other (binomial GLMM: $\chi^2_1 = 0.240$, $p = 0.624$); therefore, any relative differences in detections between treatment and control sites should reflect actual differences between noisy and quiet areas.

Of the nine seed predators documented removing seeds, only one, *Pipilo maculatus*, was detected more frequently on control sites relative to treatment sites (binomial GLMM: $\chi^2_1 = 4.133$, $p = 0.042$); a pattern consistent with previous findings that *P. maculatus* avoids noise in its nest placement [7]. We also documented seed removal by *Peromyscus* mice and *A. californica*, considered to be primarily seed predators and important seed dispersers, respectively [20]. Mice were detected at 63 per cent of treatment seed stations and only 45 per cent of control stations (binomial GLMM: $\chi^2_1 = 4.023$, $p = 0.045$; figure 3*a*). By contrast, *A. californica* was detected removing seeds exclusively at control stations ($\chi^2_1 = 5.486$, $p = 0.019$; figure 3*b*). *Peromyscus* mice and *A. californica* were also the only taxa with strong effects on seed removal and, along with *Tamias minimus*, were taxa with strong influences on patterns of seed predation at the seed station (i.e. presence of opened seed coats). Seed removal rates were approximately 30 per cent higher at stations where *Peromyscus* mice or *A. californica* were documented removing seeds compared with stations where they were not detected (LMM: $\chi^2_2 = 35.775$, $p < 0.001$; figure 3*c*,*d*). Seed predation was positively affected by the presence of *Peromyscus* mice ($\beta_{\text{mouse}} = 0.841 \pm 0.412$ s.e.) and *T. minimus* ($\beta_{\text{chipmunk}} = 1.199 \pm 0.544$ s.e.), both typically considered seed predators [20], but negatively affected by the presence of *A. calilfornia* ($\beta_{\text{scrub-jay}} = -2.031 \pm 1.005$ s.e.; binomial GLMM: $\chi^2_3 = 13.748$, $p = 0.003$). Indeed, most stations where *Peromyscus* mice (74%) and *T. minimus* (81%) were detected also had evidence of seed predation, but only 33 per cent of stations where *A. california* was detected were there signs of seed predation.

(c) Pinus edulis *seedling recruitment*

Consistent with the difference in animals removing seeds in noisy and quiet areas, *P. edulis* seedlings were four times more abundant on control sites relative to treatment sites ($\beta_{\text{Treatment}} = -1.543 \pm 0.240$ s.e.; figure 3*e*), but number of *J. osteosperma* trees ($\beta_{\text{Juniper}} = 0.036 \pm 0.016$ s.e.) and the proportion of dead organic ground cover ($\beta_{\text{Dead}} = 0.023 \pm 0.008$ s.e.) had small, positive effects on seedling abundance (Poisson GLMM: $\chi^2_3 = 38.583$, $p < 0.001$). However, neither of these variables, nor number of *P. edulis* trees, differed between treatment and control sites (juniper LMM: $\chi^2_1 = 0.726$, $p = 0.394$; dead ground cover LMM: $\chi^2_1 = 0$, $p = 1.0$; *P. edulis* LMM: $\chi^2_1 = 2.560$, $p = 0.110$), suggesting that other habitat features can be excluded as alternative explanations for *P. edulis* seedling recruitment on treatment and control sites.

4. DISCUSSION

Elevated noise levels affected pollination rates by hummingbirds and *P. edulis* seed dispersal and seedling recruitment, but the direction of each effect was different. Noise exposure had an indirect positive effect on pollination by hummingbirds, but an indirect negative effect on *P. edulis* seedling establishment by altering the composition of animals preying upon or dispersing seeds. These results extend our knowledge of the consequences of noise exposure, which has primarily focused on vocal responses to noise [8,34,35], somewhat on species distributions and reproductive success [7,10,32,36] and very little on species interactions [7,14–16]. In an example of the latter, traffic noise negatively affects bat (*Myotis myotis*) foraging efficiency by impairing its ability to locate prey by listening to sounds generated from prey movement [14]. Here, our data demonstrate that the frequency of species interactions can change without a direct effect of noise on the interaction itself, suggesting that noise exposure may trigger changes to numerous ecological interactions and reverberate through communities.

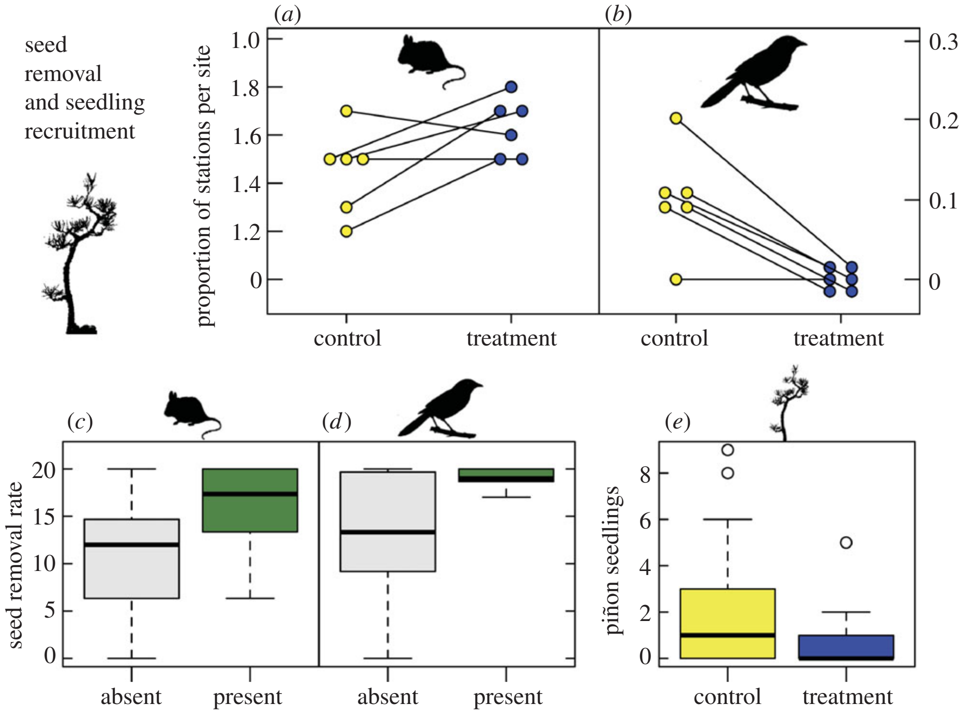

Figure 3. (*a*) *Peromyscus* mice were detected more frequently at treatment seed stations relative to control stations. (*b*) *A. californica* removed seeds exclusively on control sites. Values displayed in (*a*) and (*b*) reflect the proportion of seed stations per site where mice or jays were detected. (*c*,*d*) Seed removal rates (per 24 h) were higher when (*c*) *Peromyscus* mice or (*d*) *A. californica* were detected at a seed station. (*e*) *Pinus edulis* seedling recruitment was significantly higher on control sites relative to treatment sites. Box plots indicate the median value (solid black line), 25th and 75th percentiles (box), and whiskers denote 1.5 the interquartile range. Outliers are denoted by open circles.

Increases in pollination rates were in line with our prediction based on the positive responses to noise by *A. alexandri*, both in terms of nest-site selection [7] and abundances determined from surveys [17]. Our experimental design and use of artificial flowers were advantageous because we could control for variation in density and the spatial arrangement of nectar resources that can influence pollination patterns [37]. However, this approach precluded us from determining whether increases in pollination in noisy areas results in greater seed and fruit production. This is probable for *I. aggregata* because it can be pollen limited throughout its range [38–40] and fruit set is strongly correlated with pollinator (e.g. hummingbird) abundance [18]. Therefore, noise-dependent increases in *A. alexandri* abundances [7,17] coupled with increases in visits to artificial flowers in this study is suggestive that *I. aggregata* plants exposed to elevated noise levels may have greater reproductive output relative to individuals in quiet areas.

Seed removal, seed predation and seedling recruitment data were consistent with one another and our expectations, suggesting that noise has the potential to indirectly affect woodland structure. It is plausible that the suite of species removing seeds may differ in June and July when we conducted our study from that found in the autumn when seeds are typically available. Yet, all species documented removing seeds are year-round residents and their relative abundances are unlikely to fluctuate between treatment and control sites throughout the year. Instead, it is more likely that we underestimated the magnitude of the difference in seed dispersal quality between noisy and quiet areas for two main reasons. First, because *A. californica* typically provision young with protein-rich animal prey [41], individuals at our study area may have been foraging primarily on animal prey rather than *P. edulis* seeds during our experiments. Second, our use of seed stations on the ground did not account for seed removal from cones in the canopy by other important seed dispersers, such as *Gymnorhinus cyanocephalus* (piñon jay); a species that occurs in RCHMA, but also avoids noisy areas [7,42]. The degree to which these factors contribute to reduced seedling recruitment in noisy areas is unknown, but provides an interesting avenue of research for future study.

Although, *A. californica* and *Peromyscus* mice had the greatest influence on seed-removal rates, we were unable to track the fate of individual seeds. Nevertheless, these species influenced patterns of seed predation in a manner consistent with knowledge of how these species differ as mobile links for *P. edulis* seed dispersal and seedling establishment. Evidence of seed predation was less common at seed stations visited by *A. californica*, potentially reflecting its role as an important disperser of *P. edulis* seeds. For example, one *A. californica* individual may cache up to 6000 *P. edulis* seeds in locations favourable for germination during a single autumn [43]. Many seeds are relocated and consumed, but many go unrecovered and germinate [20]. By contrast, although *Peromyscus* mice might function as conditional dispersers under some circumstances [44,45], here their presence at a seed station was a strong predictor of seed predation, reflecting their primary role as seed predators [20]. Previous research using experimental enclosures to study caching behaviour in the field supports our findings [29,44]. *Peromyscus* mice consume a large proportion (approx. 40%) of encountered seeds and typically cache many encountered seeds that are not immediately consumed [44]. Yet, cached seeds are often recovered and eaten (greater than 80%) along with seeds cached by other individuals or species [29]. Thus, the reduced density of seedlings in noisy areas could be explained not only by fewer seeds entering the seed bank as a result of reduced densities of important avian seed dispersers that cache many thousands of seeds, but because seeds present within the seed bank experience elevated rates of predation via cache pilfering associated with noise-dependent increases in *Peromyscus* mice.

Despite the concordance between our findings and the literature regarding the roles of *A. californica* and *Peromyscus* mice on *P. edulis* seed dispersal and predation, seedling mortality caused by key seedling predators, such as *Odocoileus hemionus* (mule deer) and *Cervus canadensis* (elk), could potentially explain the higher density of seedlings in quiet relative to noisy areas. However, ungulates such as *C. canadensis* appear to avoid areas exposed to noise from high traffic volume [46], suggesting that seedling mortality owing to browsing ungulates should be greater in areas with less noise and leading to a pattern opposite from that which we observed. Still needed are confirmatory studies that track the fate of cached seeds and document patterns of seedling predation within noisy and quiet areas.

Despite the downstream consequences of species-specific response to noise exposure, the mechanistic reasons for species-specific responses are still not clear. *Aphelocoma californica* may avoid noisy areas because noise can mask their vocal communication. Larger birds with lower frequency vocalizations are more sensitive to noise than smaller species with higher frequency vocalizations because their vocalizations overlap low-frequencies where noise has more acoustic energy [17]. *Aphelocoma californica* is also the main nest predator in the study area [7,16] and it is possible that noise masks acoustic cues used to locate prey at nests (e.g. nestling and parent calls). It is also possible that these forms of acoustic interference may lead to elevated stress levels that could influence patterns of habitat use [13], but research on this potential link is currently lacking.

In contrast to the direct effect noise may have on *A. californica* communication and foraging, positive responses to noise by *A. alexandri* and *Peromyscus* mice probably reflect indirect responses to noise. Noisy areas may represent refugia from predators and key competitors that typically avoid noisy areas, including jays. For example, *A. alexandri* may preferentially settle in noisy areas in response to cues indicative of lower nest predation pressure from *A. californica*. Similarly, *Peromyscus* mice populations may increase in noisy areas not only because of reduced competition with *A. californica* and other jays for key-foraging resources, but also in response to reduced predation by nocturnal acoustic predators that may avoid noise [14], such as owls.

That noise may alter patterns of seedling recruitment adds important insights to our earlier work where we found neither *P. edulis* tree density, nor 12 other habitat features differed between treatment and control sites [7]. This, however, may be slowly changing. Reduced *P. edulis* seedling recruitment in noisy areas may eventually translate into fewer mature trees, yet because *P. edulis* is slow growing and has long generation times [47], these initial changes in stand structure could have gone undetected for decades. Such long-term changes may have important implications for the woodland community as a whole by prolonging the negative consequences of noise exposure. That is, noise may not only result in large declines in diversity during exposure by causing site abandonment or reduced densities by many species [7,10], but diversity may suffer long after noise sources are gone because fewer *P. edulis* trees will provide less critical habitat for the many hundreds of species that depend on them for survival [48].

These separate experiments highlight that noise pollution is a strong environmental force that may alter key ecological processes and services. Over a decade ago, Forman [4] estimated that approximately one-fifth of the land area in the United States is affected by traffic noise, yet the actual geographical extent of noise exposure is undoubtedly greater when other sources are considered. Additionally, this spatial footprint of noise, the anthropogenic soundscape, will only increase because sources of noise pollution are growing at a faster rate than the human population [3]. These data suggest that anthropogenic soundscapes have or will encompass nearly all terrestrial habitat types, potentially impacting innumerable species interactions both directly and indirectly. It is critical that we identify which other functionally unique species abandon or preferentially settle in other noisy areas around the world. Early detection of altered species distributions and the resulting disrupted or enhanced ecological services will be key to understanding the trajectory of the many populations and communities that outwardly appear to persist despite our industrial rumble.

This study was completed in compliance with the University of Colorado Animal Care and Use Committee.

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Attachment 9 – Wings of the Spirit: The Place of the California Condor Among Native Peoples of the Californias.

Wings of the Spirit: California Condor

Wings of the Spirit: The Place of the California Condor Among Native Peoples of the Californias

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Introduction

In June 1579 a small sailing vessel made its way cautiously along the California coast. Francis Drake, destined to become one of the world's legendary sea captains, was looking for a place to careen his leaky vessel -- the Golden Hind. He had come halfway around the world, and was to complete his voyage by sailing across the Pacific and to England, but he desperately needed a place to make repairs.

As he approached the shore of this land never before seen by European eyes (assuming it was northern California), Drake's crew was surprised to see several canoes venturing out from shore. The descriptions of this event are sketchy, but it seems clear that the native in one canoe made a statement, perhaps a blessing, and then threw a black-feathered bundle onto the deck of Drake's ship. From its description, the feathers were probably from the California condor. Drake's reaction to this event is not recorded except that it's clear the Englishmen felt they were being worshiped as gods. In fact, they may have been perceived as ghosts, coming from the land of the dead. The first gift from native Californians was probably the feathers of a California condor, and a sign of mourning ritual.

This paper briefly summarizes how the California condor was incorporated into the cultures of the peoples of ancient California by considering archaeological remains, ceremonial activities and rock art depictions. I will present selected examples from southern California and the border region where possible, with the admittance that this treatment is very cursory at this point.

The California Condor

Who amongst us has not dreamed of soaring effortlessly over the landscape seeing everything in the daily lives of lowly earthbound pedestrians? With scarcely a wing flap, condors soar over the deserts to the seacoast, cresting the highest peaks and spanning the most foreboding terrain. Such is the perspective of the California condor and perhaps the key to its special place in many native cultures across the Californias.

The California condor *(Gymnogyps californianus)* is North America's largest bird. With a wingspan of nearly 10 feet and a weight of 20-22 pounds, it commands the skies. The genus, Gymnogyps, means "naked vulture," referring to the bird's bare head and neck. The name "condor" is derived from the Quechua "cuntur", a name for the Andean condor of South America (Snyder and Rea 1998:32). Adult California Condors have a yellow-orange head, black plumage set with brown on the back, and a white triangle patch under each wing. A whitish wing bar is also found on the upper surface of the wing. As juveniles, they have black heads and light neck ring.

Condors are carrion eaters. They lack the strong talons and beaks of hawks and eagles, and depend on finding carcasses for food. They have never been known to attack a living animal. They will commonly gorge themselves when feeding on a carcass and may go days without eating. Their keen eyesight helps them locate food. They sometimes travel up to 140 miles per day in search of a meal. They are also keen observers of other scavengers like Turkey Vultures and Golden Eagles, and Common Ravens.

In Pleistocene times, California condors were found across much of North America. In a fossil context, the remains of condors are absent after about 11,000 years ago. This corresponds to the decline in large Pleistocene fauna on which they presumably fed. In historic times, the birds ranged from British Columbia to Baja California Sur, but by 1940, they were seen only in southern California. By 1977, approximately 45 birds were known to exist in the wild and by 1985, only 9 birds remained. On April 19, 1987 the last free-flying California condor was captured from the wild and placed in captivity. At that time, only 27 condors remained alive, all in zoos. Successful captive breeding programs have increased the number so that reintroductions to three different sites in southern California and the Grand Canyon have been started. The world's population has been increased to approximately 200 birds.

Condor Reintroduction to Baja California

In October of 2002, six pioneer condors raised at the Los Angeles Zoo were flown to Baja California to begin the process of reintroduction. This project is an extraordinary collaboration among the Instituto Nacional de Ecologia, the Comisión Nacional de Áreas Naturales Protegidas, the Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), the Zoological Society of San Diego, the US Fish and Wildlife Service, and the World Center for Birds of Prey in Boise, Idaho. Five young birds, under 3 years of age, were accompanied by "Xewe" an 11 year-old mentor bird who had known wild condor life. The five will be kept in a "condorminium" located in the Sierra San Pedro Mártir National Park and gradually habituated to wild living in the forests and canyons of Baja California. This marks the first time since 1930 that condors have been seen on the peninsula. It is hoped that the reintroduction of the California condor will spark an interest in bi-national conservation efforts within a proposed Biosphere Reserve.

Condors may have once been a common sight on the peninsula. Nelson's biological survey of 1906 observed a dozen condors feeding on a donkey carcass in the San Pedro Mártir range and noted they appeared "rather common" in the mountains (Nelson 1922:22). Within a decade, however, the population seriously declined throughout southern California and the peninsula. Invading gold minors apparently took a heavy toll. Condors were shot for their quills, which because of their lightness and unbreakable texture, were used to hold gold dust. These quills, worn around the neck, sold for $1.00 each (Snyder and Snyder 2000:47).

The California condor has long been a symbol of a wilderness heritage. It is surely the most impressive and majestic flying bird in North America and has figured prominently in the cultures of many North American natives. Perhaps its rebirth will signal a new understanding of the Native cultures that have known and revered it for centuries.

Flutes made from the wing bones of the California Condor have been found in central California archaeological sites. These are incised with intricate designs.

Condor Remains in an Archaeological Context

Simons (1983) has summarized the occurrence of Pacific coast condor remains in an archaeological context. He reports on 13 sites between Oregon and California spanning a time range between approximately 10,000 years ago and early historic times (1983:470). The greatest number of individual California condor bones has been recovered at the "Five Mile Rapids" site in Oregon. There the unmodified remains of 63 birds were present.

In the delta and San Francisco bay region of California, a concentration of sites have yielded bones of the California condor. These include condor bone tube/whistles fashioned from the wing bones. Some have delicate incisement. In several cases these were recovered with human burials (Simons 1983:474). One site near Sacramento revealed the remains of a condor cape buried in a human grave. In several sites the condors themselves appear to have been intentionally buried. At the West Berkeley shell mound there was the suggestion of ritual condor burial.

Ceremonial Importance

There is scattered evidence of the ritual use of California condors through much of the Californias. The sacrifice of these birds seems to have been widespread. In general, this served to transfer the power of the bird sacrificed to those engaged in its ritual killing. Possibly the condor's association with the dead (being a carrion eater), led to its incorporation into mourning activities and renewal ceremonies. It may be noted that a similar ritual sacrifice of an Andean condor was observed in 1970 in Peru. Here a captured bird was ritually dispatched in public ceremony blending Inca and early Spanish traditions (Snyder and Snyder 2000:30-32).

California condor ceremonies have been lost in the mists of time, but there are adequate verbal accounts to provide some basis for understanding them. The first recorded account comes from October 8, 1769 when Fr. Juan Crespi observed a large stuffed condor in an Ohlone village near the present day Watsonville.

Many ceremonies throughout California involved dancers dressed in capes of condor skins or condor feather bands. The oldest extant example was collected by the Russian Illya Voznesenski in central California. It is preserved in the Museum of Anthropology and Ethnography in St. Petersburg. Condor ceremony took many forms. Central Miwok shamen acquired powers from condors that allowed them to suck supernatural poisons from their patients. Among the Maidu, condor capes were used by Moki or Kuksuyu dancers. These capes were sometimes combined with Golden Eagle feathers to exaggerate the wearer's height.

Perhaps the most detailed description of condor ceremony in southern California comes from the Panes (or bird) festival of the Luiseño. It was described by Friar Boscana of Mission San Juan Capistrano and by Friar Peyri of Mission San Luis Rey in the early 19th century. Similar ceremonies were held by the Gabrilieño, Cahuilla, Kumeyaay and Cupeño (Kroeber 1907; 2002).

The Panes (clearly a California condor from its description) is brought to the festival and placed upon an altar constructed for the purpose. The bird had been captured as a nestling, with condor nest sites being owned by the village. It was raised with great care until fully grown and selected for the sacrifice. Slowly, along with much crying and grimaces, the captive birds are killed by strangulation or pressing the heart. The bird's skin was removed in one piece and the flesh thrown on a fire. Skins and feathers were used to decorate venerated objects for the annual mourning ceremony. California condor skins were also used to make skirts that were retained as important ritual objects by their native owners (Bates et.al. 1993:41; Bates 1982). It should be noted that eagles were also sacrificed and some have argued (Geiger and Meighan 1976) that it was the Golden Eagle that was most powerful. Most experts have concluded that California condors held a unique place in the ceremonial life of California natives, and that eagles were used more commonly during the historic period as condor populations declined (Simons 1983, Bates et.al. 1993).

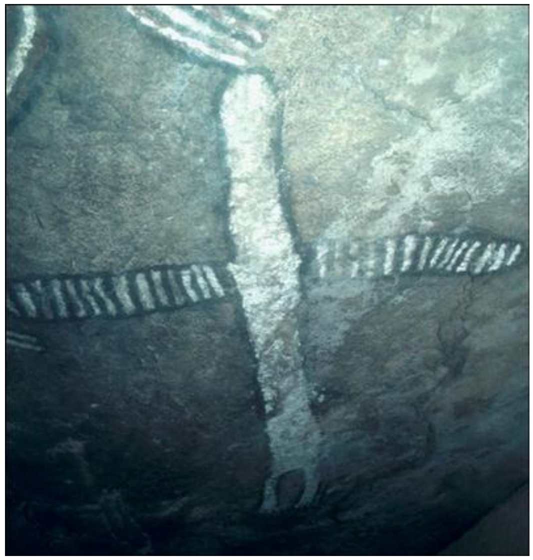
California condors could infuse humans with special powers. Vultures and condors, with their keen eyesight, were considered expert at finding lost objects. Among the Western Mono and Yokuts tribes, "money finders" wore full-length cloaks of condor feathers that reputedly enabled them to find lost valuables (Snyder and Snyder 2000:38). This power was extended to finding missing persons among condor shamen of the Chumash.

California condors also played a part in cosmic events. Among the Chumash, condors or eagles were sacrificed based on which celestial body was prominently visible at the time of the ceremony. Eagles were selected for rituals concerned with the Evening Star (Venus), while condors were chosen for rituals associated with the planet Mars (Hudson and Underhay 1978:88; Simons 1983).

Condor Cave near Santa Barbara features a spectacular condor in flight.
It is painted over a bear-paw petroglyph. (Bill Hyder photo)
The site has been identified as a probable winter solstice observatory
from its orientation and designs (Hudson and Underhay 1978).

Other painted sites within Chumash territory have also produced avian images thought to be condors (Grant 1965). At Pool Rock, for example, a winged design is centrally placed among white, red and black elements. At Chumash Painted Cave, the winged design is mixed among other symbols in a complex panel. Nearby in the Carrizo Plain exists a natural sandstone outcrop sculpted into a shape resembling a condor's head. It is joined by the head of Coyote. The feature is embellished with red designs, which have survived only in the protected niches. The site was recently identified as a sacred condor site by a Chumash elder (Carl Bjork, personal communication). Red designs decorate the condor's neck. This has been identified as a sacred site. (Carl Bjork photo)

Several Chumash sites may show winged figures with anthropomorphic traits. These have been interpreted at Ven-195 as humans in condor or eagle dance regalia. Similar designs at Burro Flats may also be a blend of bird and human form within the context of shamanism and ritual (Gibson and Singer 1978, Hyder and Lee 1994, Lee and Horne 1978).



In Yokuts territory, a distinctive condor image has been recorded. It comes from Exeter Rocky Hill (CA-Tul-83) in Tulare County. In a shallow granite shelter formed from huge boulders, a giant figure is painted on the ceiling. It measures almost six feet in length and features well-defined feet and black and white patterned design in the outstretched wings.

One of the more common forms of depicting large birds in painted rock art is with "raked" wings. This shows the wings extended with feathers down. Although not an exclusive habit, living California condors often adopt this pose when warming or drying their wings, thus it is possible to imagine it as a view born from actual observation.

Almost lost among the giant painted images of Cueva La Pintada in the Sierra de San Francisco, Baja California Sur are several black images with raked wings. Perhaps these represent the former aerial masters of these desert canyons and their feeding on the carcasses of other animals so prominently depicted. Recent studies imply that California condors may have derived much of their food from scavenging sea mammal remains along the coast. This may have made Baja California a favored land for these birds. Another rock art site called "La Pintada" is situated in the rugged coastal volcanic canyons between Guaymas and Hermosillo in Sonora. On a protected face within a narrow canyon, is a pictograph display in red, black and white. (Pictured below) Most of the images take a geometric form with shields, or perhaps turtle-designs being prominent.

Below, these black avian figures with "raked" wings may be cormorants, or perhaps condors. In the center is a familiar black image with raked wings. It is strikingly similar to other painted designs across the former range of the California condor.

Another rock art site called "La Pintada" is situated in the rugged coastal volcanic canyons between Guaymas and Hermosillo in Sonora. On a protected face within a narrow canyon, is a pictograph display in red, black and white.

Summary and Conclusions

In this paper we have soared briefly across the cultural landscape of the California condor, its archaeology, ceremonial significance and painted imagery. It is apparent that California condors held a special place in the lives and ceremonies of California natives. It was a revered creature, a master of the spirit, who gave power to humans for a variety of world renewal and cosmic purposes. It was associated with death and mourning as well as rebirth and renewal.

So as we enter a new century, the fate of the California condor hangs in the balance. Perhaps the condor colonizers of Baja California will help insure the continuation of the species. But, why should we care about the condor's survival? As the noted biologist Ken Brower pointed out, "When the Vultures watching your civilization begin dropping dead...it is time to pause and wonder" (Erlich et.al. 1988). Amen.

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